Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Defense Advanced Research Projects Agency	DATE: February 2011
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 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
Total Program Element	253.848	303.078	98.878	-	98.878	116.716	106.930	112.474	112.474	Continuing	Continuing
AIR-01: *ADVANCED AEROSPACE SYSTEMS*	253.848	303.078	98.878	-	98.878	116.716	106.930	112.474	112.474	Continuing	Continuing

A. Mission Description and Budget Item Justification

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 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	258.278	303.078	189.075	-	189.075
Current President's Budget	253.848	303.078	98.878	-	98.878
Total Adjustments	-4.430	-	-90.197	-	-90.197
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	2.421	-			
• SBIR/STTR Transfer	-6.851	-			
• TotalOtherAdjustments	-	-	-90.197	-	-90.197

Change Summary Explanation

FY 2010: Decrease reflects and SBIR/STTR transfer offset by internal below threshold reprogramming.

FY 2012: Decrease reflects the termination of the ArcLight program, drawdown of Vulture and ISIS, transfer of the Vulcan program to the new tactical and strategic energy project (MBT-03) in PE 0602715E, and reductions for Defense Efficiencies for contractor staff support.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Vulture	35.450	60.000	4.000
Description: The objective of the Vulture program is to develop and demonstrate the technology to enable an airborne payload to remain persistently on-station, uninterrupted and unreplenished, for over five years performing strategic and tactical			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
communications, position/navigation/timing (PNT) and intelligence, surveillance, and reconnaissance missions over an area of interest. Vulture technology enables a re-taskable, persistent pseudo-satellite capability, in an aircraft package. The technology combines the key benefits of an aircraft (flexibility & responsiveness, sensor resolution, reduced transmit/receive power, affordability) with the benefits of space assets (on-station persistence, no logistics tail, energy independence, fleet size, absence of in-country footprint). The system has potential in numerous roles: operation as a single platform, as a formation of multiple aircraft, or as a constellation providing infrastructure augmentation or recovery. The technology challenges include structural integrity of very lightly-loaded airframe structure, efficient and reliable energy collection, storage/retrieval and management, and reliability technologies capable of allowing the aircraft to operate continuously for five years. The Vulture program will conduct subscale and full-scale technology maturation and demonstration activities to prove out critical technologies. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:*** - Conducted initial risk reduction analyses, testing, experiments, and demonstrations. - Initiated demonstration of component performance and reliability including energy storage, propulsion, and flight management/ control systems. ***FY 2011 Plans:*** - Conduct system requirements review. - Initiate preliminary design of the flight demonstrator aircraft. - Demonstrate component performance and reliability including energy storage, propulsion, and flight management/control systems. - Perform cantilever wing, 2-D and 3-D wind tunnel test. - Continue subsystem and risk reduction testing. - Fabricate and structurally test critical wing sections. - Initiate energy collection system fabrication and testing. - Initiate 1 KW energy storage system fabrication and pressure test. ***FY 2012 Plans:*** - Conduct system critical design review. - Initiate fabrication, assembly, ground test and check out flight demonstrator in preparation for long endurance demonstration flight.			
Title: Triple Target Terminator (T3)	11.146	16.908	30.820

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Description: The Triple Target Terminator (T3) program will develop a high speed, long-range missile that can engage air, cruise missile, and air defense targets. T3 would be carried internally on stealth aircraft or externally on fighters, bombers, and UAVs. The enabling technologies are: propulsion, data links, and digital guidance and control. 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. The program is jointly funded with, and will transition to the Air Force. ***FY 2010 Accomplishments:*** - Conducted studies to define T3 trade space and concepts of operation. - Initiated preliminary design studies. - Conducted risk reduction experiments and modeling to validate designs. ***FY 2011 Plans:*** - Conduct preliminary design review of T3 concepts. - Initiate T3 critical design activities. ***FY 2012 Plans:*** - Conduct hardware-in-the-loop integrated subsystem testing. - Conduct propulsion system ground testing. - Fabricate and ground test demonstration vehicles.			
Title: Integrated Sensor is Structure (ISIS) ***Description:*** The joint DARPA/Air Force Integrated Sensor is Structure (ISIS) program 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 concealed communications links; responsive reconstitution of failed space assets; plus CONUS-based sensor analysis and operation. An MOA has been signed by DARPA and the Air Force to pursue the program objectives through to transition. The ISIS technology demonstration system transitions to the Air Force in 2013. ***FY 2010 Accomplishments:***	72.650	43.400	5.000

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Conducted preliminary design review of demonstration system. - Conducted radar system operational modeling and simulation. - Developed and demonstrated flight dynamic controls in a lab environment. - Demonstrated large-scale manufacturing of prototypes and initial integration. - Conducted radar and power system critical design reviews. ***FY 2011 Plans:*** - Conduct critical design review of demonstration system. - Conduct simulations to validate subsystem detailed designs. - Conduct risk reduction testing and demonstrations of integrated subsystems. - Manufacture airship envelope. - Manufacture and chamber test of dual-band RF apertures. ***FY 2012 Plans:*** - Assemble radar panels to pill structure and perform radar/aperture testing. - Integrate airship hull and radar aperture structures. - Install and pre-flight test power, propulsion, and ballast systems. - Manufacture and demonstrate launch on station, demonstration hardware. - Complete Ground Station development. - Complete Flight Test Readiness Review. - Launch and transit to on station, demonstration area.			
Title: Long Range Anti-Ship Missile Demonstration (LRASM) ***Description:*** 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 surface strike capability deficit. The Long Range Anti-Ship Missile (LRASM) program is investing 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 are being developed, demonstrated, and integrated into a complete weapon system. The program will result in a high fidelity demonstration to support military utility assessment. LRASM is a joint DARPA/Navy effort, with the Navy providing 50% of funds.	54.950	67.560	24.490

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
FY 2010 Accomplishments: - Completed integrated system preliminary designs and held preliminary design reviews. - Conducted high fidelity independent government performance assessment of preliminary designs against key performance criteria, validating LRASM performance potential. - Performed risk reduction testing of critical components, including propulsion direct-connect testing. - Generated supporting documentation including concepts of operation, flight test and safety plans, system engineering master plans, test and evaluation master plans, lifecycle cost estimates, and transition plans. ***FY 2011 Plans:*** - Initiate system detailed design activity. - Develop high fidelity simulation tools and initiate system performance studies. - Complete subsystem designs and developmental testing including wind tunnel tests and propulsion direct connect tests. - Develop integrated hardware-in-the-loop platforms and conduct system developmental tests. - Initiate long-lead procurements. - Commence range planning activities. ***FY 2012 Plans:*** - Complete propulsion system transition testing. - Complete missile seeker captive carry testing against surrogate targets. - Complete integrated system detail designs and hold critical design reviews. - Conduct high fidelity independent government performance assessment of detailed designs against key performance criteria. - Update supporting documentation including concepts of operations, flight test and safety plans, lifecycle cost estimates, and transition plans. - Commence fabrication, assembly, integration, and checkout of flight test vehicles for initial incremental test events. - Complete canister expulsion and ballistic flight testing. - Complete controlled test vehicle flights.			
Title: Persistent Close Air Support (PCAS) ***Description:*** The Persistent Close Air Support (PCAS) program will significantly increase close air support (CAS) capabilities by developing a system to allow continuous CAS availability and lethality to the supported ground commander. The enabling technologies are: manned/unmanned attack platforms, next generation graphical user interfaces (GUI), data links, digital guidance and control, and advanced munitions. PCAS will demonstrate the ability to digitally task a CAS platform from the ground to attack multiple/simultaneous targets. PCAS will allow the Joint Tactical Air Controller (JTAC) the ability to rapidly engage multiple moving targets simultaneously within the area of operation. PCAS's ability to digitally task a CAS platform to attack multiple/	9.000	18.000	21.000

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
simultaneous targets would improve U.S. ground forces operations and speed of attack. The system will be designed to reduce collateral damage and potential fratricide to friendly forces. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:*** - Conducted studies to define PCAS trade space and concepts of operation. - Established unmanned A-10 demonstration aircraft requirements for the live-fire demonstration. - Established JTAC kit demonstration requirements for the live-fire demonstration. ***FY 2011 Plans:*** - Conduct trade studies for an integrated PCAS system. - Conduct conceptual design and system requirements reviews of the unmanned A-10 demonstration aircraft and JTAC kit. - Complete a technology maturation plan and program risk reduction activities to ensure a successful live-fire demonstration of the PCAS system. - Initiate subcomponent developer critical enabling technology designs that will complement the system integrator A-10 and JTAC Kit designs. ***FY 2012 Plans:*** - Integrate subcomponent developer critical enabling technology components into system integrator A-10 and JTAC kit designs. - Perform initial modifications to unmanned A-10 demonstration aircraft and conduct software and hardware ground testing. - Complete initial designs of next generation JTAC kit and perform hardware and software breadboard testing. - Continue modifications to the unmanned A-10 demonstration aircraft based on software and hardware ground testing results.			
Title: Advanced Aerospace System Concepts ***Description:*** 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, 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; 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; and payload and cargo handling systems. ***FY 2010 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.	2.500	3.000	3.000

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Conducted enabling technology and sub-system feasibility experiments. ***FY 2011 Plans:*** - Perform studies of candidate technologies and develop system concepts. - Conduct proof-of-concept demonstrations to verify technologies developed. ***FY 2012 Plans:*** - Conduct modeling and simulation of system architectures and scenarios. - Perform feasibility experiments of candidate technologies and system concepts.			
Title: Autonomous High Altitude Long Endurance (HALE) Refueling (AHR)* ***Description:*** * Formerly Autonomous Aerial Refueling The Autonomous High Altitude Long Endurance (HALE) Refueling (AHR) program will demonstrate high altitude refueling between unmanned aircraft in an operational environment. The program will leverage existing RQ-4 Global Hawk unmanned aircraft to evaluate the opportunity to develop superior next generation, high-altitude, long-endurance aircraft built around the advantages of air refueling that have proven so vital to manned aviation. Specific challenges include achieving a repeatable probability of success with limited flight performance aircraft under high-altitude conditions, redundant safe separation, and unmanned flight operations. The program will also promote the application of autonomy for better effectiveness, efficiency, and safety in challenging environments and also offers the potential for direct transition to the Global Hawk fleet. ***FY 2010 Accomplishments:*** - Performed initial requirements allocation and system design. - Conducted modeling and simulation of high-altitude refueling. ***FY 2011 Plans:*** - Validate drogue performance at altitude (single-ship). - Accomplish aircraft modifications. - Initiate flight tests to achieve repeatable refueling performance. ***FY 2012 Plans:*** - Complete flight test and achieve repeatable refueling performance. - Conduct operationally stressing refueling demonstration. - Complete demonstration and document feasibility of fully autonomous aerial refueling in challenging conditions.	17.000	18.000	10.568
Title: ArcLight	2.000	5.000	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Description: The goal of the ArcLight program is to design and evaluate in simulation a tactical, long range, time critical, boost/ glide vehicle capable of carrying a payload of 100-200 lbs over 2,000 nm in less than 30 minutes. The boost/glide vehicle would be launched from a Mark 41 vertical launch system (VLS) capable booster stack. The development of the ArcLight vehicle could enable tactical, long range strike weapons capable of engaging time critical targets. Transition partners include the Navy and Air Force. ***FY 2010 Accomplishments:*** - Conducted feasibility testing of novel material technology. ***FY 2011 Plans:*** - Conduct trade studies of vehicle shape, size, critical systems, trajectory, and range estimations. - Develop initial concept of operations and military utility analyses. - Develop initial critical technology development plan. - Assessment and testing of critical system elements, including wing materials and leading edges.			
Title: Vulcan ***Description:*** The goal of the Vulcan turbine engine demonstration program is to design, build, and ground test a pressure gain combustion (PGC) technology system that demonstrates a 20% reduction in fuel consumption for a power generation turbine system. PGC technology has been under development for more than a decade and considerable progress has been made in key enabling technology areas. The technology is believed mature enough to permit a dramatic new system capability. PGC, when combined with turbine engines, offers the ability to design a new class of hybrid turbine power generation engines and Mach 4+ air breathing engines. The Vulcan system will consist of a full scale PGC, a compressor, and a turbine. The Vulcan program PGC technology would have direct application to ship power generation & propulsion turbine engines, aviation turbine engines, high-mach air breathing engines, as well as commercial turbine engines of the same variety. Beginning in FY 2012, this program is funded from PE 0602715E, Project MBT-03, Tactical and Strategic Energy Technology. Anticipated Service users include the Air Force and Navy. ***FY 2010 Accomplishments:*** - Completed designs and simulations of critical components. - Conducted risk reduction demonstrations of the combustor rig, fuel system, valve rig, initiator, seals, and thermal management system rig components. - Completed Constant Volume Combustion (CVC) engine preliminary design review. - Initiated detailed design of subsystems.	35.000	45.000	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Completed systems requirements review. ***FY 2011 Plans:*** - Conduct simulations to validate subsystem detailed designs. - Conduct risk reduction testing and demonstrations of key PGC component technologies and subsystems. - Begin CVC engine compressor. - Mature and validate critical PGC enabling technologies and analytical tools. - Design, procure and begin assembly and instrumentation of a PGC module test rig.			
Title: DiscRotor Compound Helicopter ***Description:*** The goal of the DiscRotor program is to design and demonstrate the enabling technologies required to develop a new type of compound helicopter capable of high-efficiency hover and high-efficiency, high-speed flight, with stable, continuous and reversible transition between these flight states. The aircraft concept features a mid-fuselage disc with extendable rotor blades, and an aft swept wing. With the rotor blades extended and the disc rotating, the aircraft can operate like a helicopter with vertical take-off, efficient hover, controllable low speed flight and vertical landing. With the blades retracted, the aircraft is capable of efficient wing-borne cruise at speeds exceeding any existing rotorcraft, 2-3 times that of a conventional helicopter. Transition from helicopter mode to fixed-wing flight is achieved by fully retracting the blades within the disc. An aircraft capable of long range (400 nm), high speed (350-400 kts) and vertical take-off and landing /hover will provide new capabilities to the warfighter, bridging the gap between helicopter and fixed-wing aircraft by providing improved survivability, mobility, and responsiveness for troop and cargo insertion, combat search and rescue, armed escort, and other critical missions. The DiscRotor enabling technologies are: extendable/retractable telescoping rotor blades, counter torque control, high-efficiency ducted propellers, and an integrated propulsion system. Specific objectives of the DiscRotor program include: demonstrating the feasibility of safely and repeatedly retracting/extending the blades into the disc in forward flight, characterizing the flowfield environment created by a disc-rotor, demonstrating disc-rotor enabling technologies, and designing and wind tunnel testing a retractable rotor demonstrator. Potential transition partners include the Army, Navy, Marines, Air Force, Coast Guard, and SOCOM. ***FY 2010 Accomplishments:*** - Conducted testing of a subscale rotor in a hover test rig. - Completed preliminary design of 12 foot diameter large-scale extendable/retractable rotor model. - Conducted forward flight wind tunnel testing of small-scale (5%) air vehicle and hover testing of small scale (non-retractable) rotor model. - Continued analysis and refinement of operational air vehicle configuration.	4.819	2.210	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Continued refinement of computational fluid dynamics analyses and predictions. ***FY 2011 Plans:*** - Conduct testing of a subscale rotor and fuselage in a hover test rig. - Continue refinement of operational air vehicle configuration. - Complete critical design of 12 foot diameter large-scale extendable/retractable rotor model. - Complete fabrication and check-out of 12 foot diameter large-scale extendable/retractable rotor model. - Test extensions and retractions of the 12 foot diameter large-scale rotor model in a wind-tunnel under simulated conversion conditions. - Validate DiscRotor conceptual approach, risk assessment, and definition of demonstrator requirements.			
Title: Mode Transition (MoTr) Demonstration ***Description:*** The Mode Transition (MoTr) Demonstration 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 the Falcon Combined-cycle Engine Technology (FaCET) and the Air Force/ DARPA High Speed Turbine Engine Technology Demonstration (HiSTED) program. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:*** - Completed preliminary design of a TBCC engine model. - Completed preliminary design of primary testing modifications. ***FY 2011 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.	5.055	24.000	-
Title: Shrike ***Description:*** The goal of the Shrike program was to develop a new generation of perch-and-stare micro air vehicles based on the Wasp platform which would be capable of: 1) vertical launch, 2) forward flight to a target, 3) transition from forward flight to vertical landing at the target site, 4) secure, stable attachment to its perch, 5) sustained perch-and-stare missions, to include	4.278	-	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
data collection, and 6) re-launch from the perch and fly home. Anticipated Service users include the Army, Marines, and Special Forces. ***FY 2010 Accomplishments:*** - Refined and improved prototype designs based on field testing. - Developed auto-pilot for semi autonomous landing. - Developed and demonstrated schemes for exploitation of digital communications. - Developed reduced operator footprint design. - Fabricated second increment Shrike prototypes.			
Accomplishments/Planned Programs Subtotals	253.848	303.078	98.878

D. Other Program Funding Summary ($ in Millions)

Line Item	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
• Integrated Sensor is Structure: *Air Force PE 0305205F Project 675372F*	48.533	0.000	53.000	0.000	53.000	21.000	8.000	0.000	0.000	Continuing	Continuing
• Integrated Sensor is Structure-: *Air Force PE 0603203F Project 665A*	0.200	2.100	2.800	0.000	2.800	9.400	1.000	0.000	0.000	Continuing	Continuing
• LRASM: *Navy*	35.100	67.560	24.510	0.000	24.510	0.000	0.000	0.000	0.000	Continuing	Continuing
• Triple Target Terminator (T3): *Air Force*	4.690	8.930	27.050	0.000	27.050	41.730	0.000	0.000	0.000	Continuing	Continuing

E. Acquisition Strategy

N/A

F. Performance Metrics

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