Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Defense Advanced Research Projects Agency										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*				R-1 ITEM NOMENCLATURE PE 0603768E: *GUIDANCE TECHNOLOGY*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	93.720	36.886	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
GT-01: *GUIDANCE TECHNOLOGY*	37.704	17.235	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
GT-CLS: *CLASSIFIED*	56.016	19.651	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Guidance Technology program element is budgeted in the Advanced Technology Development Budget Activity because it is developing system oriented technologies that will improve our ability to navigate weapon systems with more precision and increase the capability to meet current and emerging threats. Consequently, this program element will merge with the Sensors Technology program element in FY 2011. Many of the guidance programs have ended eliminating the need for such a specifically focused program element.

(U) The Guidance Technology project increases the ability of Global Positioning System (GPS) users to operate effectively in the presence of enemy jamming; to increase the versatility of navigation systems applications by developing microelectromechanical sensor inertial navigation system technologies; and to apply the geolocation technologies/techniques to precision threat geolocation of short-dwell emitters or passive air defense systems.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Defense Advanced Research Projects Agency	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603768E: *GUIDANCE TECHNOLOGY*

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	107.979	37.040	0.000	0.000	0.000
Current President's Budget	93.720	36.886	0.000	0.000	0.000
Total Adjustments	-14.259	-0.154	0.000	0.000	0.000
• Congressional General Reductions		-0.154			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	-5.100	0.000			
• Congressional Adds		0.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-6.125	0.000			
• SBIR/STTR Transfer	-3.034	0.000			

Change Summary Explanation

FY 2009

Decrease reflects Section 8042 rescission of the FY 2010 Appropriations Act, Omnibus Reprogramming action for the H1N1 vaccine development and SBIR/ STTR transfer offset by internal below threshold reprogramming.

FY 2010

Decrease reflects the Section 8097 Economic Assumption.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603768E: *GUIDANCE TECHNOLOGY*	PROJECT GT-01: *GUIDANCE TECHNOLOGY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
GT-01: *GUIDANCE TECHNOLOGY*	37.704	17.235	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) Fire-and-forget stand-off weapons need precise targeting information if critical fixed and mobile targets are to be eliminated effectively with minimal collateral damage and minimum cost-per-kill. This requires that: 1) military surveillance and targeting systems geolocate targets accurately in the same coordinate system in which the weapon system navigates; 2) the surveillance, targeting and weapon systems have precision navigation and guidance systems on-board; and 3) navigation and target location systems robustly operate day/night and in adverse weather. In addition, future systems designed to accomplish precision strike missions must be significantly more affordable. Thrusts are included in this project to improve our ability to navigate when the Global Positioning System (GPS) is jammed or otherwise unavailable; to increase the versatility of navigation systems applications by developing microelectromechanical sensor inertial navigation system technologies; and to apply the geolocation technologies/techniques to precision threat geolocation of short-dwell emitters or passive air defense systems.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Multifunctional Electro-Optics for Defense of U.S. Aircraft (MEDUSA)	8.807	5.892	0.000	0.000	0.000
(U) The Multifunction Electro-Optics for Defense of U.S. Aircraft (MEDUSA) program will develop the technologies and systems to give the U.S. air dominance at low altitude and at night. This program will develop the technologies to leap-frog reactive end-game countermeasures and enable increased threat warning times, denial of launch, and put Electro Optical-Infrared (EO-IR) air defense threats at risk in the Near Infrared (NIR), Mid-wave Infrared (MWIR) and Long-wave Infrared (LWIR) regimes. MEDUSA is a three-part technology program that is: 1) conducting phenomenological measurements and develop countermeasures and target classification/identification techniques; 2) developing critical component technologies such as high-power IR laser sources, advanced IR detectors, and fibers for high-power IR transmission; and 3) developing and demonstrating an end-to-end MEDUSA system. The MEDUSA technology is planned for transition to the Air Force and Army at the conclusion of technology development and flight demonstration.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Completed testing of 128x128 Near/Mid-Wave Infrared (NMIR) focal plane arrays (FPA) integrated with a low-power, high-speed Read-Out Integrated Circuit (ROIC), demonstrating high-sensitivity in a cryo-cooler package meeting program objectives for proactive infrared countermeasures. - Initiated designs for the 4x larger format NMIR 256x256 arrays needed to provide full coverage against advanced infrared missile threats. - Completed integration of 128x128 Long-wave Infrared (LWIR) detector with a high-speed ROIC, demonstrating high-sensitivity large format heterodyne receiver performance in a mechanical cryo-cooler package. *FY 2010 Plans:* - Complete initial design of large format 256x256 NMIR detector and ROICs supporting proactive IRCM and other applications. - Complete testing of first NMIR detector arrays and ROICs and initiate hybridization. - Complete testing of integrated 128x128 LWIR focal plane arrays to understand the performance of wide field-of-view coherent receivers and determine objectives for next phase of development. - Initiate design and fabrication of low power dissipation, large-format LWIR coherent arrays. - Initiate the development of high-power NMIR and LWIR laser sources to support proactive Infrared Counter Measure (IRCM) system objectives. - Complete testing of first large-format 256x256 NMIR FPAs to guide the final phase of design for these arrays. - Complete final phase of design and initiate fabrication of the large-format 256x256 NMIR FPAs. - Complete fabrication and testing of first phase of large-format LWIR coherent arrays to guide final design and fabrication. - Complete initial demonstration of high-power laser sources needed to support airborne system demonstrations. - Initiate designs for integrated NMIR/LWIR airborne proactive IRCM demonstration.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Robust Surface Navigation (RSN)	7.425	4.000	0.000	0.000	0.000
(U) The Robust Surface Navigation (RSN) program will provide the U.S. warfighter with the ability to navigate effectively when the Global Positioning System (GPS) is unavailable due to hostile action (e.g. jamming) or blockage by structures and foliage. The RSN program will use Signals of Opportunity (SoOP) from a variety of ground, air, and space-based sources, augmented by judiciously placed RF beacons; these will be received on the warfighter's forthcoming software defined radios and use specially tailored algorithms to determine position. The greater strength and diversity of these signals will provide coverage when GPS is denied due to environmental conditions or hostile activity. This is a two-part program: (1) cataloging and assessing potential exploitable signals followed by analysis and performance modeling and hardware-based concept validation, and; (2) designing, testing, and demonstrating a (non-form-fit) prototype receiver(s) and algorithms for geolocation using the SoOP. Beginning in FY 2011, this program will be budgeted in PE 0603767E, Project SEN-01. The RSN technology is planned for transition to the U.S. Special Operations Command (SOCOM) and the U.S. Army with specific elements of the program transitioning to the U.S. Navy and U.S. Air Force.					
FY 2009 Accomplishments: - Performed RSN technical risk mitigation experiments and analysis. - Validated reference station error budget for SoOP characterization and timing. - Completed Critical Design Review for full RSN system.					
FY 2010 Plans: - Develop RSN prototype system and conduct field tests and demonstrations in dense urban environments, including within large buildings and urban canyons. - Demonstrate total system readiness.					
Sub-Surface Navigation (SsN)	3.140	1.343	0.000	0.000	0.000
(U) Building on technologies developed under the RSN program, the Sub-Surface Navigation (SsN) program will provide the U.S. warfighter with the ability to navigate effectively underground, where					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
the Global Positioning System (GPS) is unavailable. SsN will also enable long endurance or covert underground missions where alternative navigation aids like inertial measurement units (IMUs) or inertial navigation units (INUs) are unsuitable. The SsN program will use Signals of Opportunity (SoOP) and will develop specialized low frequency RF beacons and specially tailored algorithms to provide 3-dimensional navigation of personnel and mobile platforms underground. SoOP include global lightning events, which are abundant, propagate over very long distances, and are essentially non-deniable signals. The greater strength and diversity of these signals will provide coverage when GPS is denied due to lack of penetration through the earth. This is a two part program: (1) analysis and performance modeling and hardware-based concept validation of beacon-based signals, and experimental verification that SoOP have propagated (and dispersed) through various geological overburdens and can be correlated with sufficient accuracy to achieve desired geolocation resolution; and (2) designing, testing, and demonstrating a (non-form-fit) prototype receiver(s) and algorithms for geolocation using both beacons and SoOP. The SsN technology is planned for transition to the U.S. Special Operations Command (SOCOM). *FY 2009 Accomplishments:* - Continued design and development of prototype system with improved beacons and receivers. - Developed hardware and software for a blended solution to use when operating the beacon-based in the infrastructure transition zone between improved and unimproved underground environments. - Developed electromagnetic modeling capability to support beacon-based system performance predictions. - Tested functional prototype beacon-based system in an underground environment. *FY 2010 Plans:* - Complete experimental measurements to support next generation, small form-factor beacon antenna design. - Complete transition of SoOP technology to U.S. Special Operations Command (SOCOM).					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Precision Inertial Navigation Systems (PINS)	6.439	6.000	0.000	0.000	0.000
(U) The Precision Inertial Navigation Systems (PINS) program will develop an entirely new class of inertial navigation instruments using atomic inertial force sensors. These sensors utilize the quantum-mechanical wave-like nature of atoms in the atomic analogue of an optical interferometer to provide unprecedented sensitivity to accelerations and rotations. The atomic sensors will further be used to measure the local gravitational field gradient to ensure that instrument alignment is properly maintained throughout vehicle maneuver, thus mitigating gravity-induced navigation errors. Initial program efforts will focus on developing fundamental technology components upon which future systems would be constructed. While originally planned for transition to the Navy at the conclusion of Phase III, program developments indicate opportunities for insertion in multiple Service applications and plans are being revised accordingly. *FY 2009 Accomplishments:* - Completed extensive laboratory testing single degree-of-freedom atom-based inertial measurement unit and single-axis gravity gradiometer and evaluated long-term performance characteristics. - Designed and constructed pre-production prototype for final evaluation by Marine Corps combat swimmers. *FY 2010 Plans:* - Complete study of technical hurdles preventing 200 hour continuous sensor system operation and design system changes to address key items identified. - Devise transition plan for technology insertion consistent with Department of Defense Positioning, Navigation, and Timing roadmap.					
Navigation-Grade MEMS Inertial Measurement Unit (IMU)	11.893	0.000	0.000	0.000	0.000
(U) The Navigation-Grade MEMS Inertial Measurement Unit (IMU) program developed micro-scale accelerometers and gyros with navigation-grade performance that use only milli-watts of power. The program transcended traditional single mass-spring methods for navigation sensing and explored					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
alternative approaches, such as multiple, interconnected mass-spring systems, micro-levitated spinning structures, micro-optical readout mechanisms, atomic interferometric readout mechanisms, and fluidic contortions. This program has transitioned to industrial performers for developing wearable inertial measurement units (IMUs) for dismounted warfighters capable of GPS-denied navigation for lengthy periods; small IMUs for unmanned air and underwater vehicles, and for guidance of small, long-range munitions. *FY 2009 Accomplishments:* - Developed micro-environmental control. - Completed control electronics integration.					
Accomplishments/Planned Programs Subtotals	37.704	17.235	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency			DATE: February 2010
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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
GT-CLS: *CLASSIFIED*	56.016	19.651	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds classified DARPA programs that are reported in accordance with Title 10, United States Code, Section 119(a)(1) in the Special Access Program Annual Report to Congress.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Classified DARPA Program	56.016	19.651	0.000	0.000	0.000
This project funds Classified DARPA Programs. Details of this submission are classified. *FY 2009 Accomplishments:* Details will be provided under separate cover. *FY 2010 Plans:* Details will be provided under separate cover.					
Accomplishments/Planned Programs Subtotals	56.016	19.651	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Details will be provided under separate cover.