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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 2005	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Guidance Technology PE 0603768E, R-1 # 53				
COST (In Millions)	FY 2004	F Y2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Total Program Element (PE) Cost	0.000	114.330	103.272	111.473	129.095	124.853	115.853	115.853
Guidance Technology GT-01	0.000	41.452	52.420	57.824	64.150	59.000	50.000	50.000
Classified GT-CLS	0.000	72.878	50.852	53.649	64.945	65.853	65.853	65.853

(U) Mission Description:

(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. This program element was created in accordance with congressional intent in the FY 2005 DoD appropriations bill. Prior year funding was budgeted in PE 0603762E, Projects SGT-01 and SGT-CLS.

(U) The Guidance Technology project will increase 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. Fire-and-forget standoff 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. The achievement of these characteristics in an integrated system is the goal of this program.

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(U)	<u>Program Change Summary:</u> <i>(In Millions)</i>	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
	Previous President's Budget	137.244	138.271	149.610
	Current Budget	114.330	103.272	111.473
	Total Adjustments	-22.914	-34.999	-38.137

Please note that this program element has been newly created from projects previously funded in PE 0603762E. The *Previous President's Budget* amount reflects projects SGT-01 and SGT-CLS funded under that PE.

Congressional program reductions	-22.914
Congressional increases	0.000
Reprogrammings	0.000
SBIR/STTR transfer	0.000

(U) **Change Summary Explanation:**

FY 2005	Decrease reflects congressional undistributed reductions.
FY 2006 - 2007	Decrease reflects program adjustments in the classified project.

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COST (In Millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Guidance Technology GT-01	0.000	41.452	52.420	57.824	64.150	59.000	50.000	50.000

(U) Mission Description:

(U) Fire-and-forget standoff 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 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. This program element and project were created in accordance with congressional intent in the FY 2005 DoD appropriations bill. Prior year funding was budgeted in PE 0603762E, Project SGT-01 and is noted as a memo entry in each program below.

(U) Program Accomplishments/Planned Programs:

	FY 2004	FY 2005	FY 2006	FY 2007
MEDUSA	(25.500)	23.452	18.000	12.824

(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 EO-IR air defense threats at risk. MEDUSA is a three-part technology program: (1) conduct phenomenological measurements and develop countermeasures and target classification/identification techniques; (2) develop critical component technologies such as high power IR laser sources, advanced IR detectors, and fibers for high power IR transmission; and

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(3) develop and demonstrate an end-to-end MEDUSA system. The MEDUSA technology is planned for transition to the Air Force at the conclusion of Phase III, which is anticipated to be completed during FY 2007.

(U) Program Plans:

- Developed and evaluated MEDUSA countermeasure and classification techniques and conduct phenomenological measurements.
- Fabricated and evaluated critical component technologies.
- Developed MEDUSA system designs.
- Build and demonstrate, from a tower, the breadboard MEDUSA design against realistic targets and environments.
- Build and field/flights test a MEDUSA brassboard design against realistic targets and environments.

	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Gyroscopes	(4.836)	4.500	5.420	5.500

(U) The Advanced Gyroscopes program is investigating the feasibility of a very high-accuracy gyroscopes and other technologies to provide extremely precise navigation, with a goal of reducing noise error to 10^{-5} degree/hour or less. This would enable more robust operations in several applications – from underwater (including covert submarine operation and littoral navigation around obstacles) to outer space (from space flight to precise, autonomous satellite positioning). Technical challenges include the exploitation of quantum effects, such as correlated photons and atom interference effects, as well as gravity – and gravity – gradiometer – based technologies.

(U) Program Plans:

- Develop concepts for achieving the required accuracy. Evaluate feasibility of underlying approach via analysis and laboratory measurements.
- Evaluate feasibility of underlying approach via analysis and laboratory measurements.
- Design, build, and test prototype navigation system.

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	FY 2004	FY 2005	FY 2006	FY 2007
Precision Inertial Navigation Systems	(3.500)	8.500	15.500	14.500

(U) The Precision Inertial Navigation Systems 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 later systems would be constructed. The PINS technology is planned for transition to the Navy and Air Force at the conclusion of Phase 3, which is anticipated to be completed by FY 2007.

(U) Program Plans:

- Develop and demonstrate an inertial navigation system with positional bias drift rate below 5 meters/hour.
- Develop integrated “atom-chips” using Bose-Einstein condensate-based coherent atom sources, including integrated waveguides, vacuum systems, and atom detectors.
- Develop compact narrow-linewidth, tunable 780 nm laser sources with large modulation bandwidth via monolithic solid-state microchip design.
- Explore novel atom interferometer component designs, including BEC waveguides, guided atom beamsplitters.
- Demonstrate motion-compensated gravity gradiometer.
- Demonstrate approaches for GPS free navigation combining MEMS inertial navigation with locally derived location position information.

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	FY 2004	FY 2005	FY 2006	FY 2007
Navigation Via Signals of Opportunity	(0.000)	5.000	10.500	13.000

(U) The Navigation via Signals of Opportunity (NAVSOPP) 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 NAVSOPP program will use signals of opportunity and specialized signals from a variety of ground-, air-, and space-based sources; these will be received on the warfighters' forth coming software defined radios, and will use specially tailored algorithms to determine position. The greater strength and diversity of these signals will provide coverage when GPS is denied due to lack of penetration into buildings and underground, and when severe multipath is a problem. The NAVSOPP is a two part program: (1) cataloging and assessing of potential exploitable signals followed by analysis and performance modeling and hardware-based concept validation and (2) designing, testing, and demonstrating of a (non-form-fit) of a prototype receiver(s) and algorithms for geolocation using the signals of opportunity. The NAVSOPP technology is planned for transition to United States Special Operations Command and the Air Force at the conclusion of Phase 3, and is anticipated to be completed by FY 2008.

(U) Program Plans:

- Evaluate feasibility of candidate approaches using modeling, analysis, and simulation.
- Develop critical NAVSOPP technologies and conduct phenomenological measurements to validate the down-selected concepts.
- Design, fabricate and test functional prototype systems for above-ground and underground use.
- Field test and demonstrate the functional prototype in realistic environments.

	FY 2004	FY 2005	FY 2006	FY 2007
Navigation-Grade MEMS Inertial Measurement Unit (IMU)	(0.000)	0.000	3.000	12.000

(U) The Navigation-Grade MEMS Inertial Measurement (IMU) program will develop tiny accelerometers and gyros with navigation-grade performance that use only milli-watts of power. The program will transcend traditional single mass-spring methods for navigation sensing and will explore alternative approaches, such as multiple, interconnected mass-spring systems, micro-levitated spinning structures, micro-optical readout mechanisms, atomic interferometric readout mechanisms, and fluidic contortions.

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- (U) Program Plans:
- Attain 3D resonator structures (e.g., spheres, full wine-glass structures).
 - Develop levitation methods.
 - Develop fluid contortion sensing.
 - Develop micro-environmental control.
 - Control electronics integration.

	FY 2004	FY 2005	FY 2006	FY 2007
Global Positioning Experiments (GPX)	(2.000)	0.000	0.000	0.000

(U) The Global Positioning Experiments (GPX) program increased the ability of GPS users to operate effectively in the presence of enemy jamming or countermeasures by demonstrating the feasibility of airborne pseudolite (APL) concepts. By receiving and re-transmitting GPS signals at substantially higher power levels, the APL overcomes the effects of jamming on DoD receivers and enable continuous operation. APLs can be rapidly deployed on unmanned aerial vehicles (or other airborne platforms) and provide theater-wide coverage for individual soldiers, combat platforms and precision GPS-guided shoot-to-coordinate weapons. The GPX program culminated with an integrated demonstrations of a full constellation of APLs which utilized shaped transmit beams in a jamming field and successfully showed it's utility for the JDAM weapon system with captive carry flights on an F/A-18 In addition, APL methods have been investigated for exploitation of signals from satellites of opportunity for precision localization in the absence of GPS. GPX program is transitioning to the Air Force GPS program office, which is currently conducting an implementation analysis.

- (U) Program Plans:
- Fabricated and integrated multiple airborne pseudolites.
 - Conducted airborne testing campaign; demonstrated successful navigation and interoperability in GPS jamming environment using multiple airborne pseudolites.
 - Demonstrated shaped transmit beam solution to near-far issue.

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	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Tactical Targeting Technology (AT3)	(3.000)	0.000	0.000	0.000

(U) The Advanced Tactical Targeting Technology (AT3) program demonstrated a passive tactical targeting system against short-dwell emitters to improve lethal suppression of enemy air defenses (SEAD). The targeting system is designed to negate emitter shutdown tactics now employed to defeat anti-radiation missiles (ARM) guidance, and thereby enable simplified ordnance inventories. The goal was to generate and distribute near real-time, comprehensive, and highly precise location of threat radars to all theater combatant aircraft without deploying any additional SEAD-dedicated, emitter-collecting platforms. AT3 accomplished this by widely deploying emitter collection packages hosted on existing airborne platforms, including combat aircraft. AT3 integrated distributed multi-platform emitter collections in real-time using existing or planned tactical data links with advanced network management and signal processing. To achieve wide deployment, AT3 focused on transition through inexpensive-upgrades to digital radar warning receivers. Enabling technologies include: coupled GPS Inertial Measurement Unit (IMU) packages, tactical communications, advanced highly dynamic data fusion network management capabilities, and algorithms to ensure robust, flexible performance of geolocation algorithms for locating multiple emitter types in noisy, high pulse density environments. AT3 has successfully completed strenuous flight tests and real-time multi-ship demonstrations with brassboard hardware. The AT3 technology is transitioning to the Air Force and Navy in FY 2005.

- (U) Program Plans:
- Completed and analyzed results from real-time flight tests at western test ranges to ensure that program goals were met.
 - Demonstrated AT3 technologies and capabilities.
 - Supported transition to Air Force and Navy.

(U) **Other Program Funding Summary Cost:**

- Not Applicable.