

UNCLASSIFIED

PE NUMBER: 0602602F
 PE TITLE: Conventional Munitions

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2004
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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
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Cost (\$ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	62.802	46.061	52.251	50.260	54.704	52.684	53.998	0.000	0.000
2068 Advanced Guidance Technology	16.905	16.589	16.359	16.454	16.960	17.366	17.717	0.000	0.000
2502 Ordnance Technology	45.897	29.472	35.892	33.806	37.744	35.318	36.281	0.000	0.000

(U) A. Mission Description and Budget Item Justification

This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies for conventional air-launched munitions. The program includes two projects: (1) development of advanced guidance technologies, including seekers, navigation and control, target detection and identification algorithms, and simulation assessments; and (2) development of conventional ordnance technologies, including warheads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments.

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

	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
(U) Previous President's Budget	58.802	46.455	50.351
(U) Current PBR/President's Budget	62.802	46.061	52.251
(U) Total Adjustments	4.000	-0.394	
(U) Congressional Program Reductions			
Congressional Rescissions		-0.394	
Congressional Increases			
Reprogrammings	4.000		
SBIR/STTR Transfer			
(U) <u>Significant Program Changes:</u>			
Not Applicable.			

Exhibit R-2a, RDT&E Project Justification

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602602F Conventional Munitions			PROJECT NUMBER AND TITLE 2068 Advanced Guidance Technology		
Cost (\$ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
2068 Advanced Guidance Technology	16.905	16.589	16.359	16.454	16.960	17.366	17.717	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional munitions advanced guidance technologies to establish technical feasibility and military utility. This project includes development of advanced guidance including terminal seekers, navigation and control, signal and processing algorithms, and guidance and control simulations. Project payoffs include: adverse-weather and autonomous precision guidance capability; increased number of kills per sortie; increased aerospace vehicle survivability; improved reliability and affordability; and improved survivability and effectiveness of conventional weapons.

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

	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
(U) MAJOR THRUST: Investigate and develop advanced guidance component technologies for adverse weather, and autonomous seekers for air-delivered munitions, such as detectors and detector arrays, receiver electronics, signal pre-processing, target recognition, spatial target characteristics, optics, and low-cost beam scanning and shaping technologies. These technologies will enable the development of next generation seekers that will increase a weapon's kill probability, reduce pilot workload, and enhance sortie effectiveness.	6.779	6.471	6.100
(U) In FY 2003: Tested in-house, high-throughput, parallel processing target acquisition algorithms. Evaluated laser ranging and detection seeker components to quantify operational range, target detection and identification, aim-point selection, and weather penetration effectiveness. Designed a low-cost, synthetic aperture radar seeker to assess future advanced guidance applications.			
(U) In FY 2004: Develop a low-cost, synthetic aperture radar seeker to assess future advanced guidance applications. Initiate demonstration of a laser ranging and detection seeker with the capability to perform 'single-shot' imaging technology.			
(U) In FY 2005: Continue testing laser ranging and detection seeker with the capability to perform 'single-shot' imaging technology. Begin ground testing a low-cost, synthetic aperture radar seeker to assess future advanced guidance applications. Initiate design of an optical seeker using multiple discriminates to improve performance against obscured or hidden targets.			
(U) MAJOR THRUST: Investigate and develop advanced navigation and control technologies for air-delivered munitions to include nonlinear controllers, biomimetic guidance, clutter rejection modules, detection and segmentation modules, and micro-electromechanical gyros. These technologies will allow a more efficient flight path to target, increase stand off ranges, and enhance strike aircraft effectiveness and survivability.	4.758	4.500	4.204
(U) In FY 2003: Completed laboratory field-testing of a reliable, accurate, miniaturized, and low-cost anti-jam weapon guidance system capable of operating in highly dynamic flight environments in the presence of Global Positioning			

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<p>System jamming devices. Designed new technologies for tactical munitions flight control systems. Advanced development of novel ways to enhance weapon system effectiveness through higher levels of integration of guidance, navigation, control, and estimation algorithms. Investigated neuro-physiology of insects for applications to guidance. Investigated clutter and multi-discriminate rejection to defeat camouflage, concealment, and deception.</p>			
<p>(U) In FY 2004: Continue evaluating new design technologies for tactical munitions flight control systems. Continue developing novel ways to enhance weapon system effectiveness through higher levels of integration of guidance, navigation, control, and estimation algorithms. Continue investigating the neuro-physiology of insects for applications to guidance. Investigate concepts for penetrator guidance below the ground.</p>			
<p>(U) In FY 2005: Continue developing new design technologies for tactical munitions flight control systems. Complete a modeling and simulation testbed for developing novel ways to enhance weapon system effectiveness through higher levels of integration of guidance, navigation, control, and estimation algorithms. Continue investigating the neuro-physiology of insects for applications to guidance. Continue investigating concepts for penetrator guidance below the ground.</p>			
<p>(U)</p>			
<p>(U) MAJOR THRUST: Investigate and develop advanced optical and digital processors and target detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. These seekers will deny an enemy the ability to hide or camouflage a target while also decreasing the pilot's workload.</p>		2.005	1.892
<p>(U) In FY 2003: Evaluated highly innovative concepts and approaches in guidance and control. Investigated biomimetic principles and concepts, including foveal vision and neuromorphic imaging systems, for use in advanced seekers for moving target scenarios. Investigated algorithms to perform flight trajectory shaping that reduce human workload.</p>			
<p>(U) In FY 2004: Enhance development of highly innovative concepts and approaches in guidance and control to include advanced seekers for moving target scenarios. Using digital simulation and hardware in the loop testing, transition biomimetic principles developed by the Air Force Office for Scientific Research for variable resolution sensors. These sensors will emulate biological or human characteristics for use in advanced seeker components for moving target scenarios. Complete investigation of algorithms to perform flight trajectory shaping that reduces human error design effects. Initiate investigating polarization measurement to differentiate the properties of manmade materials from natural backgrounds.</p>			
<p>(U) In FY 2005: Continue developing highly innovative concepts and approaches in guidance and control. Continue transitioning biomimetic principles developed by the Air Force Office for Scientific Research for variable resolution sensors. These sensors will emulate biological or human characteristics for use in advanced seeker components for moving target scenarios. Continue investigating polarization measurement to differentiate the properties of manmade materials from natural backgrounds. Develop an in-house capability to evaluate contractor-developed optic-flow algorithms.</p>			
<p>(U)</p>			
Project 2068	R-1 Shopping List - Item No. 11-3 of 11-9	Exhibit R-2a (PE 0602602F)	

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602602F Conventional Munitions			PROJECT NUMBER AND TITLE 2068 Advanced Guidance Technology			
(U)	MAJOR THRUST: Investigate and develop detailed six-degree-of-freedom and hardware-in-the-loop simulations including synthetic aperture radar, automatic target recognition, and biomimetic processing. Technologies also include trajectory optimization algorithm and polarization sensing and models to analyze guided munitions and their components that will enable requirement studies, design iteration and evaluation, and experiment risk reduction. These simulations will shorten development time, reduce development costs, and provide more effective munitions.				3.363	3.726	3.805			
(U)	In FY 2003: Analyzed efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Investigated the long-term technology and strategy for developing an advanced laser radar scene projector. Provided detailed performance estimates of guidance-related component technology, using six-degree-of-freedom simulations, for guided weapon systems. Enhanced modular, system-level, analysis tools development to provide comprehensive comparisons among inventory, planned, and conceptual munitions to identify high pay-off technologies and weapon attributes.									
(U)	In FY 2004: Continue analysis efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Complete investigating the long-term technology and strategy for developing an advanced laser ranging and detection scene projector capability. Complete developing two-dimensional laser arrays for laser ranging and detection scene projectors. Complete providing detailed performance estimates of guidance-related component technology, using six-degree-of-freedom simulations, for guided weapon systems. Continue developing modular, system-level, analysis tools to provide comprehensive comparisons among inventory, planned, and conceptual munitions to identify high pay-off technologies and weapon attributes.									
(U)	In FY 2005: Continue analysis efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Continue development of simulation model, reusable end system simulation tools. Develop a prototype waveform generator, meeting DoD simulator requirements, using a commercial synthesizer chip.									
(U)	Total Cost				16.905	16.589	16.359			
(U)	<u>C. Other Program Funding Summary (\$ in Millions)</u>									
		<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</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 0603601F, Conventional Weapons Technology.									
(U)	This project has been coordinated through the Reliance process to harmonize efforts and eliminate									

Exhibit R-2a, RDT&E Project Justification

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02 Applied Research

PE NUMBER AND TITLE

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2068 Advanced Guidance Technology

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

duplication.

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602602F Conventional Munitions			PROJECT NUMBER AND TITLE 2502 Ordnance Technology		
Cost (\$ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
2502 Ordnance Technology	45.897	29.472	35.892	33.806	37.744	35.318	36.281	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility to include technologies for advanced conventional weapon dispensers, submunitions, safe and arm devices, fuzes, explosives, warheads, and weapon airframe and carriage technology. The project also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses target vulnerability. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved warhead and fuze effectiveness; improved submunition dispensing; low-cost airframe/subsystem components and structures; and reduced aerospace vehicle/weapon's drag.

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

	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
(U) MAJOR THRUST: Investigate and develop high fidelity analytical tools such as computational mechanics models for predicting weapons' effects and assessing target vulnerability. These analysis tools will reduce air-delivered munitions development costs and provide weapons that can generate maximum lethality against a given target class.	6.507	6.321	7.125
(U) In FY 2003: Developed new hydro-code to improve predictive warhead performance capabilities by adding metal cutting, detonation waves, shear banding, and phase transitions. Upgraded and refined basic models describing fragmentation effects against various target facilities, including weapons of mass destruction (WMD). Performed phenomenology tests to provide data for the development of lethality and vulnerability codes for ground-fixed WMD targets. Applied campaign analysis tools to compare inventory, budgeted, and conceptual munitions to identify high payoff technologies.			
(U) In FY 2004: Continue upgrading and refining basic models describing fragmentation effects against various target facilities, including WMD. Continue applying campaign analysis tools to compare inventory, budgeted, and conceptual munitions to identify high payoff technologies. Develop improved engineering level predictive methods for blast effects, combined effects environment, and target structural response. Improve methodologies for predicting the penetration performance of unitary penetrating materials into complex target structures.			
(U) In FY 2005: Continue upgrading and refining basic models illustrating fragmentation effects against various target facilities, including hardened facilities and WMD. Continue using campaign analysis tools to compare inventory, budgeted, and conceptual munitions to identify high payoff technologies. Continue developing improved engineering level predictive methods with a simplified finite element model that estimates the damage from collapse and instability caused by direct weapon hits. Develop models to assess the failure of blast doors and other hardened assets in deep underground facilities.			
(U) MAJOR THRUST: Investigate and develop more efficient, affordable explosives including inert dense metal	5.206	4.050	5.119

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<p>additives, tungsten-laden explosives, cast and cure high energy composite explosives, and nano-scale metal fuels that provide both higher blast performance and lower ignition sensitivity for air-delivered munitions. These technologies will enable safer, less expensive explosive fills for inventory and future weapons.</p>			
<p>(U) In FY 2003: Completed creation of new, advanced, intermolecular energetic materials using micro-scale and nano-scale fuel and oxidizer particles. Completed efforts to develop a new class of materials for use in fragments, shaped charges, and explosively formed projectiles. Enhanced a highly energetic material development with twice the power density of conventional explosives, but exhibiting insensitive munition attributes. Evaluated materials for explosive capable of surviving Mach 4 impacts that will still functions as desired when initiated by the fuze. Completed research of dense reactive metal explosives and investigated cost-effective methods to improve current explosives.</p>			
<p>(U) In FY 2004: Continue developing a highly energetic material that has twice the power density of conventional explosives, while still exhibiting insensitive munition attributes. Complete development of an explosive capable of surviving Mach 4 impacts that still functions as desired when initiated by the fuze. Develop characterization and evaluation methodologies to test the munition application performance of high energy density materials developed in other laboratories. Initiate increasing the energy output while maintaining the producible capability of cast and cure composite explosives by using advanced energetic materials, plasticizers techniques, and formulation techniques.</p>			
<p>(U) In FY 2005: Continue developing a highly energetic material with twice the power density of conventional explosives, while still exhibiting insensitive munition attributes. Continue increasing the energy output while maintaining the producibility of cast/cure Plastic Bonded Explosives (PBX) composite explosives, by using advanced energetic materials, plasticizers, and formulation techniques. Complete an effort to add dense metal powders to PBX to enhance near-field lethality when low collateral damage is required.</p>			
<p>(U)</p>			
<p>(U) MAJOR THRUST: Investigate and develop advanced fuze technologies for air-delivered munitions, such as commercially available micro-mechanical systems, shock-hardened fuzes, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fuze technologies will enhance lethality through precise selection of burst-height at, above, or below the surface to increase weapon safety and tactical performance while simultaneously decreasing procurement costs and system supportability requirements.</p>		7.116	6.340
<p>(U) In FY 2003: Designed a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Determined the benefits of developing a high-speed, hard target fuze using sensors such as micro-electromechanical system gyroscopes. Investigated technologies that communicate battle damage assessment information through hardened mediums.</p>			
<p>(U) In FY 2004: Continue developing a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Complete investigating technologies that communicate battle damage assessment information through hardened mediums. Develop miniaturized fuze to effectively control</p>			
Project 2502	R-1 Shopping List - Item No. 11-7 of 11-9	6.705	Exhibit R-2a (PE 0602602F)

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<p>the release of anti-agent and submunition for defeating weapons of mass destruction.</p>			
<p>(U) In FY 2005: Continue developing a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Continue developing a miniaturized fuze to effectively control the release of anti-agent for defeating weapons of mass destruction. Begin developing a miniaturized fuze to provide safe and arm, burst point sensor and low power initiator in a 4 cubic inch package. Develop a wireless communication system to fuze a hard target munition.</p>			
<p>(U) MAJOR THRUST/CONGRESSIONAL ADD: Investigate and develop control and carriage technologies for ordnance packages for advanced air-delivered munitions in order to enhance weapon lethality. Examples of these technologies include high-energy explosives, mass-focus fragmentation, and multi-sensor fuzing. These technologies will increase weapon systems effectiveness by contributing to increased weapon load-out on strike aircraft and enhanced sortie effectiveness. Note: This effort includes \$1.1 million in FY2003 Congressional Add funding for defense against Weapons of Mass Destruction.</p>		13.146	5.567 8.745
<p>(U) In FY 2003: Investigated and compared subsystem technologies necessary to develop an optimum kill missile against low-observable, air targets. Investigated technologies, such as microbots and nano-encapsulation, to disrupt, deny, destroy, or damage facilities containing chemical and biological weapons. Investigated technologies that can defeat hard and deeply buried targets by simultaneously placing multiple, precise, time-of-arrival guided munitions on target.</p>			
<p>(U) In FY 2004: Continue investigating subsystem technologies necessary to develop an optimum kill missile against low-observable, air targets. Perform concept trade studies to determine the technologies necessary to deny adversary operations over long, stand off ranges.</p>			
<p>(U) In FY 2005: Finish investigating specific missile subsystem technologies to counter low-observable, air targets. Begin an effort to design and ground test precise time-of-arrival munitions. Begin to identify the critical technologies needed for an advanced next generation, low cost mini-cruise missile. Begin developing technologies to deny enemy operations through loitering low-cost multi-shot munitions.</p>			
<p>(U) MAJOR THRUST: Investigate and develop advanced warhead kill mechanisms, such as adaptable warhead, directional control and fragmenting ordnance, and application of reactive metals. The investigation includes characterization of the dynamic response of metals and geologic materials, adjustable yield ordnance packages, and distributed multi-point fire set to enhance air-delivered munition lethality. This enhanced lethality supports the development of smaller munitions with effectiveness similar to current inventory weapons and with a corresponding increase in aircraft load-out and sortie effectiveness.</p>		13.922	7.194 8.198
<p>(U) In FY 2003: Evaluated initiation-based, adaptable, and multi-mode warheads using enhanced lethality materials and miniaturization technologies for the advanced warhead kill mechanism. Evaluated ordnance technology to reduce fratricide in urban warfare scenarios. Completed assessment of multi-mode warheads using heavy metal liners to enhance lethality. Completed in-house experiments to characterize the interaction of munitions with chemical and</p>			

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biological weapon and storage containers. Conducted design trades to improve the attributes of penetrating munitions by focusing on improving warhead case survivability, control of depth of burial, trajectory control methodologies while penetrating hardened material and decreasing case thickness to allow a greater amount of energetic material to be carried to required depth of target.

- (U) In FY 2004: Complete evaluating initiation-based, adaptable, and multi-mode warheads using enhanced lethality materials and miniaturization technologies for the advanced warhead kill mechanism. Continue evaluating an ordnance package designed for low collateral damage with high near-field and minimum far-field lethality. Continue an effort to improve the attributes of penetrating munitions by focusing on improving warhead case survivability, control of depth of burial, trajectory control methodologies while penetrating hardened material and decreasing case thickness to allow a greater amount of energetic material to be carried to the required depth of target. Begin evaluating tungsten to be used for high-speed, penetrating-warhead case material. Develop the design constraints to provide adaptable warhead technologies to better attack mobile ground targets. Develop experimental data analysis techniques to characterize the dynamic response of metals used for warhead cases. Investigate effectiveness of large blast explosive mechanisms.
- (U) In FY 2005: Continue evaluating an ordnance package designed for low collateral damage with high near-field and minimum far-field lethality. Complete evaluation of low collateral damage, multi-mode warheads. Continue in-house effort to improve penetrating warhead case survivability, depth of burial, and trajectory control, with lower case thickness. Continue evaluating tungsten for high-speed penetrating weapons. Evaluate high energetic materials for adaptable warheads to attack mobile ground targets.

(U) Total Cost	45.897	29.472	35.892
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(U) **C. Other Program Funding Summary (\$ in Millions)**

	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</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 0603601F, Conventional Weapons Technology.
This project has been coordinated through the
- (U) Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Acquisition Strategy**

Not Applicable.