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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification **DATE:** May 2009

APPROPRIATION/BUDGET ACTIVITY					R-1 ITEM NOMENCLATURE					
3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					PE 0602602F Conventional Munitions					
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	61.469	57.407	58.289						Continuing	Continuing
622068: Advanced Guidance Technology	18.691	17.933	17.833						Continuing	Continuing
622502: Ordnance Technology	42.778	39.474	40.456						Continuing	Continuing

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. Programs support core technical competencies of target identification and tracking, guidance navigation and control, munition systems, explosives, fuzes, and warheads/damage mechanisms. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

B. Program Change Summary (\$ in Millions)

	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>
Previous President's Budget	58.632	55.963	60.781	
Current BES/President's Budget	61.469	57.407	58.289	
Total Adjustments	2.837	1.444	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.156		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	3.628	1.600		
SBIR/STTR Transfer	-0.791	0.000		

Change Summary Explanation

In FY 2009, Congress added \$1.6 million for Advanced Nanotube Micro-Munition Weapon Technology Initiative.

C. Performance Metrics
(U) Under Development.

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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
622068: Advanced Guidance Technology	18.691	17.933	17.833						Continuing	Continuing

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.

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

	FY 2008	FY 2009	FY 2010	FY 2011
<p>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. (NOTE: Increased funding in FY 2010 due to an increased efforts in Target Identification and Tracking, Signal and Image Processing and related Assessments.)</p> <p>In FY 2008: Tested and demonstrated, in a lab environment, test components for laser ranging seeker to provide "single shot" imaging at useful ranges. Lab tested an optical seeker that uses multi-discriminate signatures to improve targeting of obscured targets. Developed Synthetic Aperture Radar (SAR) system simulation for designing Radar Frequency (RF) seeker technologies analysis.</p> <p>In FY 2009: Laboratory demonstration of test components for laser ranging seeker to profile "single shot" images of useful targets. Test and demonstrate an optical seeker that uses multi-discriminate signatures to improve targeting obscure targets. Refine SAR system simulation. Begin developing a multimode seeker that provides improved performance in two wavelength bands.</p>	6.534	5.080	9.866	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Laboratory demonstration of test components for laser ranging seeker to profile "single shot" images of useful targets. Complete demonstration of optical seeker that uses multi-discriminate signatures to improve targeting obscure targets. Continue development of multimode seeker that provides improved performance using two complimentary wavelength bands. Develop algorithms to use wide field of view optical imager data to augment map-matching techniques, enabling navigation under GPS-denied conditions. Verify polarization theory models through simulation. Conduct tests on optical flow enhanced seeker.				
<p>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, improve resistance to Global Positioning System (GPS) jamming, and enhance strike aircraft effectiveness and survivability. (NOTE: In FY10, the assessments efforts regarding to navigation are included in this thrust.)</p> <p>In FY 2008: Tested navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Applied neuro-physiology of insects to guide small vehicles for moving targets in urban like environments. Evaluated novel navigation system within GPS jamming environments. Investigated using data links to provide target location updates for precision strike against mobile, time sensitive targets.</p> <p>In FY 2009: Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in urban-like environments. Continue evaluating navigation systems within GPS jamming environments. Evaluate utility data links to provide target location updates for precision strike against time sensitive targets. Investigate guidance navigation and control algorithms for engaging high agility, reduced signature targets. Investigate technologies applicable to indoor navigation within facilities.</p> <p>In FY 2010: Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in urban-like environments. Continue evaluating navigation systems within GPS jamming environments. Continue maturing technologies allowing weapons to communicate in a secure, low probability of detection</p>	3.300	3.455	3.916	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
mode with launch platforms, submunitions and/or ground elements. Integrated demonstration performing a multi-UAV coordinated search and attack on a time critical moving target.				
<p>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. Continue developing highly innovative concepts and approaches in guidance and control. These seekers will deny an enemy the ability to hide or camouflage a target, while also decreasing aircrew workload. (NOTE: Efforts in this thrust were combined with seeker efforts to better align the technologies.)</p> <p>In FY 2008: Verified biomimetic models through simulation. Developed polarization behavior theory models. Developed an optical flow enhanced seeker.</p> <p>In FY 2009: Continue verifying biomimetic models through simulation and field testing. Verify polarization theory models through simulation. Conduct tests on an optical flow enhanced seeker.</p> <p>In FY 2010: Not Applicable.</p>	3.570	3.851	0.000	
<p>MAJOR THRUST: Using a system approach, investigate and develop weapons by making trades between guidance, navigation and control, and seekers. The thrust will address feasibility by modeling and simulating integrated weapon systems.</p> <p>In FY 2008: Refined the set of interoperable simulations, validating the reusable aspects, to evaluate emerging munitions technologies. Updated and tested multi-spectral phenomenology models and evaluated via synthetic scene simulation. Investigated laser radar (LADAR) scene generation to demonstrate a feasible projection system for hardware-in-the-loop testing.</p> <p>In FY 2009: Continue refining the set of interoperable simulations to evaluate emerging munitions technologies. Integrate and test updates for multi-spectral phenomenology models and evaluate updated</p>	5.287	5.547	4.051	

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B. Accomplishments/Planned Program (\$ in Millions)							FY 2008	FY 2009	FY 2010	FY 2011
<p>results via synthetic scene simulation. Continue the investigation of a LADAR scene generation capability for hardware-in-the-loop testing.</p> <p>In FY 2010: Continue refining the set of interoperable simulations to evaluate emerging munitions technologies. Simulate different highly innovative concepts and approaches in guidance and control technology.</p>										
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
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603601F/ Conventional Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing
D. Acquisition Strategy										
Not Applicable.										
E. Performance Metrics										
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.										

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions					PROJECT NUMBER 622502	
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
622502: Ordnance Technology	42.778	39.474	40.456						Continuing	Continuing

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 and weapon drag.

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

	FY 2008	FY 2009	FY 2010	FY 2011
<p>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. (NOTE: In FY 2010, research activities will be conducted in this thrust were moved to the Munition Integration and the Warheads to better align them with their technical areas.)</p> <p>In FY 2008: Modeled damage to buildings caused by direct weapon effects. Developed capability to apply first principles computational tools to the design and evaluation of new munitions concepts. Identified high payoff technologies for defeating mobile targets.</p> <p>In FY 2009: Continue modeling damage to buildings caused by direct weapon effects. Continue developing capability to apply first principles computational tools to design and evaluation of new munitions concepts. Continue to identify high payoff technologies for defeating mobile targets. Apply system level analysis tools to identify promising high payoff technologies for defeating mobile targets.</p> <p>In FY 2010: Not Applicable.</p>	7.810	8.479	0.000	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<p>MAJOR THRUST: Investigate and develop energetic materials technology that can maximize weapon lethality, while applying appropriate safety and security features. This thrust will formulate, process, characterize, and model energetic materials with potential for weapon applications. (NOTE : Increased funding in FY 2010 is a result of an increased emphasis on technologies in this area.)</p> <p>In FY 2008: Continued developing highly energetic material with twice the power density of conventional explosives by formulating advanced energetic materials. Evaluated the sensitivity and detonation performance and developed design processes for new energetic formulations. Characterized the chemical reaction kinetics of new energetic materials to develop a materials properties database.</p> <p>In FY 2009: Continue developing highly energetic material with twice the power density of conventional explosives by characterizing advanced conventional explosive formulations. Evaluate the sensitivity and detonation performance, and develop process of new energetic materials. Continue developing a materials properties database characterizing chemical reaction kinetics.</p> <p>In FY 2010: Continue developing the materials properties database to develop system level models for predicting initiation. Develop explosive fills that reduce pre-detonation during high "G" loading. Investigate low-density energetic materials for use in micro-munitions. Investigate high-density case materials capable of enhancing warhead performance.</p>	6.000	6.700	9.658	
<p>MAJOR THRUST: Investigate and develop fuzes for air-delivered weapon application. This thrust will provide novel energetic initiation concepts, develop penetration fuzing, develop robust point burst fuzes, and develop predictive models to explore new fuze designs.</p> <p>In FY 2008: Tested a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Static and sled tested a wireless communication system to fuze hard target munitions. Developed waveform agile fuze to defeat smart jamming. Investigated novel warheads to initiate explosives.</p>	5.600	6.000	6.041	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<p>In FY 2009: Demonstrate a miniature fuze that provides safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Continue investigating novel methods to initiate explosives. Begin investigating miniature components to transmit bomb damage information.</p> <p>In FY 2010: Continue investigating novel methods to initiate explosives, including new modeling and testing techniques. Investigate the mechanical environment that a fuze must survive during hard target penetration events. Explore ground profiling imaging fuze technology. Begin investigating a hardened chip fuze that uses integrated logic.</p>				
<p>MAJOR THRUST: Using a system approach, investigate and develop weapons by making technology trades between fuzes, warheads, and explosives. The thrust will address feasibility of system applications by modeling and simulating integrated weapon systems. (NOTE: Starting in FY 2010, funding for Munition System assessments has been included in this thrust.)</p> <p>In FY 2008: Investigated technologies for miniature cruise missile development. Miniaturized the attack system to communicate target aim point position from behind enemy lines. Field tested a covert video distribution capability to collect and transmit data to coordinate attack of enemy targets. Investigated reaction jet control technology to enable dual role air dominance missile technology. Investigated design of precision guided munitions.</p> <p>In FY 2009: Complete development of third spiral of covert video distribution capability and transmit data to coordinate attacks of enemy targets. Continue investigating reaction jet control for dual role area dominance missile technology. Continue investigating the design of precision guided munitions by performing subsystem design trade studies. Conduct research on dispensing technologies for aerospace applications.</p> <p>In FY 2010: Complete investigation of reaction jet control for dual role missile technology. For precision guided munitions, investigate stability during dispense, dispense ejection techniques, and structures to withstand ejection loading. Develop and use a set of interoperable simulations to evaluate emerging munition</p>	14.092	8.800	12.335	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
technologies. Develop and enhance models for micromunitions, penetrators, and counter chemical, biological, radiological, and nuclear effects.				
<p>MAJOR THRUST: Investigate and develop advanced warhead kill mechanisms, such as adaptable warheads, directional control, fragmenting warheads, and application of reactive metals. The enhanced lethality supports smaller munitions with increased aircraft load-out and enhanced effectiveness. (NOTE: Beginning in FY 2010, warhead assessments efforts have been included in this thrust.)</p> <p>In FY 2008: Evaluated selected materials for high-speed penetrating weapons and the hard nose-caps against hard and combination targets. Investigated high strength next generation warhead cases with the eventual goal of terradynamic steering. Evaluated shaped charges to defeat medium and heavy armor. Investigated micro-damage technologies to neutralize electronics with small robotic weapons. Developed a small high velocity unmanned aerial vehicle (UAV) deliverable with strength to defeat hardened targets. Developed a submunition concept that can penetrate hardened target for agent defeat.</p> <p>In FY 2009: Complete evaluation of selected materials for high-speed penetrating weapons and the hard nose-caps against hard and combination targets. Continue investigating high strength next generation warhead cases with the eventual goal of terradynamic steering. Continue evaluation of shaped charges to defeat medium and heavy armor. Continue investigating micro-damage technologies to neutralize electronics with small robotic weapons. Continue developing a small high velocity UAV deliverable with strength to defeat hardened targets. Continue investigating submunition technology that provide agent defeat mechanisms against hardened targets. Begin investigations into new mechanisms for defeating agent defeat targets.</p> <p>In FY 2010: Complete investigation of high strength next generation warhead cases with the eventual goal of terradynamic steering. Complete evaluation of shaped charges to defeat medium and heavy armor. Complete investigation of micro-damage technologies to neutralize electronics with air delivered small robotic weapons. Explore compact lethality warhead technologies for use in urban terrain. Begin investigating directional warhead concepts employing reactive fragments to improve standoff kills for non-direct hit encounters. Develop numerical algorithms for material-to-material interface dynamics, loading, and vibration during high</p>	8.100	7.899	12.422	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
speed penetration. Investigate techniques to control, direct, and focus the energy release from explosives in real-time by means of applying small amounts of electromagnetic energy.				
<p>CONGRESSIONAL ADD: Advanced Nanotube Micro-Munition Weapon Technology Initiative.</p> <p>In FY 2008: Conducted Congressionally-directed effort for the Advanced Nanotube Micro-Munition Technology Initiative.</p> <p>In FY 2009: Conduct Congressionally-directed effort for the Advanced Nanotube Micro-Munitions Technology Initiative.</p> <p>In FY 2010: Not Applicable.</p>	1.176	1.596	0.000	

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Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603601F/ Conventional Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing
D. Acquisition Strategy										
Not Applicable.										
E. Performance Metrics										
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