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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)							DATE February 2000		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602303A Missile Technology					
COST (In Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	29234	47939	47183	30029	21846	27085	28262	0	231578
A214 Missile Technology	29234	35187	47183	30029	21846	27085	28262	0	218826
A223 Aero-Propulsion Technology	0	12752	0	0	0	0	0	0	12752

A. Mission Description and Justification: This applied research program element investigates new missile, rocket, and unmanned vehicle technologies for future, robust Army systems with special focus on the Future Combat System (FCS). The overall objective is to increase the survivability of launch systems, provide greater lethality and effectiveness under adverse battlefield conditions, increase kill probabilities against diverse targets, and provide powerful new simulation and virtual prototyping analysis tools. The missile research is conducted using system simulation, virtual prototyping, concept synthesis, hardware development, and focused technology demonstrations. This project encompasses seven major areas: missile guidance systems; air defense target acquisition systems; multi-spectral missile seekers; high fidelity system level simulations; missile aerodynamics and structure; smart, stealthy, smokeless missile propulsion; and focused technology integration/demonstrations. As technology areas mature, work is transitioned to PE 0603313A (Missile and Rocket Advanced Technology) to support demonstrations of capabilities for Future Missile Technology Integration (FMTI), Low Cost Precision Kill (LCPK) for 2.75 inch rockets, and Compact Kinetic Missile (CKEM), an advanced light weight hypervelocity missile. Work in this program element is related to and fully coordinated with efforts in PE 0602702E (Tactical Technology), PE 0602602F (Conventional Munitions), PE 0603601F (Conventional Weapons Technology), PE 0601104A (University and Industry Research Centers), PE 0603313A (Missile and Rocket Advanced Technology), PE 0603654A (LOSAT Advanced Concept Technology Demonstration), PE 0602782A (Command, Control and Communications (C3) Technology), PE 0605601A (Army Test Ranges and Facilities). The program element contains no duplication with any effort within the Military Departments. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL.

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B. Program Change Summary	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget (FY 2000/2001 PB)	30130	32892	31469
Appropriated Value	30380	48392	
Adjustments to Appropriated Value			
a. Congressional General Reductions	-250		
b. SBIR / STTR	-469		
c. Omnibus or Other Above Threshold Reductions		-148	
d. Below Threshold Reprogramming	-305		
e. Rescissions	-122	-305	
Adjustments to Budget Years Since FY 2000/2001 PB			+5839
New Army Vision/Transformation Adjustment		TBD	+9875
Current Budget Submit (FY 2001 PB)	29234	47939	47183

Change Summary Explanation: Funding - FY 2001: Project A214 CKEM was adjusted to reflect the new Army Vision/Transformation. Project A214 Micro-Electromechanical Systems Inertial Measurement Unit (MEMS IMU) was adjusted to add research to address high-g and affordability issues.

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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602303A Missile Technology				PROJECT A214		
COST (In Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
A214 Missile Technology	29234	35187	47183	30029	21846	27085	28262	0	218826	
<p>A. Mission Description and Justification: This project is focused on missile and rocket technologies that support high fire power/logistic support weight ratio concepts for future systems such as FCS. Efforts address concepts that enhance the survivability of launch systems, provide greater effectiveness under adverse battlefield conditions, increase kill probabilities against diverse targets, and provide powerful new simulation and virtual prototyping analysis tools. This project encompasses seven major areas: missile guidance systems; air defense target acquisition systems; multi-spectral missile seekers; high fidelity system level simulations; missile aerodynamics and structure; smart, stealthy, smokeless missile propulsion; and focused technology integration/demonstrations. A major effort in this project CKEM that is a candidate to provide overwhelming lethality for the FCS Direct Fire System. As efforts in this project mature, work is transitioned to PE 0603313A (Missile and Rocket Advanced Technology) to support demonstrations of capabilities for FMTI, LCPK for 2.75 inch rockets, and demonstration of the CKEM missile. Recapitalization opportunities are identified and pursued, when appropriate.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 13000 - Missile guidance systems - Completed signature tests for difficult targets and masked helicopters; assessed automatic and non-cooperative target recognition and tracker performance on wide spectrum realistic data sets and targets; initiated research into technologies for mini-unmanned aerial vehicles (UAVs) for missile targeting; began component development on next generation electronically scanned air defense fire control/guidance radar. <ul style="list-style-type: none"> - High fidelity system level simulations – developed and technically transferred to industry gray level co-occurrence matrix (GLCM) methods for infrared (IR) signature validation techniques; completed and demonstrated the programmable sensor emulator (“model board”) for two missile seeker projects. - Missile aerodynamics and structure – Investigated turbulent exhaust plume chemistry and solid carbon oxidation; completed Preliminary Design Review (PDR) and completed design, fabrication, and optical bench testing of risk reduction conformal dome and corrector for air and missile defense and tactical missiles. • 10950 - Smart, stealthy, smokeless missile propulsion – Demonstrated lead-free, minimum signature solid propulsion; completed actuator and control integration and completed axial pintle component design; developed gel flightweight components for long range, survivable, multi-mission capabilities. <ul style="list-style-type: none"> - Focused technology integration – Validated flightweight compact hypervelocity missile technology propulsion concepts for CKEM which will provide an overmatch capability against all tanks and armored targets; completed wind tunnel test and transitioned LCPK to PE 0603313A, which will provide reduced cost per kill, minimized collateral damage and greatly increased number of stowed kills over the present fielded system stable airframe. • 1440 - Evaluated applicability of acoustic methods to enhanced mixing concepts for propulsion for Army missile systems. • 1920 - Evaluated Scramjet hardware and developed a combustor concept for M > 10 operation, per congressional plus-up. 										
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<p>FY 1999 Accomplishments: (continued)</p> <ul style="list-style-type: none"> • 1924 - Upgraded active protection system (APS) radar test bed for counter-active protection system (CAPS) testing to represent new threat capabilities. Upgraded design of 2nd Generation countermeasure device to counter new threat capabilities and completed fabrication of 2nd Generation flight prototypes. <p>Total 29234</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 2442 -Global Positioning System (GPS)/MEMS IMU – Design and develop a small, inexpensive GPS/MEMS IMU combined unit using state-of-the-art technology applicable for multiple weapon applications including projectiles, missiles, vehicles, and aircraft. • 14545 - Missile guidance systems – Integrate and test High Quantities Anti-material Submunition (HI-QUAMS) small ladar seeker brassboard which will allow more submissiles on Army Tactical Missile System (ATACMS); develop global positioning system (GPS) jamming/spoofing models of inexpensive, small hardware for Army tactical missile application; complete baseline design for a high mobility wheeled vehicle (HMMWV)-based short range air defense (SHORAD) sensor system for air defense fire control/missile guidance radar; develop enhanced guidance link technology for loitering missiles and mini-UAVs; devise counter-countermeasures for infrared imaging seeker countermeasures. <ul style="list-style-type: none"> - High fidelity system level simulations - Extend the field programmable gate array digital quadrature modulator for increased processor throughput and higher clock rates; investigate Doppler phase shift effects on radio frequency (RF) signatures during signal integration times and develop phase coherent signal processing techniques for frequency modulated and frequency stepped RF guidance signals; extend the Ka-band RF front-end processor design of the RF target verification monitor to handle extremely short RF pulses; implement parallel processing programmable “model board” software for real-time, dynamic representation of missile seeker input optics and target image sensed scene irregularities. - Missile aerodynamics and structure - Develop "Virtual Prototype" of the Container Launched Attack Weapon System (CLAWS) missile and launch orientation module hardware and software that will provide an order of magnitude increase in firepower for selected situations; fabricate final design of conformal optical dome and corrector elements, integrate with imaging IR seeker and perform imaging and tracking demonstration of conformal optical seeker that will provide the technology to significantly extend the range of Stinger Block II. • 17580 - Smart, stealthy, smokeless missile propulsion – Complete development of improved fuel gel for long range, survivable, multi-mission capabilities which reduce assets required; develop hydrogen chloride (HCl)-free propellants, and a small scale motor testing of ADN propellants for minimum signature propulsion. <ul style="list-style-type: none"> - Focused technology integration/demonstrations – Implement Industry/Government cooperative programs for CKEM for component development in the areas of high-g guidance components and advanced propulsion, demonstrate 25% increase in missile lethality with novel penetrators and quantifying damage mechanisms other than perforation; transition current Remote Readiness Asset Prognostics/Diagnostics System (RRAPDS) technology to PATRIOT Project Office, finalize functional requirements and design specifications for RRAPDS objective system which provides near real-time logistics situational awareness thereby significantly reducing operating and support costs. • 620 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program <p>Total 35187</p>		
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602303A Missile Technology	PROJECT A214
<p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 7000 - MEMS IMU technology – Perform research to develop sensor and electronic design, foundry processes, and testing at competing contractor facilities for advancement of affordable, high-g MEMS IMUs. • 10740 - Missile guidance systems – Package the HI-QUAMS seeker that will lead to a 5-10x improvement in stowed kills for MLRS/ATACMS submissiles; fabricate and test in a laboratory brassboard MEMS based Inertial Measurement Unit (IMU) which will lead to an low cost IMU with common features for use in multiple weapon systems; fabricate and test next generation SHORAD antennas; test infrared imaging counter-countermeasures. - High fidelity system level simulations – Investigate IR target signature modeling approaches applicable to active IR target acquisition and track sensors; develop methods and software for representing 3-dimensional target geometry models applicable to active IR sensors where signal polarization may be a processing discriminant; investigate methods of projecting HWIL in-band IR target images and scenes with adequate scene detail and dynamic range to include the effects of active and passive IR countermeasures; complete and demonstrate the target verification monitor with application to all types of Ka-band pulse and CW radiation in a HWIL simulation facility. • 10343 - Smart, stealthy, smokeless missile propulsion – Complete component development of flight type hardware and integrate into a brassboard and test a flexible sustainer for long range, survivable, multi-mission capabilities which reduce assets required; complete vacuum aging study for service life prediction for cost avoidance of replacing pr opulsion systems and increased system safety and performance reliability; develop methodology for aging assessment of gel propulsion systems. - Focused technology integration/demonstrations – Revise sensor suite preliminary design, and build, test, and evaluate sensor suite breadboard hardware of RRAPDS which provides near real-time logistics situational awareness thereby significantly reducing operating and support costs; complete design of a miniature (45-60 centimeter wingspan) aerial vehicle to provide real-time targeting for short/medium range indirect fire munitions. • 9225 - CKEM – Mature multiple industry system design concepts and validate component technology for CKEM through joint industry/government cooperative program in the areas of advanced propulsion, enhanced lethality, and miniaturized high-g guidance and control • 9875 - Funds will be used in support of the New Army Vision/Transformation. <p>Total 47183</p>		
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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602303A Missile Technology				PROJECT A223		
COST (In Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
A223 Aero-Propulsion Technology	0	12752	0	0	0	0	0	0	12752	
<p>Mission Description and Justification: This Congressionally directed project focuses on missile and rocket aero-propulsion technologies. It develops aerodynamics and related propulsion technologies and demonstrates enhanced range, maneuverability, and the survivability for missiles and UAVs. It explores unique aerodynamic characteristics and propulsion concepts to enhance missile flight performance at subsonic, supersonic, and hypersonic velocities. Current efforts include: scramjet, aero-optic evaluation facility, and computational fluid dynamics.</p> <p>FY 1999 Accomplishments: Project not funded in FY 1999.</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 1909 - Scramjet - test a Scramjet propulsion concept for a missile in a ground test facility operating at full scale and at duplicated flight conditions. - Provide Scramjet hardware for testing, analytical performance predictions, and data reduction and analysis. • 2864 - Aero-Optic Evaluation Facility – Test hypersonic missiles in a ground test facility operating at full scale and at duplicated flight conditions • 7636 - Computational Fluid Dynamics (CFD) - develop a specialized computer system for designing and developing missiles and missile components using CFD. • 343 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program <p>Total 12752</p> <p>FY 2001 Planned Program: Project not funded in FY 2001.</p>										
Project A223	<i>Page 6 of 6 Pages</i>					Exhibit R-2A (PE 0602303A)				