Exhibit R-2, PB 2010 Army RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					
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	124.115	99.687	61.404						Continuing	Continuing
EM4: Electric Component Technologies (CA)	22.357	22.626	.000						Continuing	Continuing
EM6: HEATING AND COOLING TECHNOLOGIES (CA)	3.286	6.378	.000						Continuing	Continuing
EM7: POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)	55.792	25.556	.000						Continuing	Continuing
EM8: High Power and Energy Component Technology	.000	.000	13.951						Continuing	Continuing
H11: Tactical and Component Power Technology	13.276	13.121	12.837						Continuing	Continuing
H17: FLEXIBLE DISPLAY CENTER	5.863	6.540	7.007						Continuing	Continuing
H94: ELEC & ELECTRONIC DEV	23.541	25.466	27.609						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this program element (PE) is applied research on technologies in areas such as electronic components, power components, frequency control and timing devices, high power microwave devices, and display technologies. The applied research on these technologies will enable the ability to perform precision deep fires against critical mobile and fixed targets; provide exceptional all-weather, day or night, theater air defense against advanced enemy missiles and aircraft; and provide enhanced communications and target acquisition through support of capabilities such as autonomous missile systems, advanced land combat vehicles, smart anti-tank munitions, electric weapons, secure jam-resistant communications, automatic target recognition (ATR), foliage-penetrating radar, and combat identification. This PE sustains applied research on high-power, microwave, electronic components and technologies (project EM8), advanced portable power technologies (batteries, fuel cells, hybrids, engines, chargers, and power management) (project H11), applied research on flexible

displays in conjunction with the Flexible Display Center (project H17), and applied research on electronic component technologies such as photonics, micro electromechanical systems, imaging laser radar (LADAR), magnetic materials, ferroelectrics, microwave and millimeter-wave components, and electromechanical systems (project H94). Projects EM4, EM6, and EM7 fund congressional special interest items.

Work in this PE is related to and fully coordinated with efforts in PE 0602120A (Sensors and Electronic Survivability), PE 0602782A (Command, Control, Communications Technology), PE 0602709A (Night Vision Technology), PE 0602783A (Computer and Software Technology), PE 0603008A (Command, Control, Communications Advanced Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work is performed by the Army Research Laboratory (ARL), Adelphi, MD, and the Army Communications and Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth NJ.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	105.492	45.278	46.940	
Current BES/President's Budget	124.115	99.687	61.404	
Total Adjustments	18.623	54.409	14.464	
Congressional Program Reductions	.000	-.331		
Congressional Rescissions	.000	.000		
Total Congressional Increases	.000	54.740		
Total Reprogrammings	20.967	.000		
SBIR/STTR Transfer	-2.344	.000		

Change Summary Explanation

FY08 increase is due to transfer of congressional interest items of $20802 for proper execution and BTR of $165.
FY09 increase is due to congressional adds.
FY10 funding increase was due to the restructure of 0602120A, project 140 (Hi-Power Microwave), and funding provided to support power and energy initiatives and Electromagnetic Armor Power.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					PROJECT NUMBER EM4	
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**
EM4: Electric Component Technologies (CA)	22.357	22.626	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Electronic Component applied research.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
PEM Fuel Cell Tactical Generators	4.829	.000	.000	
Direct Methanol Fuel Cell-Battery Recharger Program	1.545	.000	.000	
Manufacturing Technology Development of Advanced Components for High Power Solid-State Lasers	1.546	2.325	.000	
Defense Modernization and Sustainment Initiative, Rochester Institute of Technology	1.933	.000	.000	
Micromachined Switches in Support of Transformational Communications Architecture	1.545	2.325	.000	
Renewable Energy for Military Applications	1.450	1.550	.000	
High-Frequency, High-Power Electronic and Optoelectronic Devices on Aluminum Nitride (AIN)	2.319	3.100	.000	
Roll-to-Roll Microelectronics Manufacturing in Support of the Flexible Display Initiative	1.546	.000	.000	
Silicon Carbide MOSFETs for Electric Power Systems	1.546	.000	.000	
Self-Powered, Lightweight, Flexible Display Unit on a Plastic Substrate	1.546	1.550	.000	
Flexible Solar Cell for Man-Portable Power Generator	1.778	.000	.000	
Large Format Li-Ion Battery	.774	.775	.000	
Compact Eyesafe Tactical Laser	.000	1.162	.000	
Extremely High Frequency (EHF) Transmitter for Win-T Satellite Communications	.000	1.938	.000	
Integrated Lightweight Tracker System (pending transfer to 62782)	.000	1.550	.000	
SOCOM Lightweight Unmanned Ground Robot (pending transfer to 62624)	.000	1.550	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES	PROJECT NUMBER EM4

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Fuel Cell Power System	.000	.775	.000	
Maryland Proof of Concept Alliance for Defense Technologies	.000	3.392	.000	
SBIR/STTR	.000	.634	.000	
Total	22.357	22.626	.000	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					PROJECT NUMBER EM6	
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**
EM6: HEATING AND COOLING TECHNOLOGIES (CA)	3.286	6.378	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Heating and Cooling applied research.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Advanced Tactical 2KW External Combustion Power Sources for Cogeneration Applications	.000	2.325	.000	
Miniature Cooling Unit for Electronic Devices	.967	.775	.000	
Cogeneration for Enhanced Cooling and Heating of Advanced Tactical Vehicles	2.319	2.325	.000	
Co-Generation of Power and Air Conditioning	.000	.774	.000	
SBIR/STTR	.000	.179	.000	
Total	3.286	6.378	.000	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					PROJECT NUMBER EM7	
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**
EM7: POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)	55.792	25.556	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding Power and Energy Component applied research.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Lithium Air Metal Battery	3.865	.000	.000	
Soldier Fuel Cell System	.774	2.325	.000	
Novel Zinc Air Power Sources for Military Applications	1.933	1.550	.000	
ONAMI Miniature Tactical Energy Systems Development	2.415	2.325	.000	
Soldier Portable Solid Fuel Hydrogen Generator Cartridge	3.865	.000	.000	
Thin Lithium-Iron Disulfide Primary Batteries	2.319	.000	.000	
Advanced Portable Power Institute (APPI)	1.546	1.550	.000	
Non-Flammable, High Energy Density, Low Temperature Warrior Battery	.774	.000	.000	
Advanced Lithium-Carbon Monoflouride Combat Portable Batteries	3.786	.000	.000	
Advanced Wearable Microcell Power System Process Development	1.933	.000	.000	
Bio-Battery	1.160	.775	.000	
Ceramic Membrane - 10(X) More Energy for Battery Systems	.966	1.163	.000	
Low Signature Portable Fuel Cell Power Systems	2.705	.000	.000	
Mega-Capacity Hybrid Chemistry Lithium Primary Portable Batteries	1.546	.000	.000	
Revolutionary Self-Seating Plastic Enclosure for Military Batteries	1.546	.000	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Advanced, Integrated Portable Power Generation and Charging System	2.397	.000	.000	
Enzyme Biofuel Cell (SEBC)	.966	.775	.000	
Improved Energy Density Battery	.774	.000	.000	
Portable Hydrogen Generator and Hybrid Power Source	1.546	.000	.000	
Alternative Energy Research	15.454	.000	.000	
Direct Methanol Fuel Cell Development	1.932	.000	.000	
Acid Alkaline Direct Methanol Fuel Cell Technology	1.590	.000	.000	
Military Jet-Fueled Fuel Cell Generator	.000	.775	.000	
Soldier Portable Power Pack (SP3) for the 21st Century Warrior	.000	1.647	.000	
Advanced Solder Portable Power Systems Technologies	.000	1.550	.000	
Highly Reliable, Maintenance Free Remote Solar Power System	.000	.620	.000	
Advanced Energy Storage Development for Renewable Energy Generation	.000	1.163	.000	
Program Increase	.000	5.425	.000	
Solid Oxide Fuel Cell Powered Tactical Smart Charger	.000	1.550	.000	
Tactical Asset Visibility Enhancement	.000	.484	.000	
Thermoelectric Power Generation Materials and Devices	.000	1.163	.000	
SBIR/STTR	.000	.716	.000	
Total	55.792	25.556	.000	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES	PROJECT NUMBER EM7

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					PROJECT NUMBER EM8	
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**
EM8: High Power and Energy Component Technology	.000	.000	13.951						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to fund research and evaluation of high-power electronic components and technologies. These technologies have application in compact, light-weight power and energy storage, power and energy conversion, and conditioning, radio frequency (RF)/microwave directed energy weapons (DEW), and traditional and non-traditional RF and laser electronic attack. The ongoing directed energy effects and power component work is coordinated with and, as appropriate, leveraged by DEW and power/energy programs in the Air Force, Navy, High Energy Laser Joint Technology Office, Defense Threat Reduction Agency, national labs, university consortia, and relevant industry and foreign partners.

The work in this project is coordinated with the Tank and Automotive Research, Development, and Engineering Center (TARDEC); the Armaments Research, Development, and Engineering Center (ARDEC); the Aviation and Missile Research, Development, and Engineering Center (AMRDEC); and the Communications and Electronics Research, Development, and Engineering Center (CERDEC). These efforts were previously funded in PE 0602120A (Sensors and Electronic Survivability).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work on this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
High Power Components: Research and evaluate materials and component structures that provide the higher energy density required by next generation Army systems such as electromagnetic armor, hybrid-vehicle propulsion electronics, directed energy sources, pulse power, small unattended ground sensors, and Soldier systems. In FY10, will design power sources and antennas for higher frequency and power output. Will implement silicon carbide (SiC) high-power density modules for pulse switching levels > 10 MW.	.000	.000	2.213	
High Energy Laser: Research novel solid-state laser concepts, architectures, and design components enabling high energy laser (HEL) technology for Army specific DEW applications. Exploit breakthroughs in laser technology and photonics basic research	.000	.000	2.437	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
to meet the stringent weight/volume requirements for platforms. Applied research will be conducted in close collaboration with domestic ceramic (and other) material vendors, university researchers, and major laser diode manufacturers. In FY10, will implement cryogenically-cooled, gain medium to highly scalable, eye-safe, Er-doped lasers based on advanced laser ceramics.				
Directed Energy (DE): Investigate, research, and evaluate technologies related to DEW technology, electronic warfare (EW) survivability/ lethality, and supporting high power components to enhance the survivability/lethality of Army platforms. In FY10, will design, develop and implement components to reduce the size and weight of counter improvised explosive device IED and mines systems, and continue to conduct lab and field assessments to understand susceptibility level of targets. Will investigate RF directed energy (DE) interoperability issues between an RF DE device and Army radios.	.000	.000	1.566	
Platform Power Components: Investigate, research, and evaluate compact, high efficiency, high-temperature, high power component technologies (switches, magnetics, capacitors, etc.) for hybrid platform propulsion, power generation, and power distribution. In FY10, will evaluate power components for high-temperature (100 C coolant) 250 kW traction drive inverter and 150 kW battery-to-bus converter.	.000	.000	3.966	
Power Switching for Protective Systems: Investigate, research, and evaluate technologies relating to compact, high-power, high-efficiency pulse power for electronic survivability applications such as electromagnetic (EM) Armor, advance EM Armor, and Electronic Protection Systems. Such technologies include storage capacitors, direct current (DC-DC) converters, and high rate-of-current-rise pulse switches. In FY10, will evaluate fast rise storage capacitors at 1.5 joules/cubic centimeter (J/cc) and SiC pulse switch die at 3 kiloampere (kA) with fast rate-of-current-rise.	.000	.000	1.785	
Platform Power Integration and Control: Investigate, research, and evaluate power stage and control circuit technologies for implementation of high-power density, high efficiency power converters for hybrid platform propulsion, power generation and power distribution. In FY10, will validate power switch temperature sensing and gate control circuitry for high-temperature (100 C coolant) operation.	.000	.000	1.984	
Total	.000	.000	13.951	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES	PROJECT NUMBER EM8

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					PROJECT NUMBER H11	
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**
H11: Tactical and Component Power Technology	13.276	13.121	12.837						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is on applied research to identify, advance, and enhance emerging power generation, energy storage, and power management technologies. This project funds research in electrochemistry, energy conversion, and signature suppression technologies, including those for primary batteries, rechargeable battery hybrids, fuel cells, power management, and components for electromechanical power generation. This project also researches power sources that are smaller and more fuel-efficient; advanced cooling systems that enable tactical sustainability and survivability; and investigates novel power management methods through low power design tools and operating system dynamic power management software.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research, Development and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Soldier Hybrid Power and Smart Chargers: This effort develops and evaluates hybrid power sources, rapid battery chargers, and power management technologies in order to decrease Soldier load, increase power capabilities, and decrease battery costs. In FY08, evaluated methanol fueled Soldier hybrid fuel cell power source for 72 hour mission at 700 watt-hours per kilogram; investigated rugged JP-8 burners for solid oxide fuel cell and Stirling engine power sources. In FY09, demonstrate JP-8 fueled Soldier hybrid solid oxide fuel cell; demonstrate man-portable 160 watt JP-8 linear free piston Stirling engine power source weighing less than 10 kilograms; evaluate 250 watt reformed JP-8 fuel cell for battery charging. In FY10, will develop advanced fabrication processes to reproduce lithium air cell lab results in larger scale batches suitable for production, and demonstrate in a laboratory environment with packaged cells; will develop a 25W hybrid power source, 1.5 lbs, 1300 Wh/kg; will demonstrate micro-electro mechanical system-based burner for a 150-250W portable power source functioning in a laboratory environment.	7.790	6.550	9.136	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES	PROJECT NUMBER H11

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.259	.000	
Lithium Air Battery: This effort develops and investigates materials, material processes, and electrochemical components that will produce a high energy density (>1,000 Watt-hours/kilogram) lithium air power source for Soldiers. In FY08, investigated lithium organic and inorganic materials and processes to produce highly conductive electrolytes to achieve greater than 0.5 mill-Amps/square centimeter current densities; demonstrated lithium air cells/batteries having energy densities greater than 800 Watt-hours/kilogram; demonstrated material stability of lithium air cell components to achieve high shelf life (greater than one year). In FY09, develop material and cell fabrication processes to produce high energy density, stable, safe lithium air battery; demonstrate lithium air cells/batteries having energy densities greater than 1,000 Watt-hours/kilogram.	2.110	2.935	.000	
Silent Mobile Power: This effort investigates component and system level power technologies that will provide higher energy, reduced weight, quiet, more fuel and cost efficient power generation sources to support the full spectrum of C4ISR power consumers. Products are silent mobile power sources of 2-5kW, cogeneration cooling systems, and transitional power sources in the 500W-2kW range. In FY08, conducted testing in a laboratory environment of 1-2 kW Stirling engine generator on JP-8 fuel; demonstrated controlled operational testing in a laboratory environment of 2 kW fuel cell generator on JP-8 fuel; demonstrated a preliminary prototype cogeneration cooling system using waste heat from a quiet power source. In FY09, develop integrated system controls in order to demonstrate breadboard 2 kW solid oxide fuel cell generator and 1-2 kW engine generator in relevant environments; demonstrate integrated power/cooling/waste heat recovery system. In FY10, will demonstrate in a laboratory environment a waste heat recovery system and a 500W transitional power source.	3.376	3.377	3.701	
Total	13.276	13.121	12.837	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
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E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					PROJECT NUMBER H17	
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**
H17: FLEXIBLE DISPLAY CENTER	5.863	6.540	7.007						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to fund the Army's Flexible Display Center (FDC) at the Arizona State University. The FDC conducts applied research on flexible display technologies that would make them inherently rugged (no glass), light weight, conformal, potentially low cost, low power. The resultant display technology would enable enhanced and new capabilities across a broad spectrum of Army applications. Work in the FDC is performed collaboratively with the Natick Soldier Research, Development and Engineering Center (NSRDEC).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is executed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.179	.000	
FDC: In FY08, the FDC developed and delivered 3.8" diagonal reflective displays and integrated the displays into Army Demonstrator systems. The FDC showed high resolution displays and flexible reflective displays running at video rates. In FY09, develop and deliver up to 6" diagonal reflective and emissive displays from the pilot line with increasing performance for next generation platforms (specific display sizes depend on Army customer specifications). In FY10, the FDC will begin full color designs and implement color versions of flexible displays up to 6" diagonal (reflective) and 4" diagonal (emissive).	4.863	4.861	5.038	
U.S. Displays Consortium (USDC): Flexible display partnerships funded through the USDC for tools, process, and materials development that directly support the FDC. In FY08, established programs through the USDC that support the FDC with existing tool modifications, processes, related material, and device development. These programs directly supported the FDC and the Army's mission to develop flexible displays and manufacturing technology for flexible displays.	1.000	1.500	1.969	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY09, integrate the USDC programs that directly support the FDC and the Army's mission to develop flexible displays and manufacturing technology for those displays. In FY10, the USDC will test the integrated programs and identify new technology gaps for flexible displays. In addition, programs will be developed to support emerging display technologies, such as higher performing thin film transistors for emissive displays, processes to enable flexible color filters and related integration. Flexible display partnerships will be reviewed and modified to ensure state-of-the-art tools, materials development and materials processes that directly support the goals of the FDC.				
Total	5.863	6.540	7.007	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES					PROJECT NUMBER H94	
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**
H94: ELEC & ELECTRONIC DEV	23.541	25.466	27.609						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to conduct applied research on electronics and electronic devices including opto-electronics to support advanced power and energy generation and storage; Command, Control, Communications, and Computers (C4); and Intelligence, Surveillance, and Reconnaissance (ISR) technologies. Areas of investigation include: low noise clocks and oscillators; lasers and focal plane arrays for eye-safe laser radar (LADAR) and standoff target acquisition sensors like forward-looking infrared (FLIR); micro-electromechanical systems (MEMS) for multi-function radio frequency (RF) applications as well as smart munitions; advanced RF modules to support radars and communications systems; high-temperature high-power inverter circuits for electric drives; prognostics and diagnostics to reduce logistics demands; micro-power generators and advanced batteries, fuel reformers, and fuel cells for hybrid power sources; and novel structures on new electronic materials for oscillator and opto-electronic applications. This research enables enhanced battlefield situational awareness; increased vehicle mobility, survivability, and lethality; reduced acquisition cost; and reduced operations and support costs.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Infrared (IR) Imaging: Investigate large area multi-color, passive infrared (IR) imaging focal plane arrays (FPAs) for long range target detection and identification. Investigate molecular beam epitaxy (MBE) growth techniques for the growth of mercury cadmium telluride (HgCdTe) on Silicon (Si), Strained Layer Superlattices (SLS) and Corrugated Quantum Well Infrared Photodector (C-QWIP) detector arrays for both the mid-wave infrared (MWIR) and long-wave infrared (LWIR) spectral region to significantly decrease the focal plane array cost. Design and fabricate arrays for higher operating temperature. In FY08, investigated multi color (Short Wave IR (SWIR)/MWIR/LWIR) FPAs for enhanced range and detection. In FY09, decrease defect density of HgCdTe on Si, evaluate dual color C-QWIPs and determine transport properties in SLS structures. Collect radiometrically calibrated signatures for threat events in an effort to design a test sensor and implement modeling of range performance. Exploit IR, narrow-band, and optical augmentation sensors for threat detection and evaluate utility for ground vehicle, rotary wing, and dismounted Soldier platforms.	2.139	2.170	2.194	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602705A ELECTRONICS AND ELECTRONIC DEVICES	PROJECT NUMBER H94

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY10, will determine tradeoffs between filter complexity to best exploit high intensity emissions associated with hostile fire via a visible optic sensor. Will characterize dual color HgCdTe FPAs on Si substrates, evaluate large area dual color C-QWIPs and improve lifetime in SLS detectors.				
Prognostics and Diagnostics: Investigate and evaluate prognostics and diagnostics (P&D) algorithms; design, fabricate, and evaluate MEMS and other sensors; and design, develop code, and evaluate database for the integration into decision systems to extend sensor rationalization and minimize downtime via condition-based maintenance. In FY08, fabricated core module applied to specific commodities. Module entails a coded algorithms transceiver, core sensors, processor, and remote sensor interface. Conducted preliminary tests on networked RF link and incorporated fault algorithms. In FY09, implement cross-correlated algorithms in an open architecture P&D system and conduct fault prognostic tests enhancing algorithms and user interface in an open architecture environment. In FY10, will evaluate multi-mode algorithms for diagnostic extension of electronics.	2.853	2.954	2.888	
LADAR: Investigate eye-safe, scanned and scannerless, 3-D imaging laser radar (LADAR) for both long-range reconnaissance and short-range unmanned ground and air vehicle applications. Investigate optical limiter designs with promising nonlinear materials in order to provide passive protection of electro-optic (EO) vision systems from damage from laser threat devices. In FY08, utilized Tank and Automotive Research, Development, and Engineering Center (TARDEC) testing results on the system demonstrator to further maximize performance of materials for Charge Coupled Device (CCD) protection and fabricated an integrated solid-state version of the LADAR architecture for transition to CERDEC and Armaments Research, Development, and Engineering Center (ARDEC). In FY09, transition optimized sacrificial mirrors for TARDEC Vision Protection ATO Demonstrators and implement compact, low-power MEMS scanned LADAR for robotic autonomous navigation. In FY10, will implement broad-aperture fast opto-electronic shutters for optical sights, sensors, and Soldier vision and evaluate 3-D autonomous navigation LADAR integrated onto a small robotic platform (Packbot).	1.835	1.132	3.230	
Millimeter Wave Components: Research, design, and investigate new component materials, structures, devices, and electromagnetic issues of millimeter wave (mmW) components and active devices, such as vacuum electronic (VE) devices and millimeter wave integrated	3.497	3.205	7.349	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
circuits (MMICs), to achieve higher output power, power-added-efficiency, linearity, and dynamic range for increased operation and detection range. In FY08, completed efforts on Ka-band millimeter wave power module and Gallium Nitride (GaN) modules. Designed GaN amplifier integrated in mini-package and analyze thermal properties for high power packaged amplifiers. In FY09, design and fabricate integrated high power integrated circuit package for antenna array. In FY10, will design advanced mixed-signal RF integrated circuits, and implement models to investigate new materials and processes for high speed and high power electronic devices.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.132	.000	
RF MEMS: Investigate micro- and nano- technology for small, low cost, highly reliable, RF MEMS switches, resonators, and filters for multifunction RF applications; design highly stable low-noise oscillators with low-acceleration sensitivity by integrating photonic resonators and conventional microwave components to improve the capability of radar systems to detect slow moving targets; mature components and software for C4 technology; and perform research in advanced tactical software tools for mobile, ad hoc network access control, intrusion detection, and authentication techniques. In FY08, devised a process for wafer-level packaging with a MEMS phase shifter for multifunction RF applications and completed investigation of noise perturbations and dual-mode resonators for stabile oscillators. In FY09, investigate approaches for a wafer level antenna. Prepare and integrate passive RF electronics with RF MEMS switch fabrication process. In FY10, will evaluate beam steering using an integrated piezoelectric MEMS (PiezoMEMS) enabled wafer level antenna, will evaluate an integrated PiezoMEMS switchable filter combining both low voltage switches with high-Q filters.	3.420	3.702	1.615	
Antennas: Design and develop high performance antennas and antenna arrays for RF front-end architectures supporting multifunction radar and communication systems. This work also includes evaluation and validation of these designs. Among the issues addressed in this antenna development are scanning techniques, broadbanding, beamforming, polarization, platform integration, and affordability. In FY08, validated antenna designs for integration into Army platforms through simulations and laboratory validation. In FY09, further develop these designs based on the measured laboratory data and transition the work to Communications and Electronics Research, Development, and Engineering Center (CERDEC). In FY10, will develop and assess novel platform based antenna designs.	2.662	2.507	1.757	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Photonics: Investigate a broad base of extremely quick, accurate, and novel photonic architectures to enable detection of hazardous substances to enhance Soldier survivability. Investigate the hybridization of OE devices with electronics for IR scene projectors and extremely compact low-cost 3-D proximity sensing and imaging. In FY08, characterized current biomimetic recognition elements using several laboratory analytic methodologies; evaluated olfactory sensor based on integrated MEMS photoacoustic system; characterized efficacy of molecular recognition elements devised using rapid directed evolution methodologies and investigated multi-band IR 2-D arrays for scene generation. In FY09, assess recognition elements as alternative biologically-inspired methods to produce advanced photonic and electronic structures; investigate hybrid techniques incorporating novel recognition elements and spectroscopic inspection; and investigate highly compact OE transceivers for 3-D proximity sensor arrays and imaging; extend IR scene generation to more dense arrays and higher thermal resolution. In FY10, will evaluate hybrid recognition element/spectroscopy optical assay for hazardous chemical and/or energetics detection from previous down-selected evaluations; will improve power consumption and array density in OE proximity sensors.	2.642	3.956	3.384	
MEMS: Investigate, design, and fabricate MEMS based components to improve power generation and micro-cooling technology for both the dismounted Soldier and future force systems. In FY08, investigated advanced MEMS cooling systems, demonstrated MEMS components on a small system and fabricated MEMS valves for high flow applications. In FY09, investigate improved MEMS rotary pumps, MEMS valves, and high flow low power atomizers. In FY10, will develop miniature power converters using MEMS passive components.	3.319	4.148	2.082	
Power and Energy: Investigate technology for advanced batteries, fuel reformers, and fuel cells to be used in hybrid power sources for future electromagnetic armor and smart munitions. Investigate silicon carbide (SiC) power module technologies to enable compact high temperature (up to 150C heat sink temperature) and high power density converters for motor drive and pulse power applications.	1.174	1.560	3.110	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY08, explored new technology for reserve batteries and more stable sulfur tolerant catalysts. Investigated high-temperature (90 - 120C) SiC power modules implemented in voltage-controlled SiC power devices for low power hybrid electric vehicle (HEV) power conversion. In FY09, explore higher energy reserve battery materials and higher power Li-ion battery materials. Investigate high-temperature (90 - 120C) SiC power modules for medium power conversion. In FY10, will investigate and develop high-temperature (100-130 C) SiC power modules for high-efficiency medium power conversion and implement new gas gettering agents in thermal batteries, investigate and implement heat sources for thermal batteries, and explore higher energy materials for primary batteries.				
Total	23.541	25.466	27.609	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.