Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification											DATE: February 2010
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 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	99.118	134.532	60.859	0.000	60.859	62.285	65.652	70.934	79.738	0	633.977
EM4: *Electric Component Technologies (CA)*	21.828	33.994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
EM6: *HEATING AND COOLING TECHNOLOGIES (CA)*	6.378	5.571	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
EM7: *POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)*	26.354	38.857	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
EM8: *High Power and Energy Component Technology*	0.000	8.904	13.631	0.000	13.631	15.402	15.739	18.092	20.448	Continuing	Continuing
H11: *Tactical and Component Power Technology*	12.862	12.771	11.988	0.000	11.988	10.795	11.519	12.729	14.437	Continuing	Continuing
H17: *FLEXIBLE DISPLAY CENTER*	6.361	6.971	6.974	0.000	6.974	7.008	7.133	7.244	7.376	Continuing	Continuing
H94: *ELEC & ELECTRONIC DEV*	25.335	27.464	28.266	0.000	28.266	29.080	31.261	32.869	37.477	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,

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification	DATE: February 2010
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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 -Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth NJ.

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	99.687	61.404	60.726	0.000	60.726
Current President's Budget	99.118	134.532	60.859	0.000	60.859
Total Adjustments	-0.569	73.128	0.133	0.000	0.133
• Congressional General Reductions		-5.702			
• Congressional Directed Reductions					
• Congressional Rescissions		0.000			
• Congressional Adds		78.830			
• Congressional Directed Transfers					
• Reprogrammings	1.530	0.000			
• SBIR/STTR Transfer	-2.099	0.000			
• Adjustments to Budget Years	0.000	0.000	0.133	0.000	0.133

Change Summary Explanation

FY10 Congressionally directed increases.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total 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)*	21.828	33.994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	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 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.392	0.000	0.000	0.000	0.000
Manufacturing Technology Development of Advanced Components for High Power Solid-State Lasers. In FY09, this Congressional Interest Item investigated manufacturing processed for patented AFB (Adhesive-Free Bond) process for large crystal composites and facilitated demonstration of their utility for high energy laser applications. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	2.392	2.387	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Micromachined Switches in Support of Transformational Communications Architecture. In FY09, this Congressional Interest Item investigated packaging of micropackaged micro electro-mechanical systems (MEMS) switches based on metal-metal bonding process *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Renewable Energy for Military Applications. In FY09, this Congressional Interest Item Researched novel alkaline membrane electrolyte for potential application in future soldier fuel cell systems. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	1.595	1.193	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #4 High-Frequency, High-Power Electronic and Optoelectronic Devices on Aluminum Nitride (AIN). In FY09, this Congressional Interest Item researched high frequency, high power electronic and optoelectronic devices. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	3.189	3.184	0.000	0.000	0.000
Program #5 Self-Powered, Lightweight, Flexible Display Unit on a Plastic Substrate. In FY09 this Congressional Interest Item developed reflective displays based on novel imprint lithography that will advance manufacturing base, and integrated solar cells with flexible displays. The program worked with the Flexible Display Center (FDC) to leverage the FDC developments. *FY 2009 Accomplishments:* FY 2009	1.595	3.024	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 Large Format Li-Ion Battery. In FY09, this Congressional Interest Item researched technology for manufacturing large format Li-ion battery integrated with battery management system. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.797	4.934	0.000	0.000	0.000
Program #7 Compact Eyesafe Tactical Laser. In FY09 this Congressional Interest Item researched vehicle-mounted laser devices.	1.196	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #8 Extremely High Frequency (EHF) Transmitter for Win-T Satellite Communications. In FY09 this Congressional Interest Item designed a dual band (Ka/Q) millimeter wave power module utilizing a hybrid solid-state and vacuum power booster approach. The small form factor amplifier was built and demonstrated for applicability to DoD satellite communication requirements. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	1.994	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #9 Fuel Cell Power System. In FY09 this Congressional Interest Item investigated hydrogen fuel technology applicable to light weight, high energy portable power systems driven by the hydrogen fuel source. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.797	0.000	0.000	0.000	0.000
Program #10 Maryland Proof of Concept Alliance for Defense Technologies. In FY09, this Congressional Interest Item fostered the commercialization of technologies in the RF, tube, semiconductor, MEMS, and Nano Electro-Mechanical System, Electro optics, power, energy, acoustic, and biologically derived technologies, working with technology transfer offices and venture development offices. *FY 2009 Accomplishments:* FY 2009	3.489	1.592	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #11 Advanced Power Generation Unit for Military Applications. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.647	0.000	0.000	0.000
Program #12 Mid-Infrared Super Continuum Laser. This is a Congressional Interest Item.	0.000	0.796	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #13 Soldier Situation Awareness Wristband. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.114	0.000	0.000	0.000
Program #14	0.000	1.592	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Printed and Conformal Electronics for Military Applications. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #15 Integrated Lightweight Tracker System. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.990	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #16 Eye Safe Laser Range Finder. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	2.388	0.000	0.000	0.000
Program #17 Unmanned System Algorithm Development. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	3.184	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #18 Program Increase - SOF Technology Insertion. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	5.969	0.000	0.000	0.000
Program #19 Direct Methanol Fuel Cell-Battery Recharger Program. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	2.392	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Accomplishments/Planned Programs Subtotals	21.828	33.994	0.000	0.000	0.000

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 2011 Army RDT&E Project Justification			DATE: February 2010
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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total 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)*	6.378	5.571	0.000	0.000	0.000	0.000	0.000	0.000	0.000	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 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.797	0.000	0.000	0.000	0.000
Miniature Cooling Unit for Electronic Devices: In FY09, this Congressional Interest Item performed research exploring the adaptation of a miniaturized vapor compression cooling system designed for laptops computers, for application to individual soldier cooling. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	2.393	3.183	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Cogeneration for Enhanced Cooling and Heating of Advanced Tactical Vehicles: In FY09, this Congressional Interest Item researched and evaluated environmentally approved refrigerants and secondary liquid loops to convert generator waste heat into effective space cooling and heat pumping; developed regenerative adsorption technology for the conversion of diesel engine exhaust waste heat into a cooling capability. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Advanced Tactical 2KW External Combustion Power Sources for Cogeneration Applications: In FY09, this Congressional Interest Item produced a JP-8/DF 2 fueled 2+ kilowatt demonstrator utilizing an external combustion free-piston Stirling engine. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	2.392	2.388	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Co-Generation of Power and Air Conditioning: In FY09, this Congressional Interest Item researched a co-generation system which would use energy recovery from exhaust waste heat and incorporate a renewable green energy interface. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.796	0.000	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	6.378	5.571	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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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 2011 Army RDT&E Project Justification									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602705A: *ELECTRONICS AND ELECTRONIC DEVICES*				PROJECT EM7: *POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)*			
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total 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)*	26.354	38.857	0.000	0.000	0.000	0.000	0.000	0.000	0.000	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 2009	**FY 2010**	**Base FY 2011**	**OCO FY 2011**	**Total FY 2011**
Program #1	2.392	0.000	0.000	0.000	0.000
Soldier Fuel Cell System: In FY09, this Congressional Interest Item developed a portable hydrogen generator which utilizes the pyrolysis of ammonia borane and integrated with a 20 watt proton exchange membrane fuel cell. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	1.595	1.989	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Novel Zinc Air Power Sources for Military Applications: In FY09, this Congressional Interest Item developed fourth generation zinc-air batteries in several form factors, including body-worn, with state-of-charge indicator capability. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 ONAMI Miniature Tactical Energy Systems Development: In FY09, this Congressional Interest Item demonstrated a 2-5 kilowatt co-generation absorption based heat actuated cooling system. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	2.392	2.486	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #4 Advanced Portable Power Institute (APPI): In FY09, this Congressional Interest Item developed a range of advanced power generation and delivery concepts to support military operations. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.595	0.000	0.000	0.000	0.000
Program #5 Bio-Battery: In FY09, this Congressional Interest Item researched a hybrid biological battery with long run time for low drain applications. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.797	0.795	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 Ceramic Membrane - 10(X) More Energy for Battery Systems: In FY09, this Congressional Interest Item research optimization of a lithium-air cell and battery technology based on a BA-HALF90 Battery. Cell technology is based on solid state lithium conducting membrane with high conductivity and Oxygen selective membranes to optimize rate capability. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.197	2.387	0.000	0.000	0.000
Program #7 Enzyme Biofuel Cell (SEBC): In FY09, this Congressional Interest Item investigated a biofuel cell power source technology.	0.797	1.194	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #8 Military Jet-Fueled Fuel Cell Generator: In FY09, this Congressional Interest Item designed, fabricated, assembled and tested a 3 kilowatt JP-8 fueled laboratory power generator. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.797	0.000	0.000	0.000	0.000
Program #9	1.695	2.388	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Soldier Portable Power Pack (SP3) for the 21st Century Warrior: In FY09, this Congressional Interest Item researched a 150-250 watt DC battery charger / generator. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #10 Advanced Soldier Portable Power Systems Technologies: In FY09, this Congressional Interest Item investigated a half size rechargeable battery with smart smart power manager that can process energy from multiple sources. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	1.595	2.467	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602705A: *ELECTRONICS AND ELECTRONIC DEVICES*	PROJECT EM7: *POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #11 Highly Reliable, Maintenance Free Remote Solar Power System: In FY09, this Congressional Interest Item delivered a scalable and modular 200-watt solar power supply that with potential for use in loads not connected to a main power grid. This modular portable solar power supply consists of an integrated photovoltaic panel and power converter. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.638	0.000	0.000	0.000	0.000
Program #12 Advanced Energy Storage Development for Renewable Energy Generation: In FY09, this Congressional Interest Item designed and developed a hybrid valve regulated lead acid battery including a battery monitoring system with potential for use in renewable electric energy storage solutions. *FY 2009 Accomplishments:* FY 2009	1.197	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #13 Program Increase: In FY09, investigated methods to increase efficiency of current plastic solar cells using multilayer structures and new materials; investigated methods for improved shelf life and operational temperature range. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	5.581	0.000	0.000	0.000	0.000
Program #14	1.595	0.955	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Solid Oxide Fuel Cell Powered Tactical Smart Charger: In FY09, this Congressional Interest Item demonstrated a battery charger operating on a JP 8 fueled 500 watt solid oxide fuel cell (SOFC). *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #15 Tactical Asset Visibility Enhancement: In FY09, this Congressional Interest Item investigated wireless communication alternatives which may have applicability in environments where communications infrastructure is limited or nonexistent. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.498	0.796	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #16 Thermoelectric Power Generation Materials and Devices: In FY09, this Congressional Interest Item examined advances in higher temperature, more efficient thermoelectric devices. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.196	0.000	0.000	0.000	0.000
Program #17 High-Volume Manufacturing Development for Thin-film Lithium Stack Battery Technologies. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.796	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #18 Advanced Wearable Power System Manufacturing. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.592	0.000	0.000	0.000
Program #19 Improved Energy Density Battery. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009	0.000	1.990	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #20 Military Fuel Cell Genset Technology Demonstration. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.990	0.000	0.000	0.000
Program #21 Advanced Flexible Solar Photovoltaic Technologies. This is a Congressional Interest Item.	0.000	2.388	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #22 Intelligent Energy Control Systems. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	2.388	0.000	0.000	0.000
Program #23	0.000	2.547	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Internal Base Facility Energy Independence. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #24 Advanced Hybrid Chemistry for Portable Power. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	2.547	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #25	0.000	3.183	0.000	0.000	0.000
Multi-Campus Base Facility Energy Independence. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #26	0.000	3.979	0.000	0.000	0.000
Market Viable, Dual-Use, Advanced Energy Storage Solutions Development. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #27 Direct Methanol Fuel Cell Development. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.797	0.000	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	26.354	38.857	0.000	0.000	0.000

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.

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total 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*	0.000	8.904	13.631	0.000	13.631	15.402	15.739	18.092	20.448	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 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.000	2.100	2.323	0.000	2.323
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, design power sources and antennas for higher frequency and power output. Implement silicon carbide (SiC) high-power density modules for pulse switching levels > 10 Mega Watt (MW). In FY11, will implement system with new sources and antennas for counter electronics applications. Will develop SiC based high-power density modules for switching levels > 25 MW. Will investigate and evaluate pulse power technologies for EM gun applications.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 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 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, implement cryogenically-cooled, gain medium to highly scalable, eye-safe, Erbium (Er)-doped lasers based on advanced laser ceramics.In FY11, will investigate power and efficiency scaling potential of resonantly-pumped Ytterbium (Yb)-free Er-doped fiber laser architectures for high power eye-safe DEW applications. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	2.424	2.591	0.000	2.591

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 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, 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. Investigate RF DE interoperability issues between an RF DE device and Army radios. In FY11, will support ARDEC in demonstrating military utility of payload concept. Also plan to support Air Defense Artillery Center and AMRDEC in investigating the feasibility and effectiveness of RF DEWs against electronically guided rockets, artillery and mortars (RAM) for their Enhanced Area Air Defense program. Will transition target effects data and basic design package for RF DE Air Defense System to Center via AMRDEC. Will investigate susceptibility profile for an unmanned aerial vehicle system. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.000	1.558	1.724	0.000	1.724

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #4 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, evaluate power components for high-temperature (100 C coolant) 250 kilowatt (kW) traction drive inverter and 150 kW battery-to-bus converter. In FY11, will begin investigation of power components for higher temperature operations (120 C coolant) and smaller circuits for platform upgrade programs. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.500	3.862	0.000	3.862
Program #5 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 for new platforms and platform modernization efforts. In	0.000	0.446	1.482	0.000	1.482

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY10, validate gate control circuitry for high-temperature (100 C coolant) operation. In FY11, will conduct tests with high-temperature, high power density 100 kW battery-to-bus converter. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 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, 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. In FY11, will show component technology that can be implemented into a DC-DC pulse converter at 8 kilowatts/liter (kW/l) and SiC pulse switch die at 4.5 kA with fast rate-of-current-rise. *FY 2009 Accomplishments:* FY 2009	0.000	0.626	1.649	0.000	1.649

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #7 SBIR/STTR *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.250	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	0.000	8.904	13.631	0.000	13.631

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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.

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total 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*	12.862	12.771	11.988	0.000	11.988	10.795	11.519	12.729	14.437	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this applied research project is 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 and Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	6.550	8.973	7.736	0.000	7.736
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 FY09, demonstrated a Soldier hybrid solid oxide fuel cell; demonstrated man-portable 160 watt JP-8 linear free piston Stirling engine power source weighing less than 10 kilograms; evaluated 250 watt reformed methanol fuel cell for battery charging. In FY10, develop advanced fabrication processes to reproduce lithium air battery cell lab performance in larger scale batches suitable for production, and demonstrate in a laboratory environment with packaged cells; develop a 25W hybrid power source, weighing 1.5 lbs at 1300 Wh/ kg, reducing the system size and weight by one third; demonstrate micro-electro mechanical system-based burner for a 150-250W portable power source functioning in a laboratory environment. In FY11, will develop processes and materials required for an integrated safe lithium air battery; will evaluate a disposable Soldier battery (Li/					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Air) at 600 Wh/kg in a relevant environment; will demonstrate a 150-300W portable Squad power source/charger weighing 25 lbs, and a 50-100W Hybrid power source weighing 3.5 lbs at 1000 Wh/kg. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Silent Mobile Power: This effort investigates component and system level power technologies that 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 technologies for waste-heat recovery systems, transitional power sources in the 500W-2kW range, and towable 100 kilowatt generator sets. In FY09, developed integrated system controls in order to demonstrate breadboard 2 kW solid oxide fuel cell generator and 1-2 kW Stirling engine generator in relevant environments; demonstrated an integrated power/cooling/waste heat recovery system. In FY10, demonstrate in a laboratory environment a waste-heat recovery system and a 500W transitional power source. In FY11, will demonstrate a high mobility multipurpose wheeled vehicle towable 100 kilowatt power unit in a relevant environment; will demonstrate a waste-heat recovery system in a relevant environment. *FY 2009 Accomplishments:* FY 2009	3.377	3.582	4.252	0.000	4.252

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Lithium Air Battery: This effort develops and investigates materials, material processes, and electrochemical components that produce a high energy density (>1,000 Watt-hours/kilogram) lithium air power source for Soldiers. In FY09, developed material and cell fabrication processes to produce high energy density, stable, safe lithium air battery; demonstrated lithium air cells having energy densities greater than 1,000 Watt-hours/kilogram. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	2.935	0.000	0.000	0.000	0.000
Program #4	0.000	0.216	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	12.862	12.771	11.988	0.000	11.988

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 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602705A: *ELECTRONICS AND ELECTRONIC DEVICES*	PROJECT H17: *FLEXIBLE DISPLAY CENTER*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H17: *FLEXIBLE DISPLAY CENTER*	6.361	6.971	6.974	0.000	6.974	7.008	7.133	7.244	7.376	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, and 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 Army Research Development and Engineering Centers (RDECs) that include; the Natick Soldier RDEC(NSRDEC), Tank Automotive RDEC (TARDEC), Communications-Electronics RDEC (CERDEC), Armament RDEC (ARDEC), and Aviation and Missile RDEC (AMRDEC).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 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	4.861	5.012	5.031	0.000	5.031
FDC: The FDC is developing high resolution flexible reflective (electrophoretic) and emissive (organic light emitting diodes) displays. In FY09, developed and delivered 4" diagonal reflective and emissive displays from the research line with increased performance, including color and near-video rate reflective displays. In FY10, the FDC continues full color designs and implements color versions of flexible displays up to 6" diagonal (reflective) and 4" diagonal (emissive). In FY11, the FDC will optimize color reflective displays for size and resolution, and will transition reflective displays up to 6-8" diagonal to PEO Soldier.					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 FlexTech Alliance (FTA) (formerly known as U.S. Displays Consortium): Flexible display partnerships funded through the FTA for tools, process, and materials development that directly support the FDC. In FY09, integrated the FTA programs that directly support the FDC and the Army's mission to develop flexible displays and manufacturing technology for those displays. In FY10, testing the integrated programs and identifying new technology gaps for flexible displays. In addition, programs are being 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 are being reviewed and modified to ensure state-of-the-art tools, materials development and materials processes that directly support the goals of the FDC. In FY11, will conduct flexible electronics development to enable emissive displays. The FTA will continue supporting the development for emerging needs in state-of-the-art tools, materials development and materials processes that directly support the goals of the FDC. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	1.500	1.767	1.943	0.000	1.943

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #3 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.192	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	6.361	6.971	6.974	0.000	6.974

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.

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H94: *ELEC & ELECTRONIC DEV*	25.335	27.464	28.266	0.000	28.266	29.080	31.261	32.869	37.477	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 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.507	1.743	1.774	0.000	1.774
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 FY09, further developed these designs based on measured laboratory data and transitioned the work to Communications-Electronics Research, Development, and Engineering Center (CERDEC). In FY10, develop and assess novel platform based antenna designs. In FY11, will validate and evaluate in-situ antenna performance.					
FY 2009 Accomplishments: FY 2009					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 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 FY09, investigated approaches for a wafer level antenna. Prepared and integrated passive RF electronics with RF MEMS switch fabrication process. In FY10, evaluating beam steering using an integrated piezoelectric MEMS (pPiezoMEMS) enabled wafer level antenna, evaluating an integrated pPiezoMEMS switchable filter combining both low voltage switches with high-Q filters. In FY11, will investigate system-in-package solutions for combining active components with pPiezoMEMS wafer level antenna, pPiezoMEMS switchable filters, and broadband pPiezoMEMS switch matrices. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	3.702	1.606	2.394	0.000	2.394

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Millimeter Wave Components: Research, design, and investigate new component materials, structures, devices, and electromagnetic issues of millimeter wave (mmWmmw) components and active devices, such as vacuum electronic (VE) devices and millimeter millimeter-wave integrated circuits (MMICs), to achieve higher output power, power-added-efficiency, linearity, and dynamic range for increased operation and detection range. In FY09, designed and fabricated integrated high power integrated circuit package for antenna array. In FY10, design advanced mixed-signal RF integrated circuits, and implement models to investigate new materials and processes for high speed and high power electronic devices. In FY11, will develop reduced chip-set, thermally optimized RF modules, and perform material and device measurements to correlate and validate device models for new materials and processes for high speed and high power electronic devices. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	3.205	7.290	6.499	0.000	6.499

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #4	1.132	3.223	3.109	0.000	3.109
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 FY09, transitioned optimized sacrificial mirrors for to the Tank Automotive Research, Development and Engineering Center for Vision Protection ATO Demonstrators; implemented compact, low-power MEMS- scanned LADAR for robotic autonomous navigation; and investigated phenomenology of optical in an effort to develop an optical augmentation sensor. In FY10, implement broad-aperture fast opto-electronic shutters for optical sights, sensors, and Soldier vision, evaluate 3-D autonomous navigation LADAR integrated onto a small robotic platform (Packbot), and develop an optical augmentationa laser-based sensor. In FY11, will extend opto-electronic sensor protection effort to address jamming threats and ruggedize and harden autonomous navigation LADAR and implement solid-state scannerless LADAR for unmanned ground applications.					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					
Base FY 2011 Plans: FY 2011 Base					
OCO FY 2011 Plans: FY 2011 OCO					
Program #5	2.170	2.182	2.184	0.000	2.184

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total 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 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 FY09, decreased defect density of HgCdTe on Si, evaluated dual color C-QWIPs and determined transport properties in SLS structures. Collected radiometrically calibrated signatures for threat events in an effort to design a test sensor and implement modeling of range performance. Exploited IR, narrow-band, and optical augmentation optical sensors for threat detection and evaluated utility for ground vehicle, rotary wing, and dismounted Soldier platforms. In FY10, determine tradeoffs between filter complexity to best exploit high intensity emissions associated with hostile fire via a visible optic sensor. Characterize higher operating temperature HgCdTe devices, evaluate large area dual color C-QWIPs and improve lifetime in SLS detectors. In FY11, will implement an Electro-Optic (EO) based sensor solution to detect threat launches prior to threat arrival. Will determine feasibility of integrating commercially available EO imagers into a threat warning and location sensor system. Will integrate narrow band filters into EO imager optical path to enhance threat signal count. Will evaluate large area dual color Focal Plane Arrays (FPAs) suitable for such applications as persistent surveillance and distributed aperture systems. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #6 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. In FY09, assessed recognition elements as alternative biologically-inspired methods to produce advanced photonic and electronic structures; investigated hybrid techniques incorporating novel recognition elements and spectroscopic inspection; extended IR scene generation to more dense arrays and higher thermal resolution. In FY10, evaluating hybrid recognition element/spectroscopy optical assay for hazardous chemical and/or energetics detection from previous down-selected evaluations; investigating detectors for passive IR fuzing. In FY11, will examine luminescence manipulation of hazardous materials using femto-second laser pulse-shaping excitation techniques; will investigate Silicon photonic modulator devices for high bandwidth on-chip interconnects. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	3.956	3.307	2.685	0.000	2.685
Program #7	4.148	2.072	1.570	0.000	1.570

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
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 FY09, investigated improved MEMS rotary pumps, MEMS valves, and high flow low power atomizers. In FY10, develop miniature power converters using MEMS passive components. In FY11, will validate low power atomizer integrated with heavy fuel combustors for portable power generators. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #8 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 FY09, implemented cross-correlated algorithms in an open architecture P&D system and conducted fault prognostic tests, enhancing algorithms and user interface in an open architecture environment. In FY10, evaluate multi-mode algorithms for diagnostic extension of electronics. In FY11, will design scheme for implementation on electronic subsystems.	2.954	2.773	3.013	0.000	3.013

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #9 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 150 C heat sink temperature) and high power density converters for motor drive and pulse power applications. In FY09, explored higher energy reserve battery materials and higher power lithium (Li)-ion battery materials. Investigated high-temperature (90 - 120 C) SiC power modules for medium power conversion. In FY10, 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. In FY11, will develop high temperature SiC power modules for high-efficiency high power conversion and will develop higher rate cathodes for Li-ion chemistries and investigate and develop materials, components, and devices for thin film and conformal thermal batteries and advanced liquid reserve batteries. *FY 2009 Accomplishments:* FY 2009	1.561	3.094	5.038	0.000	5.038

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #10 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.174	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	25.335	27.464	28.266	0.000	28.266

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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.