Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Army										DATE: February 2011	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602709A: *NIGHT VISION TECHNOLOGY*							
COST ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**Cost To Complete**	**Total Cost**
Total Program Element	48.250	40.228	57.203	-	57.203	53.704	44.043	38.097	38.663	Continuing	Continuing
H95: *Night Vision and Electro-Optic Technology*	26.514	40.228	57.203	-	57.203	53.704	44.043	38.097	38.663	Continuing	Continuing
K90: *NIGHT VISION COMPONENT TECHNOLOGY (CA)*	21.736	-	-	-	-	-	-	-	-	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) designs and develops core night vision and electronic sensor technologies to improve the Army's capability to operate in all battlefield conditions. Technologies pursued in this PE have the potential to provide the Army with new, or enhanced, capabilities to detect and identify targets farther on the battlefield, operate in obscured conditions, and maintain a higher degree of situational awareness (SA). Project H95 researches new infrared (IR) Focal Plane Array (FPA) technologies, assesses and evaluates sensor materials, designs advanced multi-function lasers for designation and range finding, and develops modeling and simulation for advanced sensor technologies. In FY11 through FY16 investments in advanced IR FPA technologies are increasing to expand research in novel FPA designs to ensure a world-wide technological and competitive IR sensor advantage for the United States. Project K90 funds congressional special interest items.

Work in this PE is fully coordinated with PE 0602120A (Sensors and Electronic Survivability), PE 0602705A (Electronics and Electronic Devices), PE 0602712A (Countermine Technology), and PE 0603710A (Night Vision Advanced 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 in this PE is performed by the Army Research, Development, and Engineering Command (RDECOM)/Communications-Electronics Research, Development, and Engineering Center (CERDEC)/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

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B. Program Change Summary ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	50.877	40.228	57.438	-	57.438
Current President's Budget	48.250	40.228	57.203	-	57.203
Total Adjustments	-2.627	-	-0.235	-	-0.235
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	-2.388	-			
• SBIR/STTR Transfer	-0.239	-			
• Adjustments to Budget Years	-	-	-0.235	-	-0.235

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army			DATE: February 2011
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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
H95: *Night Vision and Electro-Optic Technology*	26.514	40.228	57.203	-	57.203	53.704	44.043	38.097	38.663	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project researches and develops component technologies that enable improved situational awareness (SA) at an affordable price. Component technologies include novel focal plane arrays (FPAs), processing and electronics improvements, and modeling and simulation to predict performance and to determine operational effectiveness. This research focuses on dual band infrared (IR) FPAs necessary to search, identify and track mobile targets in all day/night visibility and battlefield conditions, and to improve standoff detection in ground-to-ground and air-to-ground operations. In addition, very large format IR FPAs are needed for sensors to simultaneously provide wide area coverage in addition to providing the resolution for situation awareness, persistent surveillance and plume/gunflash detection. With the development of multispectral and hyperspectral algorithms, advanced dual band FPAs are being developed with on-chip hyperspectral functionality, which offer the ability to perform detection, identification, and signature identification at extended ranges as well as the ability to detect targets in "deep hide". In FY11 through FY16 investments in advanced IR FPA technologies are increasing to expand research in novel FPA designs to ensure the United States' technological and competitive IR sensor advantage.

Work in this project is fully coordinated with PE 0602705A (Electronics and Electronic Devices), PE 0602712A (Countermine Technology), and PE 0603710A (Night Vision Advanced 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 in this PE is performed by the Army Research, Development, and Engineering Command (RDECOM)/Communications-Electronics Research, Development, and Engineering Center (CERDEC)/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Distributed Aided Target Recognition (AiTR) Evaluation Center of Excellence	1.278	1.288	1.323
Description: This effort researches a Defense-wide virtual/distributed capability to interactively process both real and generated 3-Dimension multispectral scenes from sensors simulations for evaluation of automatic target recognition (ATR) algorithms against realistic operational scenarios in aided or fully autonomous reconnaissance, surveillance, and target acquisition (RSTA) missions to include roadside threats/explosively formed projectiles.			
FY 2010 Accomplishments:			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Continued testing of fused multiple ground-based sensors; investigated and developed hyperspectral and multi-spectral sensors. ***FY 2011 Plans:*** Research, investigate and develop algorithms for the autonomous detection and tracking of mounted and dismounted targets/ threats for distributed aperture systems, targets of focus are those that emerge from hiding/defilade in an urban combat arena. ***FY 2012 Plans:*** Will investigate the AiTR algorithm evaluation process for multiple sensor modalities including threat explosive detection; will evaluate AiTR algorithms in order to quantify performance against established figures of merit using real data of threat explosives in urban environments to differentiate threat explosives from clutter; will evaluate AiTR algorithms using real world scenario data including urban environments, threat explosive targets, and hard targets in order to further populate AiTR algorithm performance databases.			
Title: Sensor Modeling and Simulation Technology ***Description:*** This effort develops and investigates supporting engineering models, measurement techniques, and simulations concurrently with the development and transition of core sensor technologies. ***FY 2010 Accomplishments:*** Completed the development and validation of an air to ground persistent surveillance model; developed and validated sensor performance model improvements to more accurately address the search process to include: moving targets, moving observers, and environmental effects such as glint (reflective components), and complex clutter (foliage and urban structures). ***FY 2011 Plans:*** Develop and implement new sensor measurement models to include visible and short wave infrared (IR) bands and systems with nonlinear image processing; conduct analysis to define the next generation of cooled IR technology; begin the development of next generation simulations to support wargames and engineering tradeoff studies; develop and validate models to represent color or visible electro-optical (EO) IR sensors and distributed aperture systems. ***FY 2012 Plans:*** Will refine and complete development and validation of complex search and persistent surveillance models and simulations incorporating the next generation cooled IR technology; will incorporate the ability to effectively model and simulate moving targets and platforms in a full spherical (180 degrees by 180 degrees) sensor simulation; will continue development of next generation sensor simulations to support wargames and engineering tradeoff studies.	5.008	5.054	5.187
Title: Advanced Multifunction Laser Technology	4.023	4.044	4.001

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Description: This effort investigates and evaluates laser architectures and materials required to produce multiple wavelength bands and pulse modulation formats for future laser-based systems, including laser designation, range finding, explosive detection and warning lasers. ***FY 2010 Accomplishments:*** Completed component testing and integrated laser components (to include optical receivers and electronics suitable for small unmanned aerial sensors and lightweight Soldier applications) into multi-function brass-board system. ***FY 2011 Plans:*** Evaluate and optimize operation of individual laser segment; select and optimize best technique for fabrication of structure, segmented laser diode stack and segmented output coupler mirror; evaluate candidate of laser optical bench configuration and components in the laboratory, and determine the key performance parameters of each design. ***FY 2012 Plans:*** Will investigate laser output (pulse energies, wavelength, beam divergence) to support the laser capabilities for designation, range finding, daytime pointing and explosive detection; will evaluate laser modules to perform size, weight and power trade-offs for assessment of platform transition opportunities; will assemble breadboard laser modules capable of generating the required energy or power to produce three or more wavelengths in selectable modes.			
Title: High Performance Small Pixel Uncooled Focal Plane Array (FPA) ***Description:*** This effort researches high performance, small pixel, uncooled longwave infrared (LWIR) and shortwave infrared (SWIR) technology with the objective of using large format arrays to increase recognition and identification ranges. ***FY 2010 Accomplishments:*** Investigated and developed high definition format uncooled FPA material structures enabling greater sensitivity, lower noise and faster time constants than current sensors. ***FY 2011 Plans:*** Develop a 1920 x 1080 pixel read out integrated circuit (ROIC) design for large format LWIR; research and demonstrate the large format LWIR focal plane array packaging using an in-house developed capability; deliver and test the leveraged Defense Advanced Research Project Agency (DARPA) SWIR array electronics; and investigate the development of recognition and identification ranges for both large format LWIR and large format SWIR focal plane arrays. ***FY 2012 Plans:*** Will continue the development of the pixel material processing of the LWIR FPA with associated ROICs; will develop a novel approach (increase number of pixels from 640 to 1920 pixels) to achieve high definition (HD) to optimize wafer die size based for	2.334	2.830	7.730

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
performance; will investigate and evaluate the identification range performance of the large format LWIR/SWIR FPA electronic system; will design and develop the brass-board optics for SWIR hyperspectral imaging; will research new low noise ROIC that supports HD format clocking and timing; establish multiple design lots to prove out the performance of the HD detector and ROIC; investigate camera electronics that support 60Hz HD video (>276MB/sec data rate) in order to support the testing and video analysis of the HD focal plane array.			
Title: Advanced Structures for Cooled Infrared (IR) Sensors ***Description:*** This effort researches new detector materials and substrates, and develops technologies to minimize detector defects and increase reliability through new growth and substrate preparation techniques. ***FY 2010 Accomplishments:*** Developed and evaluated large area high performance dual color (midwave/longwave) (MW/LW) infrared (IR) FPAs grown on low cost substrates such that defective pixels are reduced to less than 1%. ***FY 2011 Plans:*** Develop and test LWIR Type II Strained Layer Superlattice (SSL) 256x256 FPAs with improved material uniformity, better material and substrates structural view and lower noise levels. ***FY 2012 Plans:*** Will validate the proof of concept of 2-color 256x256 pixel LWIR and 640x480 pixel MWIR/LWIR performance; will investigate and validate new techniques for FPA development of very large (2000 x 2000 pixels) FPA grown on low cost substrates with less than 0.5% pixel defects.	4.274	4.250	3.517
Title: Soldier Sensor Component and Signal Processing ***Description:*** This effort investigates new digital image intensified (I2) components to improve maneuver and situational awareness for the dismounted and mounted Soldier, benefiting pilotage, unmanned aerial systems and unmanned ground vehicle (UGV) applications. ***FY 2010 Accomplishments:*** Investigated and developed a brass-board sensor, objective lens and monochrome display with field programmable gated array image processing. ***FY 2011 Plans:***	6.700	6.815	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Evaluate and test (laboratory, controlled environment field testing and human factors studies) the brass-board low-light camera, handsfree focus optics and monochrome display utilizing digital on-chip processing for high speed video transmission, high resolution, high dynamic range and no-focus digital filtering/closed loop control.			
Title: Compact Hyperspectral Imaging (HSI) Component Technology ***Description:*** This effort investigates hyperspectral focal plane arrays (FPAs) and sensors for ground and air based platforms that possess the capability to detect targets and discriminate from clutter for overwatch scenarios, while ground-based hyperspectral sensors can detect targets from clutter in close-in urban situations. ***FY 2010 Accomplishments:*** Developed a HSI program to investigate advanced FPAs in the visible, near infrared (NIR) and long wave infrared (LWIR) region, incorporating on-chip multispectral capability via novel processing, to assist in identification of difficult military significant targets in urban and rural environments; investigated and selected best HSI configurations for visible, NIR and LWIR HSI, including FPAs. ***FY 2011 Plans:*** Characterize HSI imagers from each modality and waveband of interest to exploit sensor capability and identify targets of military significance in diverse environments; integrate sensor hardware and software; will conduct tests on the HSI images to assess the sensor capability.	2.897	3.447	-
Title: Digital Readout Integrated Circuit (ROIC) ***Description:*** This effort investigates and develops new ROIC technology (analog to digital) incorporated into affordable very large format and multiband infrared focal plane arrays (IR FPAs) used in sensors for targeting, situational awareness, and persistent surveillance that maintain performance with increasingly smaller pixel sizes. ***FY 2011 Plans:*** Conduct design of small digital ROIC unit cell to meet dynamic range requirements by doing analog to digital conversion within the pixel; improve digital ROIC sampling noise to meet signal/noise requirements through improved control of parasitic capacitances; research and investigate innovative on-chip signal processing designs to reduce overall IR sensor size, weight and power. ***FY 2012 Plans:*** Will fabricate 640x480 pixel digital ROIC implementing innovative on-chip signal processing designs with reduced pitch unit cell; will measure dynamic range and signal/noise performance; will conduct analysis allowing correlation of digital ROIC sampling noise and parasitic capacitances to signal/noise data; will conduct design of ROIC for the 640x480 pixel FPA with reduced pitch unit cell while maintaining performance.	-	2.600	7.500
Title: Enhanced IR Detector ("nBn") Technology	-	4.300	10.300

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Description: This effort investigates and improves a new detector structure ("nBn") that enables very small pixel and higher operating temperatures both of which should lead to much more affordable sensor systems due to smaller system optics and cryogenic coolers. ***FY 2011 Plans:*** Develop structures to improve the "nBn" detector through varying dopant levels, types and thickness of individual semi-conductors material layers; investigate the optimal focal plane array (FPA) design for smaller pixels, longer wavelength sensitivity and higher operating temperatures to reduce size, weight and power; perform ("nBn") growth on Gallium Antimonide (GaSb) and/or Gallium Arsenide (GaAs) wafers to reduce defects in the "nBn" FPA. ***FY 2012 Plans:*** Will fabricate 1-2 Mega pixel (Mpix) FPA implementing successes from design of experiments on dopant level, type and thickness of individual semi-conductors material layers; will further investigate growth of semi-conductor material layers (nBn) on larger diameter (approximately 4-6 inches) GaSb and/or GaAs wafers to reduce defects of the FPA and determine cause of defects; will design 5Mpix FPA incorporating feedback from the results of the 1-2Mpix FPA design process.			
Title: Strained Layer Superlattices (SLS) Technology ***Description:*** This effort investigates and improves the recent advances in III-V material thin film crystal growth of infrared focal plane arrays (IR FPAs) using a very flexible Strained Layer Superlattice (SLS) structure which allows multiband IR FPAs to be produced at much lower costs with improved uniformity. ***FY 2011 Plans:*** Improve the performance of SLS detectors through increased sensitivity; reduce excess noise of SLS longwave infrared detectors levels through novel side-wall passavation materials and techniques and novel diode architectures; develop lithography suitable for high definition format, small pixel, multiband SLS FPAs; design uniform large area SLS wafers by transitioning SLS growth from 3-inch to 4 to 5-inch diameter Gallium Antimonide (GaSb) wafers or establishing new growth processes on alternative Gallium Arsenide (GaAs) substrates to reduce defects in the SLS FPA. ***FY 2012 Plans:*** Will fabricate 640x480 pixel, dual band, midwave infrared/longwave infrared (MWIR/LWIR) or MWIR/MWIR FPA utilizing results of design of experiments involving passivation material and techniques, diode architectures and lithography; will design 640x480 small pixel (15/20 micrometer) dual band MWIR/LWIR FPA on alternate substrates, incorporating feedback from the results of experiments involving passivation material and techniques, diode architectures and lithography; will correlate material	-	5.600	11.700

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
performance of growth on GaSb versus GaAs; will convert detector fabrication processes from 3 inches to 5 inches diameter GaSb wafer capability.			
Title: Wide Field of View Displays and Processing for Head Mounted Display Systems ***Description:*** This effort researches and investigates wide field of view leap-ahead technology for Soldier vision enhancement components. ***FY 2012 Plans:*** Will investigate and evaluate techniques for the development of foveated (pitted) pixel architecture sensors and displays for ultra high resolution without trading field of view or low power.	-	-	3.328
Title: Solid State Low Light Imaging ***Description:*** This effort develops true starlight and below low light sensing, solid state focal plane technology with very low power and low production cost for Soldier vision enhancement under reduced visibility and low light conditions. ***FY 2012 Plans:*** Will research, investigate and assess the power, cost and low light sensitivity trade-offs for employing pixel enhanced quantum efficiency silicon material; will evaluate pixel design architecture for in-pixel gain and ultra-low noise readout circuits.	-	-	2.617
Accomplishments/Planned Programs Subtotals	26.514	40.228	57.203

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 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
K90: *NIGHT VISION COMPONENT TECHNOLOGY (CA)*	21.736	-	-	-	-	-	-	-	-	Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Night Vision Component Technology applied research.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Next Generation Communications System ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** This Congressional Interest Item, continued the development of fiber optic based sensor network into the existing expeditionary sensor platform for persistent surveillance.	0.795	-	-
Title: Night Vision Technology Research ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** This Congressional Interest Item, developed advanced infrared (IR) focal plane array components to improve the capability to rapidly search for targets in clutter and provide wide area persistent surveillance; developed building blocks for IR FPA product that enable cost effective, end-system manufacturing, and sensor material production; an emerging sensor technology, Strained Layer Superlattice (SLS) that may have higher operating temperatures eliminating the need for complex and expensive cryocoolers. Developed an extended MWIR response, 5 megapixel nBn array and associated test set so that performance could be verified. Performed pixel design optimization studies to incorporate commercial-off-the-shelf (COTS) fabrication techniques. Designed and developed a LWIR pointer for utilization with current uncooled LWIR based systems especially the deployed thermal weapon sight. Developed a dual f number cooler dewar assembly (ICDA) incorporating an 860 x 480 dual band array.	8.207	-	-
Title: Personal Miniature Thermal Viewer (PMTV) ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:***	0.796	-	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
This Congressional Interest Item, provided a small, lightweight (9 ounces), low power handheld or weapon mounted 20 degrees or 40 degrees field of view 320x240 pixel or 640x480 pixel uncooled thermal imager.			
Title: IR-Vascular Facial Fingerprinting ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** This Congressional Interest Item, developed an infrared sensor that passively tracked the spectral ratio over time providing cues to location of cancer.	2.388	-	-
Title: Materials for Infrared Night Vision Equipment ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** This Congressional Interest Item, assisted with the production of large Cadmium Telluride on Silicon alternate substrates by a US merchant supplier. The current state-of-the-art HgCdTe, used for infrared detector manufacturing, is grown on small CdZnTe substrates supplied by an off-shore company.	7.163	-	-
Title: Power Efficient Microdisplay Development for US Army Night Vision ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** Researched a more power efficient microdisplay suitable for inclusion into U.S. military thermal imaging and night vision devices.	2.387	-	-
Accomplishments/Planned Programs Subtotals	21.736	-	-

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.