ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - APPLIED RESEARCH	**0602709A - Night Vision Technology**	**H95**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H95	NIGHT VISION & EO TECH	22734	23746	20598	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification:

PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

This Program Element (PE) researches, investigates and applies core night vision, and electronic sensor technologies to improve the Army's Objective Force capability to operate in, and own the dark. Technologies and applications under this PE are an integral part of the Future Combat Systems (FCS). This PE provides the Objective Force warrior with new, or enhanced, capabilities to see farther on the battlefield, operate in obscured conditions, and maintain a higher degree of Situational Awareness (SA). It provides cost savings, performance reliability, and reduction in the size and weight of sensor and data display systems. Technologies also are being investigated to reduce the power requirements, and power consumption of the electronics. The use of a distributed network of thermal, acoustic, magnetic and other micro-sensors will provide the Objective Force with potentially revolutionary increases in battlespace awareness. This will improve the overall survivability, lethality and SA. It will enable commanders and staff to plan and execute more effectively at increased Operational Tempo (OPTEMPO). Micro-laser sources will provide the individual soldier with affordable, high performance tactical laser range-finding, target designation, obstacle avoidance and laser radar (LADAR). Innovative near wavelength IR (NIR) and short wavelength IR (SWIR) sensors provide low power, eye-safe, micro-laser illumination to increase range for target identification. Solid state SWIR sensors will passively image and detect high velocity, kinetic energy munitions under low light conditions. Imaging sensors are being designed and fabricated for the Anti-Personnel Landmine Alternative (APLA) program. This PE also will design and fabricate advanced electronics to improve the contrast, and brightness, of miniature, flat-panel displays for use by infantry, armored, aviation and field maintenance organizations. Aided/Automatic Target Recognition (ATR) technologies will enable dramatic reductions in the time necessary to acquire targets, detect landmines, and collect intelligence data, while reducing the warfighter's cognitive workload. The ATR Center of Excellence will quantify the performance and utility of ATRs. Sensor models will be created to accomplish trade studies and performance predictions. Models also will support constructive simulation/wargaming for analysis of alternatives. Hardware-in-the-loop, multispectral sensor simulations will support end-to-end predictive modeling and evaluation of new technologies in a virtual environment. This will allow warfighters to train in a non-threatening environment, employing maturing technologies and hardware to develop operational capabilities, concepts of operations, and Tactics, Techniques and Procedures (TTPs). This PE supports Soldier Systems that will transition to the Objective Force. Work in this PE contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0602712A (Countermine Technology) and PE 0603710A (Night Vision Advanced Technology). Work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on Sensors and Electronic Devices. This program is managed by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA. Contractors include: Boeing, Anaheim, CA; EOIR, Spotsylvania, VA; Fermionic, Simi Valley, CA; Fibertek, Herndon, VA; Kaiser, San Jose, CA; Litton, Orlando, FL; Lockheed Martin, Lexington, MA; Planar Systems, Beverton, OR; Raytheon, Dallas, TX; Rockwell, Thousand Oaks, CA; SAIC, San Diego, CA; Sarnoff, Princeton, NJ; TRW, Fairfax, VA; and VG Semicon, Beverly, MA. This program supports

the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 3919 - Designed and matured a 1024x1024 detector with long wavelength infrared (LWIR) FPA for application to overhead sensor technology for battlefield awareness.

  - Integrated analog to digital (A/D) conversion circuitry on an IR FPA to reduce read-out circuit noise, and improve detector response to target, or background temperature differences.

  - Established a new lab for uncooled technology to develop and test alpha-silicon test structures.

  - Evaluated, in collaboration with industry, an advanced read-out integrated circuit (ROIC) with non-uniformity correction circuitry on an IR FPA, to calibrate all detector pixels and provide a uniform response to target, or background, temperature differences.

  - Collected target, and background signature data with dual color, and near IR cameras to support comprehensive characterization of reflectivity differences of typical "un-modified" targets, camouflaged targets, cultural background objects, and natural background materials.

- 895 - Established prototype fabrication processes for growing next generation, multi-spectral IR detector arrays directly on a silicon semiconductor ROIC.

- 4604 - Designed solid state NIR FPA for operation at 2.0 microns and 2KHz frame rate for threat warning applications.

  - Designed low noise FPA for pulse gated laser imaging applications. Demonstrated 1.5 micron photocathode for pulse gated imaging applications.

- 3730 - Constructed and distributed models that better represent advanced EO sensor technologies (i.e. scanning vs. staring sensors). Made significant progress improving the search model.

  - Established a multispectral simulation environment to support design trade-offs, maturation, and evaluation of various advanced sensor programs.

  - Performed multiple validation efforts on the IR sensor simulation.

  - Integrated realistic interactive sensor simulation capability into the Mounted Maneuver Battle Lab at Fort Knox, KY and the Military Operations In Urban Terrain (MOUT) site at Fort Benning, GA.

- 1225 - Established and evaluated ATR processing architecture using adaptable computing technology for space/volume constrained applications and platforms.

  - Constructed partitioning and software translation tools that allow hardware specific ATR software to be ported to different processing architectures.

FY 2000 Accomplishments (Continued)

- Evaluated utility of synthetic forward looking IR (FLIR) imagery for ATR. Established baseline of FLIR ATR performance.

• 1372 - Integrated IR/charge coupled device (CCD) micro-sensors with acoustic and seismic micro-sensors to increase effectiveness of distributed sensor nodes in distinguishing between different targets or threats.

- Constructed a comprehensive uncooled IR FPA model for defining theoretical performance limits.

- Constructed fixed network of IR micro-sensor arrays to enhance target detection capabilities, define communication links, and define training requirements.

- Designed instant-on capability for uncooled IR micro camera.

• 2058 - Developed low power 640x512 pixel flat panel displays and associated drive electronics for dismounted soldier applications.

• 980 - Matured a low cost 1 lb. micro-laser that provides 2Km range performance.

• 233 - Completed testing on the Cooperative Eyesafe Laser Project (CELRAP) (Partner: Japan).

• 686 - Matured active and passive polarization sensors in the visible, 1-2.5, and 3-5 micron wavebands. Improved cueing and clutter rejection.

• 3000 - Modeled, matured and evaluated critical components of Congressional interest combustion driven laser. Critical components include the low threshold fiber clad laser, optimum brightness optical combustion sources, and efficient light-pipe optical couplers.

• 32 Laser study

Total 22734

FY 2001 Planned Program

• 4125 - Develop a prototype process for fabricating micro-lenses on focal planes to focus incident radiation on small pixel detectors. Provide improvements in detector sensitivity and sensor performance.

- Mature and test prototype advanced lithography process to reduce the number of fabrication steps for IR FPAs.

- Fabricate and test alpha-silicon wafer in-situ contacts using NVESD micro factory facilities.

• 1536 - Investigate and mature prototype process for semiconductor microfactory fabrication of ROIC that will be required to simultaneously readout the response from high speed, large area (640x480 and 1024x1024 element) dual color FPAs. Limited capacity readout circuits are a major technical barrier to higher performing next generation IR devices.

- Design next generation mid wavelength IR (MWIR) and LWIR FPA devices to provide high performance at elevated operating temperatures (120K vs. current 77K).

FY 2001 Planned Program (Continued)

- 4550 - Complete testing and evaluation of near IR solid state cameras based on alternative detector materials. Characterize performance, and define manufacturing yield issues for the alternative materials.

  - Define design parameters for a low cost, uncooled near IR and far IR sensor for dismounted soldier applications. Provide a fused output of the two spectral bands to enhance the operator's perception of "color" contrast, shadows, and depth.

- 3370 - Extend development of search and target acquisition sensor predictive modeling. Transition algorithms to constructive modeling and wargaming community.

  - Mature performance prediction models of multispectral sensor systems and target acquisition for specific targets.

  - Improve model prediction for environmental effects impact on sensor performance.

  - Incorporate additional sensor simulation capabilities that better represent complex urban terrain, and the battlefield environment.

  - Establish initial simulation tool set to support maturation of systems which use advanced, integrated, distributed, networked sensors. Transition tool set for use in Battle Lab experiments.

  - Continue sensor simulation validation efforts.

- 805 - Construct an open "heterogeneous" ATR processor architecture capable of hosting ATR software/algorithms designed for unique, or propriety, hardware. Reduce the time and cost required to integrate ATR capability into new platforms.

  - Establish standardized methods and procedures for mine detection ATRs.

  - Investigate emerging sensor technologies and ATR performance evaluation technology and methods.

- 1490 - Evaluate small scale integrated network of acoustic, seismic, and IR imaging micro-sensors to provide a significant unattended tactical sensing capability. Detect, track, and classify time critical mobile and stationary targets.

  - Evaluate low power consumption micro-sensors. Support electronics that permit unattended micro-sensor operation for up to 60 days.

  - Perform experiments utilizing prototype micro-sensor nodes in various configurations. Optimize warfighter effectiveness.

- 2100 - Mature full color, 640 x 512 pixel, flat panel display technology to enhance dismounted soldier performance through the use of color maps and symbology.

  - Mature color, 800 x 600 pixel, flat panel display technology for mounted and aviation applications.

- 1100 - Mature eyesafe micro-lasers capable of 2500 meter range performance and more than 5 shots per second.

- 237 - Perform final demonstration in CELRAP.

FY 2001 Planned Program (Continued)

- 700 - Mature on-chip neomorphic processing, hyperspectral spatial and temporal signature processing for development of compact, high performance sensors.
- 3422 - Construct, analyze, and evaluate, fully portable prototype of combustion driven eyesafe, self-powered laser, and its control electronics.
- 310 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 23745

FY 2002 Planned Program

- 4848 - Mature alternate readout circuit electronic technology to achieve small pixel geometry without performance reductions.
  - Mature A/D conversion techniques suitable for incorporation on FPA to improve sensitivity and dynamic range. Enable target identification at current detection ranges.
  - Investigate high operating temperature modes of IR FPAs against performance requirements.
  - Establish new techniques for etching detector material for high aspect ratios to achieve larger collection efficiency in multi-color detector stacked photodiodes and better pixel-to-pixel isolation.
  - Mature high frame rate (small time constant) material structures in alpha-silicon.
  - Investigate anti-reflection structures on micro-lenses for improved collection efficiency.
- 1279 - Establish baseline ATR performance for multi and hyperspectral sensors. Include those having advanced filtering and processing capability.
  - Investigate optimal human use of intelligent sensors for military applications.
  - Develop ATR hardware/software business plan to address the acquisition, and life cycle support requirements associated with introduction of ATR technology into Army tactical systems.
  - Show real-time reconfiguration of adaptable processor hardware, which could reduce the size, weight, and power requirements typical for ATR processors.
  - Host target cueing algorithms on real-time commercial-off-the-shelf (COTS) hardware. Evaluate performance.
  - Collect additional ATR problem set data to support algorithm maturation and evaluation.
- 3632 - Leverage clutter metric and shape characterization efforts for maturation and evaluation of a performance predication capability useful for specific targets.
  - Complete modeling of multispectral sensor systems.

FY 2002 Planned Program (Continued)

- Integrate environmental effects into model.
- Complete validation of 8-12 micron thermal sensor simulation.
- Continue validation of other sensor simulation bands.
- Advance state-of-the-art for simulation of distributed networked sensor simulation. Transfer improvements to battlelabs.
- Complete sensor simulation for better representation of complex urban terrain and the dirty battlefield environment. Begin development of dynamic terrain representations.

• 4048
- Mature extremely low power IR imaging micro-camera with instant-on capability.
- Investigate alternate components in a set of micro-sensors (acoustic, seismic, magnetic, IR tripwire, laser tripwire, etc.). Optimize ATR function in an isolated network of micro-sensors.
- Mature low power, compact micro-sensor network for field experimentation.

• 5065
- Mature 1920x1080 pixel, high-brightness, monochrome Active Matrix Liquid Crystal Display (AMLCD) for aviation platforms.
- Mature EO-Attenuator for active sunglass tinting of helmet mounted displays (HMDs).
- Characterize performance of 640x512 pixel, full color, flat panel displays for the soldier.

• 939
- Integrate micro eyesafe solid state laser devices with receiver. Evaluate 2500 meter ranging at 5 hertz, using low cost laser technology.

• 787
- Investigate multispectral and polarization imaging phenomenology as part of a fused sensor suite, with an active laser ranging sensor.

Total 20598

B. Program Change Summary	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	20021	20465	20574	0
Appropriated Value	20111	23965	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-319	0	0	0
c. Omnibus or Other Above Threshold Reductions	-49	0	0	0
d. Below Threshold Reprogramming	32	0	0	0
e. Rescissions	-41	-219	0	0
f. OSD Realignment	3000	0	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	24	0
Current Budget Submit (FY 2002/2003 PB)	22734	23746	20598	0

In FY01, Congress added ($3500) million for Combustion-Driven Eye Safe Self Powered Laser, to mature and field a three-dimensional identification friend-or-foe system capable of identifying aircraft and vehicle threat systems in real-time.