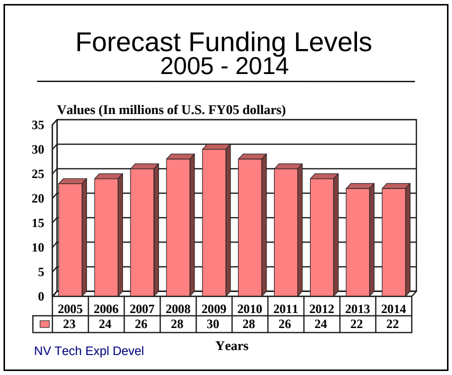
Night Vision Technology Exploratory Development - Archived 10/2006



Outlook

- Work in this program transferred in FY2006 to other night vision programs such as Night Vision Advanced Technology Airborne Systems, Night Vision Advanced Technology Combat Vehicles, Night Vision Advanced Technology Weapon Systems, and Night Vision Systems Advanced Development

Orientation

Description. An effort to develop initial electro-optical technology-based concepts for future land-based systems, as well as air- and sea-based applications that may apply.

Sponsor

U.S. Army
Communications-Electronics Command
Night Vision and Sensors Directorate
Fort Belvoir, Virginia (VA)
USA

Status. Application of technologies to intended platforms.

Total Produced. Not applicable.

Application. The key objectives of this program are to develop advanced electro-optical technologies for devices that can acquire and track enemy targets at maximum weapons systems ranges under varying conditions of illumination.

Price Range. Indeterminate, as this is a technology-based research and development program.

Contractors

Contractor(s) not selected or not disclosed.

Technical Data

Characteristics. The Night Vision Technology Exploratory Development program is concentrated on infrared focal plane arrays, advanced optics, low-energy lasers, advanced aided target recognition, low-cost, low-observable, multispectral technology and performance modeling, simulation, and analysis for supporting systems development. Additionally, this program supports the Joint Precision Strike Demonstration (JPSD), Rapid Force Projection Initiative (RFPI), Advanced Concept Technology Demonstrations (ACTD), and the Land Warrior integrated technology program.

The use of thermal, acoustic, magnetic, micro-sensor and micro-laser sources is being investigated. The micro-lasers will have the potential to provide the individual soldier with high performance tactical laser range finding, target designation, obstacle avoidance, and laser radar. Near infrared (NIR) and short wavelength infrared (SWIR) sensors will provide increased range for target identification. Solid-state SWIR sensors also have the potential to passively detect high velocity, kinetic energy munitions under low light conditions.

Imaging sensors are being designed and fabricated for the Anti-Personnel Landmine Alternative program. Aided/Automatic Target Recognition (ATR) technologies are being researched to dramatically reduce the time necessary to acquire targets, detect land mines, and collect intelligence data.

Variants/Upgrades

This is a continuous exploratory research and development effort. There are no product variants or upgrades in the standard definition of the terms.

Program Review

Background. In the early 1990s, exploratory research of uncooled focal plane arrays had been completed. This technology was then transitioned to a major advanced technology initiative for the development of rifle sights, munitions sensors, and missile seeker sensors. Shortly thereafter, a second-generation thermal model (FLIR 90) was released to all users of thermal devices.

By mid-1995, advanced thermally matched readouts were developed that maximized focal plane array size architectures for applications requiring large area/ multispectral staring arrays. This technology advancement demonstrated the initial thermal scene-rendering capability for virtual imagery, and validated 3-D thermal models.

Over the course of FY96 and FY97, attempts were made to complete the thermal scene rendering capability for virtual imagery. This provided a database for the simulated night scene to be used in the dismounted Battlespace Battle Lab. Once completed, the initial version of the advanced focal plane array is expected to be integrated into high-density aided target recognition processor modules.

Optics. The advanced optics initiative focuses on the development and demonstration of a family of core optics and display technologies for future head-mounted vision systems that will be utilized by the Land Warrior soldier system, Mounted Warrior (a vehicle version of Land Warrior), Second-Generation FLIR Horizontal Technology Integration, the Advanced Image Intensification Advanced Technology Demonstration, Comanche, and the Advanced Helicopter Pilotage Technology Demonstration.

State-of-the-art optics technologies such as binary, diffractive, and holographic implementations of head-mounted vision systems became the rage in the early 1990s. Initial evaluations of these applications were completed in FY95.

Advanced designs for objective and ocular optics for the Land Warrior Helmet Mounted Vision System (HMVS) were completed during FY96. Also during this time period, cost/weight reductions of potential optical system upgrades using binary optics hybrids were demonstrated.

The next round of efforts in optics technologies concentrated on developing core display electronics and sensors that could be fabricated into advanced optics components for demonstration in Land Warrior HMVS during FY97.

In FY00, IR/charge-coupled device micro-sensors were combined with acoustic and seismic micro-sensors to increase effectiveness of distributed sensor nodes in distinguishing between different targets or threats.

A prototype process for fabricating micro-lenses on focal planes was researched in 2001 to focus incident radiation on small pixel detectors. Improvements were also provided that year in detector sensitivity and sensor performance, as were the investigation and testing of prototype advanced lithography processes in order to reduce the number of fabrication steps for infrared focal plane arrays.

Infrared micro-camera technology was also demonstrated in 2002 as part of the Warrior Extended Battlespace Sensors effort. Infrared micro-cameras for netted micro-sensor field applications were subsequently developed and delivered in 2003. Acoustic and infrared image sensor fusion algorithms for positive target identification and multiple target deconfliction were also developed.

Under the Low-Power Display Components effort in 2002, full-color active-matrix organic-light-emitting diode displays for Land Warrior/Objective Force Warrior requirements were developed.

In the Soldier Vision System Components effort in 2003, optimal head-mounted configurations were determined for multispectral indirect-view pixel-fusion components. Also, a miniature video-based low-light level mobility sensor was evaluated. More than $1 million was spent on this effort.

Nearly $4 million was spent on the Warrior Extended Battlespace Sensors effort in 2003. Affordable, infrared micro-cameras were tested for micro-sensor field applications to aid in improved target identification.

Lasers. In lasers, great importance has been placed on the development of modular technology for Army tactical laser countermeasures, obstacle avoidance, biological agent detection, range finding, enhanced target recognition, and laser radar for integration with vehicle target acquisition sensors. This technology development supports the Target Acquisition, Hunter Sensor Suite, and Battlefield Combat Identification technology demonstrations.

A high-repetition-rate laser module, demonstrated in FY97, led to the integration of laser radar rangefinder functional software modules and the transition of eye-safe multifunction lasers to the Target Acquisition Technology Demonstration Program.

During FY98, efforts focused on developing compact fundamental laser modules and wavelength conversion modules that could be combined as needed for different applications such as target designation, eye-safe range finding, laser radar, and chemical detection.

Significant improvements in laser technology were achieved through FY00. A realistic interactive sensor simulation capability was integrated into the Mounted Maneuver Battle Lab at Fort Knox, Kentucky, and the Military Operations in Urban Terrain site at Fort Benning, Georgia. The testing of the Cooperative Eye-Safe Laser Project was completed and the critical components of the combustion-driven laser were developed and evaluated.

In 2001, eye-safe micro-lasers capable of 2,500-meter range performance and more than five shots per second were designed, and a final demonstration in the Cooperative Eye-Safe Laser Radar Program was performed. Citing congressional interest, a fully portable prototype of a combustion-driven eye-safe self-powered laser and its control electronics was also constructed, analyzed, and evaluated.

Work on the Micro-Eyesafe Solid State Laser Sources effort in 2002 saw the development of new, ultra small, low-cost eye-safe lasers for various U.S. Army applications.

For 2003, around $5 million was spent on the Third-Generation Forward Looking Infrared (FLIR) Technology effort. This funding went, in part, to the testing and evaluation of 3-D laser radar (LADAR) with high-range resolution and multiple view points.

Signal Processing. Under the signal processing initiative, emphasis was placed on the exploitation of advanced aided target recognition processing prototypes and the implementation of near-real-time processing of target acquisition data from multiple sensors such as second-generation thermal imagers, millimeter wave radar, and lasers, to enhance lethality and survivability of future weapons systems. This high-performance processor technology transitions directly to the Hunter Sensor Suite, the Target Acquisition Technology Demonstrations, and various additional future technology demonstrations.

The signal processing effort also involves the investigation of technologies that will enable the development and evaluation of low-cost, low-observable, multispectral systems that conceal friendly force assets from threat sensors. The effort will also investigate sensors that would acquire enemy low-observable targets. Furthermore, it supports the technology development needed for an electronic capability consisting of interactive three-dimensional (thermal, millimeter wave, radar) models, sensor simulations, and scene generation to evaluate aided target recognition and human performance models.

During FY96, high density multi-chip modules were integrated into a commercial processor. These rapid prototyping processor modules, which utilize computer-aided design techniques, were then demonstrated the next year.

Evaluation of the practicality and affordability of large single-spectrum staring/scanning arrays occurred in 1998. Another accomplishment from that year included the validation of imager performance models for transition to high sensitivity integrated detector/dewar demonstrations, and the demonstration of smart on-chip functions such as spatial and temporal filtering.

Among the many program accomplishments of 1999 was the development of architecture for partitioning smart, integrated, circuit processing hardware functions between on- and off-focal planes. This reportedly improves sensor performance and reduces processing hardware requirements for weapons platforms.

Target and background signature data with dual color and near-IR cameras were collected in FY00 to support comprehensive characterization of reflectivity differences of typical "unmodified" targets, camouflaged targets, cultural background objects, and natural background materials.

An open heterogeneous Aided/Automatic Target Recognition (ATR) processor architecture capable of hosting ATR software/algorithms designed for unique or proprietary hardware was constructed in 2001, as was a reduction in the time and cost required to integrate ATR capability into new platforms. Standardized methods and procedures for mine detection ATRs were also established.

In 2002, work on the Overhead Sensor Technology for Battlefield Characterization (a joint Communications and Electronics Command [CECOM] and Space and Missile Defense Command project) saw research for advanced overhead sensor technologies for wide area battlefield surveillance in real time.

Over $4 million was spent through 2003 on the Advanced Sensor Modeling and Simulation effort. Work in this area saw a "Paint the Night" image design tool integrated directly into a computer for improved imaging.

Funding

Funding for this program was switched to other Night Vision programs covering similar efforts.

Timetable

Month	Year	Major Development
	FY95	High-tech optics technology study completed
	FY96	High-density multi-chip signal processing modules integration
Late	FY97	Night Vision Land Warrior demonstration
	FY98	Developing laboratory variable repetition rate laser pump module
	FY99	Completion of common source laser brassboard
	FY00	Design and development of focal plane display for battlefield awareness
	FY01	Completion of test and evaluation of near-infrared solid-state camera
	FY02	Transfer of simulation improvements to battlefield
	FY03	Start of production for Land Warrior
	FY04	Land Warrior deployed
	FY05	Development of large format, low light video sensors for Phase II Objective Force Warrior transition

Worldwide Distribution

Although this is a **U.S. Army**-led effort, the Night Vision Technology Exploratory Development program adheres to Tri-Service Reliance Agreements on Electro-Optics, with oversight and coordination provided by the Joint Directors of Laboratories.

International interchange of information is accomplished primarily through active participation on various NATO working groups, the Technical Cooperation Program (United States, United Kingdom, Canada, and Australia), and the International Standardization Program.

Forecast Rationale

The U.S. Army's Night Vision Technology Exploratory Development effort was folded into other night vision programs for FY2006. When this report was first published several years ago there was a separate funding line in the defense budget. Many of the activities in this effort are apparently being taken over by some of the other numerous night vision programs. These include Night Vision Advanced Technology Airborne Systems, Night Vision Advanced Technology Combat Vehicles, Night Vision Advanced Technology Weapon Systems, and Night Vision Systems Advanced Development (covered as separate reports in this book).

Ten-Year Outlook

The funding for this report has been deleted.