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STATEMENT BY

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BEFORE THE

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UNITED STATES SENATE

ON TECHNOLOGY FOR COMBATING TERRORISM AND WEAPONS OF MASS DESTRUCTION

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ON ARMY SCIENCE AND TECHNOLOGY PROGRAM
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INTRODUCTION

Mr. Chairman and Members of the Committee thank you for the opportunity to describe the Fiscal Year 2003 (FY2003) Army Science and Technology (S&T) Program and the significant role S&T has in accelerating the pace of The Army's Transformation.

We want to thank the Members of this Committee for your important role in making today's Army the world's preeminent land combat force and your support of our Transformation Goals. Your continued advice and support are vital to our success.

TRANSFORMATION

We are a Nation and an Army once again at war. This new century brings a new kind of war—the worldwide war against terrorism. Events since September 11th have reinforced the need to continue and accelerate the Army's Transformation to a more strategically responsive Objective Force. The versatility, agility, lethality and survivability by our forces in Afghanistan provide a glimpse of the full spectrum capabilities we are seeking to achieve in the Objective Force. A clear example of this is the new lightweight ballistic protection worn by our soldiers during combat operations in Operation Anaconda. The new Interceptor armor jackets, credited with saving many lives and minimizing combat injuries, were produced through the Army Manufacturing Technology (MANTECH), Enhanced Manufacturing Processes for Body Armor Materials project, through the U.S. Army Natick Soldier Center, Natick, Massachusetts.

The Army's Transformation is well underway and the S&T program is in the third year of executing its focus on achieving Objective Force capabilities and re-shaping Research and Advanced Technology programs to support the Army Vision. We are transforming today's Army to an Objective Force that provides the Joint Force Commander with versatile early entry capabilities, without extensive logistics "tails," fixed forward bases but still having the combat power to "finish quickly and decisively."

THE ROLE OF ARMY S&T

The goal of the Army's Science and Technology (S&T) program is to provide technical solutions for the Army's Objective Force. We are committed to providing this technology to accelerate the Transformation. The largest single S&T program that we have is the Future Combat Systems (FCS). FCS represents a true paradigm shift in how we fight – perhaps as significant as the introduction of the tank or the helicopter. FCS is the single largest S&T initiative, representing over 40% of all S&T funding. In the Army's quest for true innovation, it has partnered with the Defense Advanced Research Projects Agency (DARPA) to explore innovative FCS concepts and technologies. FCS is not "a platform." It is a system of battlefield capabilities in which the whole exceeds the sum of its parts. Fielding FCS will blur current distinctions between heavy forces and lighter forces, while providing lethal overmatch. Some of the key challenges include:

- **Survivability:** Survivability is the primary technology challenge because our combat systems must weigh less than 20 tons to be rapidly deployable. This forces us to find new ways to protect our soldiers. To survive a first round engagement to "See First" and "Understand First", individual FCS platforms will require advances in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) as well as integrated platform protection systems. Technology options under development include advanced communications and sensor systems that will increase situational

awareness and allow us to “see first” and farther than the enemy; active protection systems which are designed to degrade, deflect or defeat incoming threats before they can hit our vehicles; signature reduction techniques that will make us harder to see and therefore harder to hit; and lightweight armor that weighs ¼ of the current armor, but provides the same protection.

- **Lethality:** Although our systems will be lighter weight, they must maintain the lethality overmatch of current systems. Desired capabilities include lethal and non-lethal, line-of-sight and non-line-of-sight, gun, missile and directed energy weapons that will provide for the destruction or incapacitation of multiple targets. Options under development include the precision and loiter attack missile systems that will allow us to conduct precision engagements against the enemy at much greater ranges than he can; lightweight, lower caliber guns and ammunition capable of precision direct and indirect fire at long ranges, potentially enabling us to combine capabilities of the traditional tank and artillery piece into one system; extremely lethal compact kinetic energy missiles that ensure overmatch against advanced protection systems, and directed energy systems like lasers and high-power microwaves for lethal and non-lethal applications.
- **C4ISR:** Network centric operation is the linchpin for FCS and the Objective Force, providing the foundation for comprehensive situational awareness and the capability for instantaneous prioritization, distribution and engagement of multiple threats. On-the-move, distributed command and control, multi-function sensors and sensor fusion algorithms, and development of a seamless Tactical Internet among leaders, soldiers, platforms, and sensors are critical to achieving these goals. Options under development include digital, secure on-the-move communications for collaborative planning and execution, positive command and control, and shared situational awareness; enhanced radar and sensor systems for longer range detection, accurate identification and precise localization; information assurance to counter information attack and avoid deception, denial and disruption; and aided

target recognition to reduce the target identification and weapon engagement timeline – the sensor to shooter latency.

- **Power Generation & Management/Electric Propulsion:** The Objective Force will require efficient power generation and management systems to remain lightweight, but still function at a fraction of the logistics burden of the current force. Fortunately, the Army can leverage commercial investments, and is engaging with industry to achieve mutual development benefit. Options under development include hybrid electric drive for high acceleration, design flexibility and increased fuel efficiency; fuel cells for efficiency, quiet operation, reduced environmental impact and potential water generation; advanced diesel engines scaled for FCS-class vehicles with higher power density and greater fuel efficiency; low power demand electronics to increase energy efficiency; and efficient power management designs.
- **Human Engineering:** Future leaders and soldiers will face increased challenges because of the variety of missions and complexity of tasks that they must accomplish. We must minimize this complexity while ensuring our soldiers are better trained and rehearsed for the full spectrum of missions they may be required to perform. Options under development include human/machine interface designs that decrease task complexity and execution times, improve performance levels, and minimize physical, cognitive, and sensory demands; associate systems to complement human operators, offload routine tasks and enhance high priority task performance; and embedded/deployable training and mission rehearsal environments.

UNMANNED SYSTEMS

Over the past two years, the Army has increased its investment in unmanned systems technology to support Congress' desire for fielding substantial unmanned capability among future operational ground combat vehicles. The Army has implemented a bold robotics technology investment strategy to provide these

unique capabilities for the Objective Force. The Army has also structured the FCS program with phased unmanned system upgrades to support the introduction of progressively more robust unmanned ground combat capabilities.

As part of its on-going partnership with DARPA, the Army is sponsoring the development of FCS concepts that involve significant unmanned capabilities. The collaborative Army/DARPA FCS program will define and validate FCS design and operational concepts, including the role of unmanned ground vehicles (UGVs) and unmanned air vehicles (UAVs). Further, in February of 2002, the Army has established a new unmanned Combat Armed Rotorcraft technology development Memorandum of Agreement. The Army strategy is to begin fielding substantial unmanned capabilities through the FCS program and synergistically integrate manned and unmanned systems throughout the Objective Force.

Additional Army technology investments that have direct relevance for FCS and the Objective Force are being made with DARPA. They include the Organic Air Vehicle (OAV) and a UAV rotorcraft with a large payload, long endurance and a vertical take off and landing capability (the A-160 Hummingbird), advanced command, control and communication technologies, and novel sensor systems. These technologies hold the potential to permit the FCS, and its associated dismounted forces, to operate in complex terrain by exploiting organic, non-line-of-sight fire capabilities through remote sensing and communications relays.

OTHER S&T PRIORITIES

Beyond the FCS, our S&T program must continue to support the full range of capabilities required for the remainder of the Objective Force. Some key areas of investment include:

- **Objective Force Warrior:** Integrated soldier system of systems to provide leap-ahead capabilities for the dismounted soldier with dramatic weight and power reduction – with a goal of providing full warfighting capabilities at 40lbs or less. The system of systems will provide seamless

connectivity with other soldiers, weapon systems, FCS, and robotic air/ground platforms to achieve overmatch for the full spectrum of future operations.

- **Medical Technology:** Individual health monitoring, medical and dental preventive treatments, including: vaccines and drugs against malaria, hemorrhagic fever, and scrub thyphus, to significantly reduce Disease and Non Battle Injury (DNBI) casualties. In addition, these technologies seek to reduce the medical footprint. Innovative products include far-forward stabilization and resuscitation, hemorrhage control, minimize neural injury, decrease the mortality rate, and speed soldiers' return-to-duty.
- **Advanced Simulation:** Modeling and simulation technology, such as an innovative partnership with the entertainment and game industries through the University of Southern California (the Institute for Creative Technologies or ICT) to accelerate the development of compelling immersive environments for training, mission rehearsal, and concept development. Another project, the Joint Virtual Battlespace (JVB) program, is an enabling technology for evaluating how FCS contributes to the total capability of the Objective Force, and how the Objective Force plays in a joint force. JVB, combined with virtual prototyping, also seeks to provide an effective means to take time out of the Operational Test and Evaluation process.
- **Rotorcraft Technology:** As the DoD lead for Rotorcraft Science and Technology, the Army is investing in the critical technologies to increase performance and reduce logistics demands for both manned and unmanned rotorcraft. Most significant is the new thrust to develop an Unmanned Combat Armed Rotorcraft capability.
- **Micro electro-mechanical System Inertial Measurement Unit (MEMS IMU):** The Army has recently solicited 50%-cost share proposals to develop a low-cost, gun hardened and high accuracy MEMS IMU for gun-launched guided munitions, tactical missile and other military applications. The focus is to produce a MEMS IMU that will be bought by the DoD in

bulk, thereby giving the economy of scale necessary to yield an inexpensive unit price. The goal is a military tactical-grade IMU that meets 90% of DoD munition and missile needs at a low-performance unit price, available from two, or more, commercial contractors.

- **High Energy Lasers:** As we move to a more all-electric force this "electric" laser approach will be a key enabler to achieve unprecedented combat overmatch on the battlefield. The Army S&T program continues to investigate high energy solid state laser technology options for potential application on the tactical battlefield. In this effort, we are seeking to identify the most promising solutions to ensure speed of light engagement and laser weapon lethality throughout the spectrum of battlefield environments of weather, dust and obscurants.
- **Basic Research:** As the Army's mission challenges have increased, it has become even more important to maintain world-class quality in the basic research program. Investment in knowledge and understanding of fundamental phenomena to enable future technological development includes: support for academic research through the Single Investigator Program (e.g. microturbines, materials science, solid-state physics); investment in paradigm shifting centers (University Affiliated Research Centers (UARCs) such as ICT); support of industry-led centers through the Collaborative Technology Alliances (Communications & Networks, Advanced Decision Architectures, Power and Energy). A specific new thrust was added in 2002 with the selection of the Massachusetts Institute of Technology (MIT) to serve as the Army-sponsored University-Affiliated Research Center (UARC) for the Institute for Soldier Nanotechnologies (ISN). The ISN will provide the Army with a corps of expertise in the development and application of nanotechnology for the soldier; including the creation of uniforms and materials that could help heal soldiers, protect against bullets, chemical agents or monitor a soldier's life support processes. Soldiers are at the center of Army Transformation. New technologies and developments by ISN in nanotechnology will bring

significant progress in the Army's transformation of soldier equipment. The 2003 budget request includes funding for the creation of the Army Institute of Biotechnology Center, to identify, conduct research and transition militarily relevant biotechnology.

S&T WORKFORCE

We cannot achieve our goals without the top caliber scientists and engineers who develop these technologies for our soldiers. Recruiting and training S&Es remains a challenge. We are working to identify innovative approaches to recruiting, retaining and refreshing the Army S&E workforce. I will be sharing these insights across the department. I want to assure this committee that I am committed to ensuring the quality of our S&E workforce. Our soldiers depend on them.

TECHNOLOGY TRANSITION

Successful transition of Army Science and Technology is central to enabling the Army vision. The Army S&T community has been challenged to develop a revolutionary warfighting capability within an accelerated timeframe. To accelerate technology transition, the Army adopted new and aggressive management practices and methodologies to manage risk. The Army has adopted Technology Readiness Levels (TRLs) as the method to measure the maturity of the technologies being developed. TRLs were identified in the recommendations put forward in the 1999 General Accounting Office Report[1] citing best practices for the management of technology development. The GAO stated that critical technologies and/or subsystems should be at a high level of maturity prior to making the commitment for development and production of a weapons system. The Army has adopted this approach and is using TRLs to track and communicate technology maturity levels to the acquisition community.

We can take time out of the transition process by maturing technology in the S&T phase to TRL 7 – system prototype demonstration in an operational environment. By doing this, we spend more in S&T, but save time and money in Systems Development and Demonstration (SDD), then proceed faster to production.

Risk management is another tool designed to improve the transition of advanced technologies to the warfighter by providing the gaining acquisition Program Manager with a risk assessment and risk mitigation plan for S&T programs. While Technology Readiness Levels (TRLs) assess the estimated maturity of a technology, the risk management process focuses on identifying, tracking and managing potential cost, schedule and performance risks. In FY01, the Army Science & Technology (S&T) community implemented a pilot program to perform risk management on selected S&T efforts. Lessons learned from this pilot program will be used to tailor the risk management process that will be applied to all Science and Technology Objectives efforts preparing to transition to acquisition.

PROMOTING TRANSITION FROM NON-TRADITIONAL DEFENSE CONTRACTORS

The Army is continuing in its efforts to promote technology transition from non-traditional defense contractors. Legislation in Fiscal Year 2002 directed the Army to establish a venture capital fund similar to that established within the Central Intelligence Agency (CIA) to identify, develop, and field new technologies as rapidly as needed to support the transformation. The Army has engaged the RAND Corporation to assist the effort in establishing such a fund in concert with the guidance from the Congress. We expect that the Army will be ready in short order to announce its approach to the Congressional directive.

[1] "BEST PRACTICES: Better Management of Technology Development Can Improve Weapon Systems Outcomes," GAO/NSIAD-99-162, July 1999

The Army is responding to previous authorities such as Section 1113. There has been significant interest from our laboratories in the positions available under this legislation. We have provided criteria to the Army labs in concert with the needs of the Army transformation in those technical areas of highest interest. The Army labs have responded with candidate positions. We expect that the hiring of these personnel will begin in May.

TECHNOLOGY TO COMBAT TERRORISM

Defense Emergency Relief Funds will support S&T developments to combat terrorism in the area of Deterrence, Indications and Warning (DIW), and retaliation and recovery. Included are the development of improved sensors, sensor suites and resultant operational modalities in the following areas:

- **Remote/Perimeter Sensing**- Increase the capability of distributed remote sensor systems by the addition of extremely compact day/night thermal imaging capability and improved long range command, control and reporting capability. Camouflaged, remotely emplaced imaging sensors capable of RF transmitting day/night “snapshots.”
- **Urban/Cave Assault Kits**- Develop and fabricate individual soldier systems to allow soldier maneuverability and weapon aiming in constrained areas in true dark. Based on micro thermal imaging cameras mounted on soldier helmets and weapons with imagery presented on a helmet-mounted display.
- **Blue Force Awareness**- Develop and evaluate techniques to improve soldier navigation and location capabilities in complex urban and field environments. Included are dead reckoning navigation and blue force situation monitoring in the absence of viable Global Positioning System signals, ultra-wide band tags for intra-unit soldier awareness and real-time blue force identification of moving vehicles through modification of existing radars for tactical unmanned aerial vehicles (TUAVs).

- **Counter Terrorist Echelon Surveillance**- Extend the range of surveillance and identification of potential terrorist activity at the individual soldier, light vehicle and airborne platform (TUAV) echelons. Incorporate short wave infrared imaging techniques to extend identification ranges out to current detection ranges, automated gimbal scan electro-optical imaging from ground vehicles fused with moving target indicator (MTI) radar for faster cueing of suspect activity and lightweight/high performance day/night thermal imaging from a TUAV platform for wide area/change detection assessments including recently deployed land mines.

CONCLUSION

The Army must have a diverse S&T portfolio that is responsive to current and future warfighter needs. The S&T community seeks technological solutions that can be demonstrated in the near term, explores the feasibility of new concepts for the midterm, and explores the imaginable for an uncertain far-term future. Since the Army vision was announced in October 1999, the Army S&T effort has been reshaped, refocused and reinforced to speed the development of those critical technologies essential to transform the Army into the objective force. The Army S&T community has accepted the technical challenges embraced in the Army Vision. We have committed our energies and our vital resources to accelerate the pace of Army Transformation!