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TESTIMONY OF

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BEFORE THE UNITED STATES SENATE

COMMITTEE ON ARMED SERVICES

SUBCOMMITTEE ON EMERGING THREATS AND CAPABILITIES

MARCH 3, 2004

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Introduction

Mr. Chairman, members of the committee, thank you for the opportunity to appear before you today to talk about the science and technology (S&T) program of the Department of Defense (DoD). S&T remains postured to support both the near term Global War on Terrorism (GWOT) and the transformation of DoD. We are excited about the capabilities and possibilities that continue to be opened by S&T throughout the Department. Secretary Rumsfeld stated in last month's FY05 Budget testimony that the Department and Congress have a common challenge: "to support the troops and to make sure they have what they will need to defend the Nation in the years ahead." The Department's S&T program is vital to the support of our troops and is simultaneously developing the capabilities for our future forces. While there are still many challenges, I believe the S&T program has been productive over the past year, and the increasing emphasis on accelerating the transition of technology is showing positive results.

As the Director of Defense Research and Engineering, serving in the role of the Department's Chief Technology Officer, I have established five priorities. These priorities facilitate the Secretary of Defense's goals. Our Research and Engineering goals are to:

- Integrate DoD S&T and focus on transformation
- Enhance technology transition
- Address the national security science and engineering workforce

- Expand outreach to the combatant commands and intelligence community
- Accelerate technical support to the war on terrorism

Taken together, these priorities provide a sound strategic roadmap to support the transformation of the Department of Defense, and where technology can help, address the immediate challenges of the Global War on Terrorism. We have strengthened the programmatic oversight processes over the past year to better ensure that the goals and objectives of the Department are met. We have revised the Joint Warfighting Science and Technology Plan (JWSTP) to better integrate and align our S&T program with the needs of Combatant Commands and the joint functional concepts. We have instituted focused reviews of the Defense Advanced Research Projects Agency (DARPA) activities to ensure the best integration of the DARPA research and results into the Department's coordinated research and engineering program. We have expanded reviews with the Components to assess technology maturity and enhance technology insertion in support of defense acquisition programs.

Integrate DoD S&T and Focus on Transformation

This goal strives for an integrated program across the DoD Services and Agencies that is aligned with transformational goals of the Department. Two enabling elements for this goal -- *how much* the DoD invests in S&T, and into *what technologies* the Department invests its S&T dollars.

The FY05 President's Budget Request is a solid budget proposal for S&T programs. The DoD request for S&T in FY05 is \$10.553 Billion,. The budget request achieves about 1.5% real growth in S&T, when compared to the FY04 President's Budget Request. The Department's S&T investment has increased from \$7.8 Billion to \$10.5 Billion in the last three years of the President's Budget Requests.

We are mindful however, that additional funding, without focus, will not ensure transformation. We have focused the budget request on several important technology areas that should enhance transformation and deliver critical military capabilities, and in addition, provide technology solutions to support the Global War on Terrorism. The FY05 President's Budget Request continues the direction of aligning S&T dollars to support the Department's six critical operational capabilities as outlined in the Quadrennial Defense Review. These capabilities are: protect bases of operations, deny enemy sanctuary, project and sustain US forces, enhance space operations, assure information operations, and leverage information technologies. Additionally, we continued with three broad, cross-cutting initiatives that address the development of DoD critical transformational technologies. These three initiatives have matured over the past year. They are the National Aerospace Initiative; Energy and Power Technologies, and Surveillance and Knowledge Systems. Finally, we continued to identify potential technologies for acceleration in support of initiatives for force protection of our remarkable men and women deployed in Afghanistan and Iraq.

An important point to emphasize is the continuing importance of basic research to enable the development of future military capabilities. In the past 20-30 years, basic research has spawned such advances as the Global Positioning System, Stealth, and Night Vision devices. The pace of technology development is increasing so the generation of new ideas through basic research remains a high-payoff component of the S&T program. The FY05 President's Budget Request for basic research is \$1.3 Billion. Although the investment level for basic research remains constant, the payoff continues to produce significant discoveries, sometimes on a critically shortened time-scale. For example, the success of the thermobaric weapon is directly linked to the basic research in DoD. The thermobaric weapon went from basic research through operational testing in 90 days. Basic research also closely links the DoD with universities that provide a great breadth of leading edge research, some that can be applied in the very near-term. For instance, the technology used to decontaminate the Senate offices and federal facilities in the aftermath of the anthrax attack come from an on-going university-based basic research project. The university linkage is also key in the education of the future defense workforce.

Component Initiatives

The Army's Future Combat Systems is a complex transformational initiative that networks combat and support vehicles, unmanned air and ground systems, and soldiers together as an integrated system. As this system matures, it

will provide a revolutionary capability to move, shoot, communicate and defend. A technology solution called “ZEUS” is a good example of enhanced technology transition in support of the GWOT. ZEUS involves a HMMWV mounted laser neutralization system for unexploded ordnance. ZEUS is currently fielded in Afghanistan. This technology has neutralized 10 different types of ordnance totaling 210 targets. The improved standoff range for ordnance neutralization enhances the safety of our troops.

The Air Force’s major transformational projects derive from the envisioned joint battlespace infosphere capabilities. Those would provide technology for applications ranging from decision quality information to demonstrations of small and micro satellites that could dramatically enhance our ability to conduct enduring space operations. This movement to the transformational aspects of space and information is central to the Air Force’s investment profile, and will support the entire Department.

The Navy’s transformational programs include the electric ship which is an “umbrella” program to integrate an array of technologies that could provide an integrated propulsion, support, and weapons suite to maximize the capability of future naval operations. For the GWOT, the Naval Research Labs developed and prototyped Dragon Eye, a successful project currently deployed in Iraq. Dragon Eye is a lightweight, person portable unmanned aerial vehicle with a changeable sensor package. One such package allows for the collection and detection of

chemical, biological, and radiological agents and provides a stand-off surveillance capability.

Our investment in the Defense Advanced Research Projects Agency (DARPA) continues to emphasize high-risk, high payoff research and development in a number of strategic thrust areas, as outlined in the DARPA Strategic Plan. I would like to highlight a DARPA-Service collaborative project that is supporting transformation in the Department and should ultimately provide a unique surveillance capability. The Organic Air Vehicle (OAV) is a small, man-portable unmanned aerial vehicle (UAV) that can fly and hover using a large horizontal fan. The UAV has been tested in 9, 15, and 29 inch diameter versions—and each can carry different payloads. This vehicle is being developed as a component of the Army's Future Combat Systems. DARPA's programmatic agility, when linked with Service programs, accelerates technology development and transformation.

Cross-Cutting Initiatives

One of the joint transformational technology initiatives is the National Aerospace Initiative (NAI), which consists of research and development in hypersonic flight technology, affordable and responsive space access, and an increased focus on space science and technology enablers.

NAI provides an integrated technology roadmap for the Department to increase our capability in several mission areas such as high speed/hypersonic flight, access to space, and space technologies. For example, hypersonic

capability could provide an air breathing option to conduct strikes from strategic distance in a short amount of time, reducing vulnerability of future systems, and help to deny enemy sanctuary. In the FY05 budget, the Department increased hypersonics funding primarily in support of the USAF-DARPA Single Engine Demonstrator (SED). The objective of the SED program is to flight test the Air Force Hypersonic Technology (HyTech) scramjet engine using hydrocarbon fuel accelerating a vehicle from boost (approximately Mach 4.5) to approximately Mach 7. The NAI also has the potential to capture American interest in aerospace technology, while providing needed technical capability for the warfighter.

A second transformational technology thrust is Energy and Power Technologies. This thrust involves a coordinated investment across the Department to improve power from systems such as microbatteries for soldiers to massive generators for ships. This initiative is investing in technology that could develop batteries with over five times the energy density, fuel cells that are reliable and safe to use in the battlefield, and capacitors that will decrease size needed to store electricity on ships by a factor of 5-10. The initiative is also focusing on “electric” weapon systems such as high power microwaves, lasers, and electromagnetic guns that will provide greater options for our forces.

The third cross cutting initiative is Surveillance and Knowledge Systems (SKS). SKS is a broad-umbrella program to develop capabilities to achieve information and decision dominance through integrated Communications, Command, Control, and Computers and Intelligence, Surveillance, and

Reconnaissance systems (C4ISR). This initiative seeks to bring about major improvement in sensing, communications and networks, knowledge management, and information security to provide superior decisions on shorter time scales than can be made by potential adversaries. Instead of treating each component separately, SKS has the goals of detecting objects in the area of interest (battlespace) through enriching sensors (optical, radar, acoustic, etc); moving the sensed information to present a coordinated picture of the area of interest; using advanced software to make sense of the information; and presenting this knowledge-based result to assist decisions. By using such an integrated approach, the goal is to allow our forces to react faster and smarter than potential adversaries. The initiative should continue to make the vision of network centric warfare a reality.

Enhance Technology Transition

The relevance of research and engineering efforts hinges on the rapid and effective transition of technology to fielded military forces. In partnership with Congress, we established the Quick Reaction Special Projects (QRSP) program, a flexible continuum of technology transition projects that moves products from the Department to the warfighter quickly. The QRSP includes three technology transition projects: the Quick Reaction Fund; the Technology Transition Initiative (TTI); and the Defense Acquisition Challenge Program (DACP). We leverage the Foreign Comparative Test and the Advanced Concept Technology Demonstration

(ACTD) programs to get the best technologies to the joint warfighters in the shortest time possible.

The Quick Reaction Fund (QRF) meets critical warfighter technology requirements that cannot wait for the traditional two year budget cycle. In FY03 we started six projects, three of which have already deployed to support the war on terrorism in Iraq. We have continued rapid technology insertion from the QRF in FY04. This year, funds were provided for the development of a HMMWV mounted wideband microwave based integration system, called PING, to identify concealed weapons. PING has seen positive results in testing. We also used the funds to demonstrate and test ordnance disposal robots, a capability that has saved lives in Iraq.

Last year we initiated the congressionally-directed Technology Transition Initiative (TTI). TTI provides bridge funding for critical technologies that have recently been evaluated for procurement and enables the Services to speed transition to acquisition programs of record. For example, the water purification pen provides warfighters the ability to purify water in unsanitary conditions. It is now available via the GSA Catalog for purchase from all government agencies. This technology transition was accomplished 18-24 months earlier than the normal acquisition process due to our ability to use TTI, and is being used today by warfighters in Iraq and Afghanistan.

Under the direction of our new Comparative Test Office, the Defense Acquisition Challenge (DAC) program and the Foreign Comparative Testing

(FCT) program inject the very best domestic and foreign technologies into existing capabilities, supporting the Department's spiral development strategy. Through the FCT program, we significantly enhanced the Army's Automatic Chemical Agent Detector Alarm (ACADA). The advanced power supply for this sensitive Chem/Bio detector was obtained from the United Kingdom. The power supply improved unit reliability and significantly reduced equipment weight. Over 22,000 of these detectors are deployed worldwide, protecting forces in Afghanistan, Iraq, and even those of us sitting here in the Capitol region.

In the DAC program, we selected 23 proposals from nearly 300 submittals. One example is an especially promising technology which provides hemoglobin substitute for blood transfusions project known as the Restore Effective Survival in Shock (RESUS). We believe RESUS has the potential to dramatically increase the survivability of our troops. This remarkable polymerized hemoglobin is compatible with all blood types, can be stored for 3 years without refrigeration, and is pathogen free. The support Congress has provided to the QRSP program has enabled execution year flexibility to support new needs of the operational force and new technology opportunities.

The Advanced Concept Technology Demonstration (ACTD) program is our flagship technology transition process for matching innovative technologies with joint and coalition operational concepts. This program earned a reputation for anticipating emergent threats and fielding transformational capabilities for Combatant Commands. Sometimes referred to as our "try before you buy"

approach, ACTDs look for the 80% solution to jump start the acquisition process through fielded, hands-on demonstrations. For example, we successfully demonstrated the high-speed lift capability of the Theater Support Vessel ACTD in real-world operations during OIF. Our Language and Speech Translator ACTD enabled us to quickly decipher confiscated documents which led to the location of several high profile Iraqi leaders. These and many other successful ACTDs draw the thanks of warriors engaged in OEF and OIF.

Address the National Security Science and Engineering Workforce

The third DDR&E goal is a broad national strategic issue involving the availability of scientists and engineers who are American citizens. Warfighting capabilities demonstrated on the battlefield since Operation Desert Storm are derived from the Department's technological capabilities developed within DoD research and development (R&D) laboratories, industry, and universities. These capabilities were built on the intellectual capital and competitiveness of the scientists and engineers, educated years earlier, who conceived the scientific ideas and engineering applications that became our present warfighting capabilities. We produced stealth technology, the global positioning system, night vision devices, precision weapons and pioneered the development of the internet through the "ARPANET" with the U.S. technical talent educated primarily in the 1960s and 1970s.

We now see warnings that America's advantage in defense-related scientific and engineering intellectual capital is eroding. The significance of this problem is outlined in the Report of the U.S. Commission on National Security in the 21st Century (Hart-Rudman Report) which stated: "Second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous than a failure to manage properly science, technology, and education for the common good over the next quarter of a century". The decreasing numbers of experienced scientists and engineers in the DoD draws from the available pool of high quality scientists and engineers who are U.S. citizens. The numbers of U.S. citizens in graduate schools studying defense related disciplines has decreased in the last decade according to National Science Foundation, National Science Board and National Academy of Sciences reports.

To begin to address these issues, over the past year the Department has increased the individual stipend and total number of National Defense Graduate Fellowships. In addition, we are continuing to examine our future workforce needs to ensure that we will have the best technical talent available for national security R&D.

Expand Outreach to the Combatant Commands and Intelligence Community

We are enhancing the connectivity between the Combatant Commands and the Intelligence Community and the DoD technology community. Over the past year, we have revised our S&T strategic planning approach, leading to a wholly

revised “Joint Warfighting Science and Technology Plan” that was cooperatively developed by the Combatant Commands, Joint Staff, and S&T Executives. We have also initiated several technology net assessments in partnership with the intelligence community to reduce the possibility of technology surprise in the future and better inform our S&T investment plans.

Accelerate Support to the War on Terrorism

Maturing and fielding technology continues to be our most important near term goal. Within a week of the attacks of September 11, 2001, the Department established the DoD Combating Terrorism Technology Task Force (CTTTF). This Task Force is still on-going, and is in its third major phase. The first phase accelerated technologies for homeland defense and the initial war in Afghanistan; the second phase delivered technology in support of the war in Afghanistan and Iraq. The current third phase is identifying and accelerating technology for deployed force protection. The Task Force is comprised of S&T senior leaders from all DoD Components, flag-level officers from the Joint Staff and selected Combatant Commands, the Central Intelligence Agency, the Department of Energy, and now the Department of Homeland Security. The CTTTF continues to provide a valuable forum to examine the technology alternatives to address immediate operational needs to support the GWOT.

Phase I in the Fall of 2001, resulted in such capabilities as the BLU-118B (thermobaric weapon) with applications to caves and tunnels, a backscatter gamma

ray system to inspect cargo in closed containers, and a nuclear quadrupole resonance system that can detect small quantities of explosives. We also sponsored a rapid study to determine radiation levels needed to kill anthrax spores—knowledge that supported the detailed response to the anthrax attacks of 2001.

In Phase II, the CTTTF reacted to a broad set of operational issues that emerged leading up to and including support for Operation Iraqi Freedom. Technologies were accelerated to fielding for several specialized, unique weapons which focused on specific, anticipated threats. Notable among these was the AGM-114N Thermobaric Hellfire which built upon previous efforts supported by the CTTTF in development of thermobaric weapons which were employed in Afghanistan in Operation Enduring Freedom. The CTTTF sponsored the Passive Attack Weapon to rapidly transition an Advanced Technology Development prototype program to production, fielding 230 weapons in 160 days. This effort included weapons production, development of operational tactics, delivery aircraft certification, field testing, certification, and deployment.

In the current Phase III, the Task Force's focus has been directed at Operation Iraqi Freedom force protection capabilities. While specific details on programs are classified, actions are underway to mitigate effects stemming from terrorist use of weapons such as Improvised Explosive Devices (IEDs), mortars, and rocket propelled grenades. Key focus is on detection and defeat of IEDs and on predictive analysis capabilities.

The CTTTF will continue to serve as a conduit for matching the identification of new challenges in the GWOT with available technologies developed both by the DoD, through commercial sources, and with other Departments of the Federal Government. A key element of this effort is the need to have in place a process and funding to quickly identify, and then field, in militarily significant numbers, a series of new capabilities. The nature of the current operations indicates that the opponents, while often using low technology weapons, are very adaptive. We need the processes and flexibilities to anticipate, respond to, predict, and mitigate their adaptation cycles if we are to be successful in this long-term struggle.

Conclusion

The sustained investment in science and technology over the past decades has enabled the Department's development of needed new capabilities. To enable transformation, this investment should continue. Technology development results are largely achieved through long-term, stable investment in R&D. Not every technology needs to be transitioned immediately, but a strong R&D base is critical. Although, the FY05 President's Budget Request does focus on transformation technologies, it also maintains the flexibility to respond to near term operational requirements and technology opportunities. The balance has been, and remains important.

In closing, the S&T program and the objective of Secretary Rumsfeld to provide transformational capabilities to the DoD are absolutely intertwined. I have mentioned only a few examples within the DoD S&T program. I believe the DoD successes in technology and transformation are significant, and I appreciate the opportunity to come before you today to tell you about them. We appreciate the support the Senate Armed Services Committee has provided for the Department's S&T program. Thank you.