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TESTIMONY OF

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**BEFORE THE SUBCOMMITTEE ON
EMERGING THREATS AND CAPABILITIES
OF THE
SENATE ARMED SERVICES COMMITTEE**

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Mr. Chairman and distinguished members of this Subcommittee, I appreciate the opportunity to discuss the Department of Defense's FY 2006 science and technology (S&T) program. The Secretary of Defense remains committed to transforming the military with a robust science and technology program. Our military capabilities must become more rapidly deployable, sustainable, and be able to operate across the full spectrum of operations – from peace to war and transition back to peace again. Our S&T efforts should support transformation by providing the ability to strike with greater speed, agility, lethality and precision while maintaining increased global knowledge. We remain excited about near-term and long-term transformational capabilities and possibilities that continue to be made possible by Defense S&T.

As the Director of Defense Research and Engineering, serving in the role of the Department's Chief Technology Officer, I want to highlight a few representative accomplishments within the S&T program and our planned efforts for FY 2006 within the framework of our five established priorities which are:

- Integrate DoD S&T and focus on transformation
- Enhance technology transition
- Expand outreach to the Combatant Commands and the Intelligence Community
- Accelerate support to the Global War on Terrorism (GWOT)
- Strengthen the national security science and engineering workforce

These priorities continue to help shape the S&T program. DoD S&T is an enabler for transformational capabilities for our future force and is providing near-term capabilities for the Global War on Terrorism.

Amid the significant budget pressures from ongoing operations in Iraq and Afghanistan, the Department has maintained its commitment to S&T. Our FY 2006 DoD S&T President’s Budget request of \$10.52 billion is slightly less than \$10.55 billion we requested last year. The FY 2006 President’s Budget request is 28% higher than the FY 2001 request of \$7.5 billion.

President Budget Request (Then Year \$ Millions)	FY 01	FY 05	FY 06
Army	\$1,294	\$1,783	\$1,735
Navy/Marine Corps	\$1,463	\$1,718	\$1,776
Air Force	\$1,291	\$1,919	\$1,980
Defense-Wide	\$3,494	\$5,130	\$5,031
Total DoD S&T	\$7,543	\$10,550	\$10,522

The FY 2006 S&T budget request supports transformation and reflects the strategic factors of increased pressures and threats from asymmetric and terrorist activity and increased pace and globalization of technology development. The Department has increased the investment in chemical and biological defense S&T by nearly \$200M in this year’s request. We have increased funding for sensors, surveillance, radio frequency and electronic warfare systems by nearly \$100M. We have also increased funding for combating terrorism technology activity, which could lead to new capabilities for force protection, Improvised Explosive Device (IED) mitigation, etc. We are increasing our investment in hypersonic and propulsion technologies, network-based S&T, and Quick

Reaction Special Projects. Some programs that reflect a decrease in funding from FY 2005 are Ballistic Missile Defense Advanced Technology Development (generation beyond the emerging generation), traditional Army combat vehicles, and classified programs. Taken as a whole, the DoD S&T program is reshaping to meet the needs of the DoD.

Integrate DoD S&T and Focus on Transformation

We have expanded the inputs to our S&T decision-making process to include capturing more information about global S&T activity, increased formal and informal inputs from the Combatant Commands (COCOMs), more interaction with the interagency processes, and an expanded comprehensive review process with the Services and Defense Agencies. These changes help support the Department's strategic planning process and better integrate and align our S&T investments. Mechanisms for assessments of the inputs are being aided by enhancing the Defense Technical Information Center's (DTIC) role in electronic data collection and analysis.

The rate of change and development of S&T on a global basis will continue to increase into the 21st century. Therefore, a key component of our strategy is to gain the best possible insight into technology development throughout the world, and making that information available to all DoD users. The Defense Technical Information Center (DTIC), which has been realigned under the direction of DDR&E, will be the single

repository for global technical information and capabilities with a searchable web portal that will be accessible throughout the Defense Department.

A key element in achieving an optimal S&T investment strategy which responds to national security and joint warfighter needs is a collective understanding of the motivations, requirements, directions, and opportunities of the DoD Component S&T organizations that manage S&T resources. Accordingly, we have modified the S&T review process to a “Comprehensive S&T Review” process to better rationalize the program with strategic direction of the Department, and identify additional gaps or emphasis areas. This new two-year review cycle builds on current processes (e.g. Technology Area Review Assessments, Basic Research reviews, etc.) and will help guide S&T investment decisions for budget and program planning cycles. While the Department is reshaping its strategic planning and investment review process, we have continued to support basic research, on-going technology initiatives, and near-term technology acceleration.

As a foundation for our S&T capability, the Department’s Basic Research program provides new knowledge and understanding in areas that underpin national defense. Applying that knowledge and understanding yields advanced technologies that enable us to increase military system capabilities; makes those systems easier and less expensive to manufacture, operate and maintain; and improves the way we carry out our missions.

The Basic Research program is focused on areas with the highest potential for long-term military benefit. Our investment complements other Federal programs and is the major source of funding in selected disciplines critical to defense, such as electrical

and mechanical engineering, where DoD provides more than 70 percent of the overall Federal investment in university basic research.

Basic research performed in universities and government laboratories is also important because it is an integral part of the education and training of scientists and engineers for the nation's defense workforce. We are bringing forward a legislative proposal in this area to expand the technical workforce available to the Department.

We have sustained funding for three cross-cutting initiatives: National Aerospace Initiative; Energy and Power Technologies; and Surveillance and Knowledge Systems. These initiatives address the development of critical DoD transformational technologies and continue to make technical progress.

The National Aerospace Initiative (NAI) is an integrated S&T effort for high-speed and hypersonic systems, space access systems, and space payloads. The National Research Council completed an "Evaluation of National Aerospace Initiative" in 2004 which supported the direction of NAI. Our progress in hypersonics was demonstrated in 2004 when the NASA X-43A, which was supported by DoD, completed two successful flight tests at speeds of Mach 7 and Mach 10. In January 2005, we conducted a successful separation flight test of HyFLY, a high speed system designed to fly above Mach 6. The FY 2006 budget request maintains support of the foundational NAI technologies in the Army, Navy, Air Force, and DARPA. With the planned funding, three stepping stone projects, HyFLY, Scramjet Engine Demonstrator (SED), and Revolutionary Approach to Time-Critical Long Range Strike (RATTLRS) will have at least one flight each by 2009. A "Space S&T Strategy" was developed in 2004 under

sponsorship of DDR&E and the DoD Executive Agent for Space, and submitted to Congress. There have been several important accomplishments recently in space access propulsion technology under the DoD-NASA-Industry Integrated High Payoff Rocket Propulsion Technology (IHRPT) program. The first advanced U.S. liquid rocket engine technology demonstrator since the Space Shuttle Main Engine (SSME), the Integrated Powerhead Demonstrator, has begun full-up engine testing at NASA Stennis Space Center. The successful “hot-fire” ignition in February 2005 is the culmination of 10 years of joint development toward a fully reusable engine. Additionally, the DoD is developing electronic propulsion for satellites, which could provide a significant increase in on-orbit propulsion capability relative to today’s systems.

The Energy and Power Technologies initiative continues to advance the goal to transform the electric components of our weapons systems and improve military logistics. The \$260M FY2006 DoD investment addresses several topics. The demands for primary and auxiliary power, as well as the electric power density for our air, ground and sea platforms are increasing; which in turn increases the demands for thermal management also addressed in the initiative. We are testing megawatt-size superconducting motors and generators that take a fraction of the space of conventional machines. Rechargeable Lithium-ion batteries and state-of-charge battery life indicators for soldier system power are in production. We are developing a new hybrid fuel cell/battery power system for the individual soldier weighing less than half of our current systems.

The Surveillance and Knowledge Systems (SKS) initiative comprises a broad set of Command, Control, Communications, Computers, Intelligence, Surveillance, and

Reconnaissance (C4ISR) programs intended to give our forces dominant battlespace awareness and understanding. The investment is about \$1B per year, with 50% attributable directly to SKS objectives and the other half leveraged from other development programs that contribute to SKS capability. During the past year we made considerable progress toward the objectives identified in the SKS roadmap with a strong focus on supporting current operations in Iraq and the technical objectives enabling “command and control on the move.” During 2004 we successfully prototyped a 20 node mobile, ad-hoc network in a realistic C4ISR demonstration, moving us toward the capability needed for the Department’s vision of network-centric operations. Through strong Service and DARPA collaboration, we supported operations in Iraq by transitioning acoustic sensing technology from the laboratory to the field to counter the mortar and sniper threats. We also provided forces in Iraq with Command Post of the Future (CPOF) technology allowing commanders to maintain greater command and control in all situations.

The Quick Reaction Special Projects program remains an important tool in addressing the reality of a rapidly changing world. Under the Quick Reaction Fund, projects must be completed in a year. Over the past year, we have developed and proven technologies through the Quick Reaction Fund that range from demonstrating an affordable, more capable seeker to a novel, affordable dry lubricant that can be used on small arms weapons, which will provide improved capability to deployed troops with less logistics and maintenance required.

Enhance Technology Transition

We have enhanced technology transition from ideas to fielded capabilities through continued collaboration with S&T, Acquisition, Logistics, and user communities. In addition, we have expanded the use of Technology Maturity Assessments to link S&T projects with acquisition programs, ensuring an avenue for transition and support to system development efforts.

The Advanced Concept Technology Demonstration (ACTD) program continues to match innovative joint and coalition technologies with warfighter needs in operational demonstrations. Key aspects of this program are the operational concepts developed and the residual “leave behind” capabilities that are provided, allowing the warfighter to “touch and feel” the technology that is being considered before expensive acquisition decisions are made. A number of products from the ACTD program are being demonstrated and deployed in Iraq, Afghanistan and other operational theaters. For example, Special Operations Command (SOCOM) was the operational sponsor of the FY 2002 Pathfinder ACTD. This ACTD provides networked communications, real-time urban reconnaissance and targeting for precision weapons within a hostile environment from an unmanned aerial vehicle (UAV). As a result of this successful ACTD, SOCOM has fielded approximately 60 Raven UAVs into combat theaters. The Army has also subsequently deployed several hundred Ravens in response to an “Urgent Needs Statement.”

Beginning in FY 2006, we have proposed a Joint Capability Technology Demonstration (JCTD), realigning a portion of the ACTD effort into a new business

process that complements the Department's increased focus on meeting the needs of the joint and coalition forces. The JCTD business model would continue to focus on the most critical needs of the Combatant Commander but move even faster than the current ACTD program with final demonstrations by the end of the third year. JCTDs would provide more of the resources up-front, and would also provide non-S&T resources at the end of a project (Budget Activity 4 and 5) to help address the transition issues. Using this approach, Military Services' budget process should be better phased with successfully demonstrated capabilities.

The Technology Transition Initiative (TTI) Program and Defense Acquisition Challenge Program continue to expand transition mechanisms. The TTI program jump-starts funding for technologies developed in defense S&T programs. For example, the National Geospatial-Intelligence Agency Semantic Web Network has transitioned to support Marine Expeditionary Forces in Iraq. The system provides a single point of access to multiple data sources, distributed search capability to support operational planning, and is interoperable with other intelligence analysis system tools. The system is being used by approximately 100 intelligence analysts in Iraq, and saves approximately 4-5 hours of manual activity per query.

The Defense Acquisition Challenge (DAC) Program is an "on ramp" for domestic companies to inject new technologies into existing programs of record while supporting the DoD's spiral development strategy. For instance, the DAC program funded a project that replaces traditional fire barrier materials with a flexible aerogel thermal insulating blanket for use on the DD(X) and other platforms. Aerogel has demonstrated many

superior characteristics over traditional insulating materials, including lighter weight, better blast and heat resistance as well as lower costs.

The transition of promising technology also occurs through our domestic production program, the Defense Production Act, Title III. Title III authority was used to establish a production capability for eyewear that provides protection from lasers on the battlefield. A domestic manufacturer had extensive coatings experience in this area but only a laboratory-scale production capability. Under the Title III project, a production process to maximize coating performance and minimize cycle time and cost was funded. The result was an all-new, ISO-9000 certified production facility with a capacity of 32,000 Laser Eye Protection (LEP) spectacle/goggle pairs per year.

Another important tool for technology transition includes Technology Readiness Assessments (TRA) which serves as a valuable tool for assessing the maturity of critical technologies for major acquisition systems. Some of the major Technology Readiness Assessments completed during 2004 are the Littoral Combat Ship (LCS); the CVN 21 Next Generation Aircraft Carrier, the Aerial Common Sensor, the Global Command and Control System-Joint (GCCS-J), and the Distributed Joint Command and Control (DJC2).

We also enhanced transition of technologies initiated through the DoD Combating Terrorism Technology Task Force (CTTTF). For instance, post 9/11, one of the novel technologies identified and supported by the Task Force, thermobaric explosives, was accelerated, tested, certified, and fielded in 90 days through a collaborative effort between the Defense Threat Reduction Agency (DTRA), Air Force, Navy, Department of Energy, and industry. Using the FY 2002 Quick Reaction Munitions Funds, the CTTTF

built upon this initial investment in thermobaric explosives in response to a requirement from the Marine Corps for an improved Hellfire warhead.

DTRA worked in coordination with the Army and Navy, on the AGM-114N Hellfire development effort. Several candidate thermobaric warhead fills were tested and assessed during final development. The chemical mix selected is substantially more effective in attacks against enclosed structures than the current Hellfire blast and fragment variants. The demonstration program developed weapons in approximately one year with an initial delivery of approximately 60 residual assets. Multiple missiles were deployed and successfully employed in the opening of Operation Iraqi Freedom. Since that time, the Department has invested additional funds in the AGM-114N and will deliver over 100 units to USMC and SOCOM by June 2005. The AGM-114N is now transitioning to production with a significant increase in fielded units planned over the next two years.

Expand Outreach to the Combatant Commands and the Intelligence Community

We have expanded outreach to the Combatant Commands (COCOMs) and the Intelligence Community. We work closely with the COCOMs through the Joint Staff Joint Functional Capability Boards to develop the Joint Warfighting S&T Plan (JWSTP), ensuring that our S&T plans support operational requirements and are developed in conjunction with our warfighters.

We continue to interact and collaborate with federal, state and local governments in areas that affect both military and civilian mission areas. One important project that the Department has funded with other partners (e.g. Department of Homeland Security) is

called the Homeland Security/Homeland Defense Command and Control ACTD. This ACTD links DoD capabilities (e.g. United States Northern Command) with civilian authorities to address important communication and common operational picture challenges for federal, state and local communities.

Over the past two years, we have conducted net assessments to address global progress in technology areas such as nanotechnology, energetic materials, and directed energy. We will continue to refine the net assessment process and expand it to other technology areas. DDR&E is a formal member of the S&T Intelligence Committee, a National Intelligence Council Working Group, with representation from across the IC.

Accelerate Support to the Global War on Terrorism (GWOT)

The Combating Terrorism Technology Task Force (CTTTF) continues to coordinate potential solutions to new challenges in the GWOT with the technology communities in the DoD, academia, industry, and other departments of the federal government. The Task Force is currently in its third major phase of operation. The first phase accelerated technologies for homeland defense and the war in Afghanistan, in late 2001. Phase II delivered technology in support of Operation Enduring Freedom and Operation Iraqi Freedom. Technologies were accelerated to field several specialized, unique weapons which focused on specific threats, such as the AGM-114N Thermobaric Hellfire discussed previously and other support to our fighting forces.

The current, third phase of the CTTTF is focusing on technology for force protection and counter-insurgency operations in the Global War on Terrorism,

particularly, Operation Iraqi Freedom. While many specific details on programs are classified, actions are underway to mitigate effects stemming from terrorist use of weapons such as IEDs, mortars, and rocket propelled grenades. A key focus is on detection and defeat of IEDs; predictive analysis capabilities; intelligence; surveillance and reconnaissance; and countering the IED kill chain.

The CTTTF has also energized the need to rapidly evaluate technologies within a representative environment. Consequently, the CTTTF established a research, development, test and evaluation site at the Yuma Proving Grounds in Yuma, Arizona. This site consists of over ten miles of roads, road interchanges, buildings and other features found within a representative rural, desert climate. The purpose of the test site is to evaluate new technologies and provide recommendations on the potential of the system or technologies under evaluation. The test site has been a valuable resource for gathering data and evaluating new prototypes developed by the scientific and engineering community, while enabling the warfighter to assess military utility and maturity.

Promising technologies identified are funded through Rapid Reaction Fund (RRF) within the Quick Reaction Special Projects Program. The RRF continues to be a vital resource to develop and rapidly transition many new technologies for GWOT into the hands of warfighters, thereby saving lives. We appreciate your continued support in providing the flexibility to fund emergent technologies for our warfighter.

Strengthen the National Security Science and Engineering Workforce

The future of the U.S. national security science and engineering (S&E) workforce is a growing and increasing concern. Since 1999 more than 12 major studies, including a 2002 report from the President's Council of Advisors on Science and Technology, warn of the deteriorating situation within the U.S. S&E workforce. The warnings cite several trends that continue to erode domestic S&E capability to a point where the U.S. may no longer be the primary innovator in several areas crucial to national security. One trend is the declining U.S. citizen S&E workforce. The Partnership for Public Service recently reported that 60% of federal employees are over 45 years old which indicate a significant number of our workforce with valuable skills will soon be eligible for retirement, many of whom benefited from the National Defense Education Act of 1958. The declining supply of U.S. citizens awarded degrees in defense-related S&E fields, coupled with recent projections of domestic growth in demand for S&E's by 2010, suggests that the DoD and other federal agencies with national security functions will face increased competition with domestic and global commercial interests for top-of-their class, security clearance eligible scientists and engineers. During 2004, the Department was engaged in several activities to help understand and characterize the national security workforce situation both within the Department and outside, to include interagency forums (e.g. National Security R&D Subcommittee of the National Science and Technology Council), industry (e.g. National Defense Industrial Association and Aerospace Industry

Association studies and workshops), and national “competitiveness” forums (e.g. National Innovation Initiative).

We have enhanced efforts to address this situation and develop an outstanding workforce with 21st century critical defense skills. These new S&E’s will be needed to meet tomorrow’s science and technology challenges. Last year Congress provided the Science, Mathematics and Research for Transformation (SMART) legislation that authorized the Department to carry out a scholarship program with an employment payback component. This fall about 25 promising students will enter the two-year program. To ensure we maintain an effective workforce, we propose to expand the SMART Pilot and built a permanent program presented in the budget request as a legislative proposal titled “SMART – National Defense Education Act (NDEA) Phase 1” (or the National Defense Education Program). The proposal would provide additional authorities that would improve our ability to develop, recruit, and retain individuals who will be critical in fulfilling the Department’s national security mission. We look forward to your continued support in this critical, foundational area for national security.

Conclusion

Our S&T investment is focused on technology capabilities to enable the warfighter to meet the challenges of today, while preparing them to meet the challenges of the future. The budget request supports the on-going transformation of the DoD while simultaneously ensuring we do all we can to provide potential solutions to on-going, world challenges.

We have successfully transitioned technologies to support Global War on Terrorism and we continue to identify opportunities to minimize research and development cycle-time and enhance technology transition. We are expanding our interaction with the Combatant Commanders and the intelligence community; and expanding our global knowledge base to invest in the right priorities and programs. We recognize that our future technological advantage depends on the quality of our scientists, mathematicians, and engineers, and thus we are building our workforce through the proposed National Defense Education Act.

In closing, Mr. Chairman, I sincerely thank you and the committee for this opportunity to outline our successes and to review our plans for the future. We appreciate your strong support of our S&T program, and I look forward to working with you as we transform our plans into actions.