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SUBJECT: Fiscal Year 2006 Air Force Science and Technology

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INTRODUCTION

Mr. Chairman, Members of the Subcommittee, and Staff, I very much appreciate the opportunity to provide testimony on the Fiscal Year 2006 Air Force Science and Technology (S&T) Program. The United States Air Force continues to transform to a capabilities-focused Expeditionary Air and Space Force based on the Concepts of Operations for each of the seven major tasks the Air Force must be capable of accomplishing to support our combatant commanders. The Air Force is focused on delivering the ability to effectively and affordably train, organize, and equip our military forces. The Air Force Integration Capabilities Review and Risk Assessment (I-CRRA) master planning process encompasses the effects and capabilities required by the seven Concepts of Operations. This master planning process is key to ensuring we have a high correlation between our S&T programs and the warfighting capabilities required by these Concepts of Operations. In fact, in the Fiscal Year 2006 President's Budget (PB) request, the Air Force reprioritized approximately $500 million of its S&T Program to address capability needs identified in the master planning process.

The United States Air Force is committed to defending America by unleashing the power of science and technology. Our S&T Program enables us to achieve our vision of becoming an integrated Air and Space Force capable of rapid and decisive global engagement. The Air Force S&T Program is aggressively pursuing high payoff technologies and is focused on current and future warfighting capabilities to address not only traditional threats, but also the Global War on Terrorism (GWOT). The Air Force is focusing on technologies to meet the capability needs of the combatant commanders. Many of these technologies could be applicable to a number of different joint uses and the Air Force actively pursues joint programs and sharing of technology with the Services, Defense Agencies, Homeland Security, and others.

A broad foundation of basic, applied, and advanced technology S&T investment enables our scientists and engineers the freedom to innovate and is the key to ensuring the Air Force will meet the challenges of tomorrow. The output of this broad base of science investments provides our leadership the opportunities to respond quickly to a rapidly changing world. A key example of this flexibility is our rapid response to the GWOT with technologies to help defend against both traditional and asymmetrical threats. We are able to deal with the uncertainty of tomorrow because of our broad investment in S&T today — an investment geared towards winning decisively, protecting our forces, and minimizing collateral damage at anytime and any place in the world.

S&T BUDGET/SENIOR LEADERSHIP INVOLVEMENT

Fiscal constraints, operational demands, and ongoing peacekeeping operations and conflicts in places such as Afghanistan and Iraq, continue to place a great burden on our people, our already stressed operational systems, and our supporting logistics. However, the Air Force is working to increase S&T funding to ensure we maintain our technology options in support of future warfighting needs. The Air Force Fiscal Year 2006 PB request for S&T is $1.98 billion — this includes $1.4 billion in "core" S&T efforts, which represents an increase of over $60 million or almost 2.3 percent real growth compared to the PB requested amount for similar "core" S&T efforts in Fiscal Year 2005. An additional $77.8 million in Joint Unmanned Combat Air Vehicle or JUCAS funding was added to the S&T Program in Fiscal Year 2006 only.

Of the programs that were transferred to Air Force S&T the year before last, all continue to do well. The University Research Initiative program plus the High Energy Laser programs, which were devolved to the Air Force by the Office of the Secretary of Defense (OSD), continue to receive oversight and policy guidance from OSD, while the Air Force works hard to ensure these programs support the diverse multiple military objectives inherent in joint programs. In addition, the Seismic Research Program for detection of nuclear explosions has been successfully integrated into the core Air Force S&T Program. We continue to work with OSD, the Air Force Technical Applications Center, the Army, and the Department of Energy to ensure the right level of investment in seismic research that will address operational nuclear explosion monitoring needs.

Warfighter and senior Air Force leadership involvement in the planning, programming, and prioritizing of Air Force S&T continues to be a priority. The I-CRRA master planning process, previously mentioned, involves several levels of senior Air Force leadership, including the Secretary and the Chief of Staff of the Air Force plus all the four stars, and promotes a greater understanding within the Air Force of the S&T Program and its link to warfighting capabilities. The Chief, along with the Secretary, the Air Force Service Acquisition Executive, and the Air Force Materiel Command Commander, also participates in a full portfolio review of the S&T Program similar to the former S&T Summits. The Capabilities Program Execution Review continues to provide a forum in which the Commander of each Major Command is afforded a focused look at his portfolio, an opportunity to resolve issues at the system/program level, and insight into the S&T Program. Finally, the Applied Technology Councils (ATCs) continue to bring acquisition product centers, logistics centers, major user commands, and laboratory personnel together to review, discuss, and prioritize S&T efforts.

TRANSFORMATION

The objective of Air Force S&T is to develop technologies for lighter, leaner, and more lethal weapon systems and their support structure through the continuing discovery, exploitation, demonstration, and rapid transition of technology to meet users' operational needs. All of this must be done recognizing that we will, in a number of situations, be operating in a joint and often a coalition environment. The S&T world is usually where new weapon systems begin their development process. This is the ideal time to consider the full life cycle cost savings by considering maintenance, sustainment, and disposal costs. During a conflict, it is not unusual for combat-identified problems or needs to be highlighted and near-term solutions developed — the Battlefield Air Operations (BAO) kit and the robotics Improvised Explosive Device (IED) destruction robotic vehicle are examples. Yet, it is imperative that the S&T process considers the entire life cycle cost of a proposed system from development to disposition.

As the Air Force continues to transform from a Cold War to a post-Cold War Air and Space Force, we must prepare for both traditional and new forms of terrorism to include attacks on our space assets, attacks on our information networks, cruise and ballistic missile attacks on our forces and territory, and attacks by adversaries armed with chemical, biological, radiological, nuclear, or high explosive weapons. To address these emerging possibilities, the Air Force has established a process of transformation to achieve and maintain the advantage through changes in operational concepts, organization, and/or technologies that significantly improve its warfighting capabilities or ability to meet the demands of a changing security environment.

When examining the concept of combat transformation, one must remember transformation is not the result of a one-time improvement or change, but rather a continuum of sustained and determined efforts. It is more than new "show stopping" technology as it includes adapting existing capabilities, using them in new ways, changing the organization structure to increase effectiveness, and changing doctrine and our Concepts of Operations. We are also working to ensure that as we transform we continue to integrate these expanding capabilities with those of the other Services and non-military elements of national power — we must evolve and embrace joint and coalition operations as we transform. Finally, we do not believe that transformation should be achieved at the expense of ongoing operations in support of the Department of Defense strategy of maintaining adequate readiness and infrastructure, conducting critical recapitalization, and attracting quality personnel — to achieve rational transformation, there must be a careful balance between these requirements, which all compete for limited resources.

We work closely with the warfighter to anticipate new operational needs arising from changing national and world security environments and to develop and demonstrate S&T applications to rapidly mitigate traditional and GWOT threats. At almost $2 billion, the Fiscal Year 2006 PB request for Air Force S&T is funded at a level to achieve the distinctive capabilities that support Air Force warfighting needs.

WORKFORCE

The Air Force scientist and engineer (S&E) workforce is another area where senior Air Force leadership involvement has played a pivotal role; and the steps taken to address S&E workforce issues are meeting with great success. The Air Force is generating enough S&Es at present to sustain Air Force needs through its Developmental Education programs and various recruitment and retention initiatives. Our workforce continues to be highly motivated and productive and the fact that approximately 20 percent of our laboratory S&E government workforce is active duty military gives us a direct link to the warfighter, which in turn helps us to focus technology development on warfighting capability needs. The Air Force is committed to continuing to shape its S&E workforce with the vision to enhance excellence and relevance of S&T into the 21st Century and appreciates the support Congress has already provided.

TECHNOLOGY TRANSITION

Our goal is to get technology to the warfighter. There are several ways we measure our effectiveness in obtaining this goal. The Air Force believes that looking at legacy systems is one of the most effective metrics available. While not perfect, it does demonstrate the transition of S&T products into operational warfighting capabilities. An excellent example is the F-35. A number of Air Force S&T developed or sponsored technologies that transitioned to the F-35 can be traced back to S&T investments in previous years. These technologies include efforts such as low-observable materials and airframe structures; advanced two-dimensional, thrust vectoring nozzles; new durable turbine engines; airframe design; and advanced radar.

In the space arena, examples of technologies that have transitioned into space "products" include radiation-hardened electronics; longer life, lighter weight lithium ion batteries; lightweight composite materials; compact, more efficient solar cells; and Hall thrusters. In addition, a number of information-related technologies from the Joint Battlespace Infosphere (JBI) program have transitioned into operational and commercial use. The JBI network centric environment provides the framework to establish basic principles and draft standards for a variety of different applications.

Spiral acquisition allows an opportunity for very rapid technology transfer. A good example is our BAO kit, which Air Force ground controllers use to call in air strikes. Changes in this system were rapidly transitioned into use during Operation Enduring Freedom in

Afghanistan. The BAO kit is one of the Air Force's top priorities and continues being developed in several different acquisition spirals as the different technology areas mature. The technology upgrades to Global Hawk's propulsion and power system are another example of spiral acquisition. Power extraction from the low-pressure turbine will triple the current on-board power capacity, an internal starter generator will provide essential in-flight engine restart capability, and low-temperature fuel additives will decrease operations and maintenance costs associated with current fuel mixtures.

Technology transition into operational use is the ultimate metric for assessing the value of our S&T investment and the warfighting capabilities it provides to the Air Force. As evidenced by our high technology legacy systems, the technology transitioned from S&T into developmental and operational products is extensive and provides confidence that S&T funding is being wisely invested.

WORLD-CLASS RESEARCH

The quality of our program is assessed by the Air Force Scientific Advisory Board (SAB) through yearly reviews. The SAB conducts an in-depth review of half of the S&T Program each year, covering the entire program over a two-year period. Eleven technical areas were identified as world-class research during the last two-year cycle of reviews.

The Directed Energy Directorate's Starfire Optical Range at Kirtland Air Force Base, New Mexico, is leading atmospheric compensation technology development for use in large ground-based telescopes to image satellites and propagate laser beams through the atmosphere. They have just developed a sodium laser system that will allow compensation for a significantly larger portion of the atmosphere along the laser's path. This will enable higher-quality, ground-based observations of space objects and enhanced propagation of laser beams through a turbulent atmosphere. Satellite images obtained by using this technology can provide real-time status information that cannot be obtained in any other manner.

The SAB cited the Information Directorate's cyber operations tools research at Rome Research Site in Rome, New York, as an exemplar laboratory program with a strong vision, leading edge research that anticipated operational needs, and having invented and delivered an impressive array of offensive and defensive cyber operations tools to the warfighter.

The SAB also cited the Information Directorate's research in Advanced Computing Architectures, a program that includes technologies dealing with current problems and technologies of the future. Especially mentioned was the work with the Joint Strike Fighter, Unmanned Air Vehicles (UAVs), and the Joint Tactical Radio System.

Another SAB-rated world-class research program is Directed Energy Bioeffects being worked by our Human Effectiveness Directorate at Brooks City-Base, Texas. Specific research areas include understanding laser effects on humans, radio frequency dosimetry, and the fundamental bioeffects knowledge of lasers. The Materials and Manufacturing Directorate at Wright-Patterson Air Force Base, Ohio, conducts world-class research in probalistic micromechanical modeling of material durability that is based on the physics of failure. Thermo mechanical process modeling of metals is having a significant impact on material standards and process control.

The SAB also rated the Automatic Target Recognition (ATR) work performed by the Sensors Directorate at Wright-Patterson Air Force Base, Ohio, as world-class. ATR enables faster and more accurate detection, identification, and prosecution of time-critical targets. We are developing ATR tools to better detect targets in urban and obscured environments, as well as to change detection algorithms to aid in the detection of improvised explosive devices or IEDs. By fusing detection and cueing tools with signature databases and advanced signature modeling we continue to shorten the "kill chain."

The Space Vehicles Directorate's weather research at Hanscom Air Force Base, Massachusetts, continues to be a SAB-rated world-class technology development program. The weather modeling and simulation capability undergoes frequent spiral upgrades to specify and forecast space weather from the Sun to the ionosphere.

Also, while not specifically identified by the SAB, the Air Force has a significant investment in various aspects of nanotechnology. Scientific breakthroughs and technology advances in the past few years have demonstrated the large potential of nanotechnology to address a number of different Air Force applications. Attributes, such as high strength, could result in lighter and faster air vehicles and could enable miniature satellites. Nanotechnology could also make a significant contribution to advanced energy and energetic materials.

COMBATING TERRORISM

The Air Force S&T Program has a considerable portfolio of technology focused on the GWOT. One prime example is the Elastomeric Coating, which the Air Force developed to protect key buildings and installations from close proximity explosions. This easy-to-apply spray coating is contributing to the safety and protection of deployed troops.

As mentioned earlier, the Air Force continues to provide spiral upgrades to the Air Force Special Tactics Combat Controllers BAO kit. Lighter batteries, hearing protection, and more efficient target designation are some examples of ongoing BAO kit technology enhancements. Another enhancement example is the Battlefield Air Targeting Camera Autonomous Micro-air vehicle (BATCAM). BATCAM replaces the current UAV system in the BAO kit with one that is five times smaller and ten times lighter, yet still provides covert reconnaissance, is simple to operate, inexpensive enough to be expendable, and can provide real-time battle damage assessment. Still another example is the Battlefield Renewable Integrated Tactical Energy System (BRITES). BRITES is designed to replace the various batteries that are currently carried with a system and is 50 percent lighter, but still provides for the same capability. These new BAO kits provide a joint capability that will help save American lives and the lives of innocent civilians. BAO enhancements provide a revolutionary and highly effective way to combat the GWOT threat.

In close coordination with the other Services, the Air Force is utilizing its expertise in metal-infused ceramics to develop a more effective, lightweight armor. This new material was being developed by the Air Force for air vehicle applications. It turns out, however, that the new advanced lightweight metal-infused ceramic armor has additional applications and could be used in body protection armor and has been shown to be effective against shrapnel and multiple small arms shots. Additionally, the metal-infused ceramic armor is cheaper, lighter, and easier to produce than the standard plates.

The Bombot robot provides a joint-Service capability to aggressively destroy explosive devices. The Air Force was selected to develop Bombot because of our expertise in ground vehicle robotics. The effort resulted in the development of a very small reusable robot that has been deployed to Iraq for destruction of IEDs. The robot is a small, off-road remote controlled vehicle equipped with a small explosive charge delivery system. It is remotely controlled and uses either video or feedback or simply line-of-sight radio frequency to find the IED, drop the explosive destruction charge, and move to safety. This small robot weighs 17 pounds and costs about $3,000.

The Air Force continues to leverage its success in man-portable, shoulder-fired missile (MANPADS) countermeasures with the development of the Affordable Laser Infrared countermeasure Survivability System (ALISS). ALISS provides aircrew with a highly effective, threat-adaptable, jamming infrared countermeasure to the proliferating MANPADS threat. Even with its emphasis on affordability, ALISS provides missile launch detection and jamming out to beyond the maximum range of existing MANPADS with few false alarms. Additionally, since ALISS is a pod system it can be retrofitted onto a variety of aircraft platforms, including civilian aircraft.

The Air Force is also developing technology to better prosecute the offensive portion of the GWOT. The Hardened Surface Target Ordnance Package (HardSTOP) is an airdrop munition technology development focused on multi-story targets in urban terrain. HardSTOP is equipped with over fifty mini-penetration charges to allow it to hit targets within multi-story buildings and soft bunker type targets. Additionally, HardSTOP provides low-collateral damage with a precisely selectable explosion diameter of as little as 20 feet.

TRANSFORMATIONAL TECHNOLOGIES

There are many other Air Force technology areas that deserve special mention. Let me highlight just a few examples. Solid state lasers have been around for many years, but we are finally seeing them approach weapons class power levels. These lasers offer great promise as small, efficient, electrically powered systems that can project effects at the speed of light with a magazine that depends only on available power generation. The Joint High Power Solid State

Laser program is jointly funded by the Air Force, the High Energy Laser Joint Technology Office, and the Army. In the next few months, we should see three competing systems demonstrating close to 25 kilowatts with the potential of good beam quality over relevant shot times. We are also developing and tracking other promising solid state technologies. There are many potential applications for high-powered solid state lasers such as aircraft self-protection, anti-sensor weapons, and tactical weapons on ground, sea, and air platforms. Following these demonstrations, we will evaluate how to best get these transformational technologies to the warfighter.

The Scramjet Engine Demonstrator (SED) is the culmination of our Hypersonics Technology (HyTech) work at Wright-Patterson Air Force Base, Ohio, and is the cornerstone of future hypersonic capabilities, such as destroying time-critical targets and responsive access to space. The objective of the SED program is to demonstrate the viability of a hydrocarbon-fueled scramjet engine through flight and ground test and, as such, is the first-ever flight demonstration of a hydrocarbon-fueled scramjet engine.

In Fiscal Year 2006, the Air Force will continue to research and demonstrate a low collateral damage warhead, allowing a "behind-the-wall" threat prosecution with a highly localized lethal footprint. The warhead case consists of a low-density, wrapped carbon-fiber/epoxy matrix integrated with a steel nose and base. The low-density composite case can survive penetration into a one-foot hardened concrete wall. Upon detonation, the carbon-fiber warhead case disintegrates into small non-lethal fibers with little or no metallic fragments, thus significantly reducing collateral damage to people and structures. The warhead explosive fill is a dense inert metal explosive containing fine tungsten particles to provide a ballasted payload with sufficient penetration mass. The tungsten displaces energetic material so as to reduce the total energetic used. The net results are higher dynamic energy impulse all within a small lethal footprint.

CONCLUSION

In conclusion, the Air Force is fully committed to providing this nation with the advanced air and space technologies required to meet America's national security interests around the world and to ensure we remain on the cutting edge of system performance, flexibility, and affordability. The technological advantage we enjoy today is a legacy of decades of investment in S&T. However, in this post-Cold War world, we cannot afford to rest on our laurels. We are focusing our S&T Program to meet the challenges of a new security environment. The Global War on Terrorism drives a different construct for Air Force S&T and we are focusing our top talent and investing our funding on the many efforts that address GWOT. Air Force Core Competencies in S&T enable solutions to meet these emerging threats. The Air Force S&T Program continues to provide for the discovery, development, demonstration, and timely transition of affordable technologies that keep our Air Force the best in the world.   As an integral part of the Department of Defense's S&T team, we look forward to working with Congress to ensure a strong Air Force S&T Program tailored to achieve our vision of a superior Air and Space Force that can identify and defeat both traditional and GWOT targets.

Mr. Chairman, thank you again, for the opportunity to present testimony, and thank you for your continuing support of the Air Force S&T Program.