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HOUSE ARMED SERVICES COMMITTEE
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INTRODUCTION

Ms. Chairwoman, Members of the Subcommittee, and Staff, I am pleased to have the opportunity to provide testimony on the Fiscal Year 2011 Air Force Science and Technology (S&T) Program.

The United States faces a variety of challenges to our national security and global interests. As an integral member of the Joint team, America's Air Force provides the critical capabilities of Global Vigilance, Global Reach, and Global Power. The current complex and uncertain security environment with which we're faced requires a balance-driven approach to prevail in today's operations and prepare for tomorrow's challenges by identifying and investing in new scientific research and technology development. This balanced approach postures the Air Force to provide an array of capabilities to Combatant Commanders across the spectrum of conflict — from building partnerships to ensuring the readiness of strategic deterrence forces.

AIR FORCE S&T FISCAL YEAR 2011 PRESIDENT'S BUDGET REQUEST

The Air Force Fiscal Year 2011 President's Budget Request for S&T is approximately $2.2 billion, which includes approximately $200 million supporting devolved programs consisting of High Energy Laser efforts and the University Research Initiative. These investments sustain a strong and balanced foundation of basic research, applied research, and advanced technology development to provide demonstrated transition options to support future warfighting capabilities. This year's budget request includes an increase of $12 million, reflecting Air Force leadership's continued support for its S&T Program, even in today's fiscally constrained environment.

Balancing investments to prepare for a wide range of future contingencies is a challenge that involves maintaining military superiority against near-peers with traditional threats, while

addressing terrorists with unconventional weapons and tactics. The Air Force S&T Program continues to address this challenge by shifting investments among a broad portfolio to attain a balance between near-term capability support, sustainability of existing systems, operations requiring more efficient fuel usage, enhanced manufacturing capabilities, and revolutionary technologies that address far-term warfighting needs. The Air Force must continuously strive to effectively and efficiently allocate its S&T resources to provide the warfighter with superior air, space, and cyberspace capabilities and ensure the technological superiority that is a centerpiece of our Air Force heritage.

The Air Force shifted over $100 million of S&T resources from advanced technology development to basic and applied research. This shift supports the Administration's emphasis on scientific research and represents an increase to basic research of approximately eight percent. This increased emphasis on basic research will better support a long-term investment in the development of world class science, technology, engineering, and mathematics (STEM) capabilities for the Department of Defense and the Nation. The Air Force basic research program supports over 1,500 graduate students and 500 post-doctorates, as well as several student education outreach programs that will create the Science and Engineering (S&E) workforce of the future.

AIR FORCE S&T SUPPORTS AIR FORCE STRATEGIC PRIORITIES

The Air Force S&T Program provides the foundation for the majority of the Air Force's following five Strategic Priorities:

- Continue to Strengthen the Nuclear Enterprise
- Partner with the Joint and Coalition Team to Win Today's Fight
- Develop and Care for Airmen and their Families

- Modernize Our Air, Space, and Cyber Inventories, Organizations, and Training
- Recapture Acquisition Excellence

Further, these Strategic Priorities help shape S&T investments along with input from the Capabilities Review and Risk Assessment and a new planning process covering the Air Force core functions that is starting to emerge. The Air Force has established an S&T "tiger team" to capture this new strategic planning process in the Air Force's S&T strategic planning process with an emphasis on integration of advanced technologies to provide new capabilities for the warfighter. The new S&T process will be primarily focused on S&T demonstration efforts and may involve approval and prioritization at the corporate Air Force leadership level.

AIR FORCE S&T INVESTMENT IN FUTURE AIR FORCE CAPABILITIES

The Air Force S&T Program is the building block of the larger modernization enterprise, and is poised to discover, develop, and demonstrate technologies that are sufficiently mature to modernize legacy systems and transition into new system developments. The objective is to develop and demonstrate technologies that are delivered at the right maturity level, at the right insertion date, and with the right performance to meet the needs of the warfighter.

To achieve these S&T objectives requires a healthy and vibrant S&E workforce that can deliver joint warfighting capabilities to address the challenging security environments of the 21st century. The Air Force S&T Program is committed to developing and caring for over 3,100 S&Es. This commitment is reflected in the utilization of various flexibilities afforded the Air Force under the Laboratory Personnel Demonstration Project and other workforce development initiatives. Our Fiscal Year 2011 budget proposal enables us to recruit, develop, mentor, and retain the best and brightest scientists and engineers — a key priority within the S&T Program.

In addition, our scientist and engineer development teams continue to create new leadership development tools and initiatives to vector laboratory scientists and engineers into the appropriate career paths necessary to ensure future Air Force technical leaders for years to come. Workforce initiatives at the Air Force Research Laboratory are also proving successful in increasing mission effectiveness and improving the health and morale of laboratory personnel. These initiatives place great emphasis on the value of our people and maintaining the right mix of highly qualified scientists and engineers.

For the past three years, the Air Force has been leveraging this S&E workforce to re-invigorate systems engineering and development planning, and we continue to develop the tools necessary to assess the maturity of pre-program materiel concepts before they are selected as the preferred solution. The Air Force's Technology Readiness Assessment process has proved to be a highly beneficial tool to ensure a program's technology maturity. To further enhance these benefits, the Air Force is collaborating with the Office of the Secretary of Defense to develop a synergized independent program review and assessment process that integrates multiple technical reviews (e.g., technology, systems engineering, reliability, manufacturing, logistics, and risk) into a single Program Support Review.

In addition, the Air Force has matured a new rapid reaction S&T process to become more responsive to high-priority, near-term warfighter needs. The process involves a quick-look study team being formed to assess the need, conduct a root-cause analysis, and identify potential solutions. Concurrent with warfighter needs, or technology "pull" improvements, the S&T community anticipates capability needs, assesses technological trends, and develops emerging technologies that may "push" innovative or unanticipated capabilities to warfighters. As the pace, assortment, and availability of technological choices occurs more rapidly, the ability to develop and select the most advantageous technologies and transition them effectively and

efficiently has become essential to win today's wars, modernize aging systems, and develop and mature technologies that are available for transition into new system developments.

AIR FORCE S&T SUPPORT OF SERVICE CORE FUNCTIONS

The Air Force S&T Fiscal Year 2011 President's Budget Request supports the following Service core functional areas.

NUCLEAR DETERRENCE

The S&T Program plays a vital role in the continued strengthening of the nuclear enterprise through various investment programs, including nuclear detonation remediation activities, radiation-hardened electronics, threat warning systems, and the Technology for Sustainment of Strategic Systems program. Additionally, the S&E workforce provides extensive intellectual capital in this important area.

AIR SUPERIORITY

New and unprecedented challenges to our Nation's Air Superiority continue to emerge and threaten to remove the technological advantage enjoyed by our Air Force. The Air Force, with the Defense Advanced Research Projects Agency (DARPA), is developing technologies that will culminate in the demonstration of an Electric Laser on a Large Aircraft (ELLA) that is built around DARPA's High Energy Liquid Laser Area Defense System (HELLADS) laser device. After HELLADS development is complete, the Air Force will couple it to a beam control system for a series of ground demonstrations followed by integration of a system module into the forward bomb bay of a B-1B. ELLA will be used to demonstrate the aircraft self-defense capabilities of a high energy electric laser in a practical platform.

A new type of magnetron that may be used to defeat enemy electronics is the result of Air Force funded research and holds the potential for more compact microwave sources with faster

start-up, as well as higher peak and average power. Higher power magnetrons could be utilized to jam and defeat enemy electronics, while higher frequencies have the potential to improve radar resolution and the more compact packaging of the new magnetron may enable airborne applications. In addition, we continue to develop other robust electronic protection technologies and techniques to counter current and advanced electronic attack deception technologies. A countermeasure system with the proactive ability to scan, detect, track, and identify an enemy tracking system has also been demonstrated.

SPACE SUPERIORITY

America's ability to operate effectively across the spectrum of conflict rests heavily on our space capabilities. Developing technologies to assure responsive access to space and the use of space assets remains a top Air Force priority. We continue to develop and demonstrate liquid rocket technologies to support a future reusable booster system. We also continue to address the prevalent space situational awareness challenges presented by the need to be able to detect, track, and identify, as well as provide on-demand, highly detailed characterization of individual space objects and near-real-time, high-fidelity forecasts of space environmental effects.

The S&T Program has been instrumental in developing technologies for the Joint Space Operations Center (JSpOC), which allows space operators to perform space situational awareness activities to protect our use of space assets. JSpOC technologies under development will enable decision makers to rapidly understand activities, threats, conditions, and situations by exploiting information and synchronizing effects across air, space, and cyber domains to gain and maintain mission assurance through a global space situational awareness picture.

Last March, TacSat-3 was launched and we are collaborating with the U.S. Army and other partners to test and prove the capabilities of tactical-mode collection and processing, utilizing the

primary hyperspectral imaging payload. TacSat-3 was designed as the next step in smaller, lighter, lower cost satellites that would be more responsive to the warfighter in the field.

CYBER DOMAIN

Operating within the cyber domain has become an increasingly critical requirement for our networked force. The Air Force is firmly committed to developing the necessary technologies to defend the cyber domain and enable our forces to operate in cyberspace under a wide range of conditions, including contested and degraded environments. Our Fiscal Year 2011 budget request continues to emphasize research, as well as technology development and demonstration in this important Core Function to allow us to grow our cadre of cyber S&E experts to protect and defend information networks.

Our information technology architecture enables an entire universe of command and control and intelligence, surveillance, and reconnaissance (ISR) capabilities that underpin all aspects of Joint operations and are paramount to maintaining our technological superiority and mission assurance in every domain. The S&T Program continues to assist forces in Iraq, Afghanistan, and elsewhere with new and more effective means for rapidly processing, exploiting, and fusing information from a wide array of sources and disseminating this information to operators at the tactical level. Developing improved ways to share information with allied Air Forces is critical to success. We are developing the ability to share classified information across multiple computer networks operating at different security levels.

To be sure, cyber technologies enhance our ability to maintain unprecedented situational awareness at all levels of operations; however, our reliance on them has also created vulnerabilities that we must address and mitigate. We have recently transitioned multiple technologies developed under a Cyber Attack Mitigation Exploitation Laboratory to collaborative partners. Strategies and policies are continually under development to improve cyber defense, resiliency of networks, and

surety of data and communication, so that we will continue to have confidence in cyberspace operations.

GLOBAL PRECISION ATTACK

Enhanced long-range strike capabilities are one means of ensuring our power projection capabilities, thereby, countering growing threats to our forward-deployed forces and bases. Building on insights developed during the Quadrennial Defense Review, the Secretary of Defense has ordered a follow-on study to determine what combination of joint persistent surveillance, electronic warfare, and precision-attack capabilities, including both penetrating platforms and stand off weapons, will best support United States power projection operations over the next two to three decades. Findings from that study will inform decisions that shape the Fiscal Year 2012-17 S&T Program. We are already conducting a comprehensive reassessment in the conventional weapons arena looking at gaps, material solutions, and technology needs across the breadth of operational capabilities to include air superiority, close controlled strike, intra-theater strike, and long-range strike.

The X-51 Scramjet Engine Demonstration project will provide hypersonic propulsion technologies needed for an affordable, fast reaction, stand off weapon or access to space vehicle. The X-51's first flight is planned for this year and will allow us to correlate flight test data with ground test data and modeling and simulation analyses. In support of hypersonic and space access technologies, we continue to emphasize high temperature materials' development and thermal management research. Directed Energy and micro-munitions' technologies will deliver precision effects and will provide warfighters the ability to engage high-value fleeting targets in an urban environment with low-collateral damage. Our development of airborne high-powered microwave systems, capable of knocking out adversary computer and communication networks, is an example of an extremely low-collateral damage, precision attack technology.

RAPID GLOBAL MOBILITY

Global Reach ensures our Joint team can deploy, maneuver, and sustain large forces on a global scale. In Iraq and Afghanistan, Air Force mobility assets are central to sustaining the Joint and Coalition team. On any given day, Air Force C-5s deliver life-saving Mine Resistant Ambush Protected vehicles into theater, C-17s airdrop critical supplies to forward-based ground forces, and C-130s provide tactical airlift to move theater-based personnel and equipment. To manage these diverse mission sets, we are developing and demonstrating technologies that can transition to hardware and software architectures for Air Mobility Command. These technologies can synchronize real-time events, such as route planning, refueling, projected time over country, and diplomatic clearance events. They also can decrease mission disruption, increase effective resource allocation decisions, and reduce airlift replan time.

We are developing novel technologies to assist in prolonging the life expectancy of our aircraft systems and we are also looking at ways to decrease the cost of sustaining these systems. Our strong commitment to composite aircraft structures, materials, and manufacturing techniques has led to potential ways to shorten the development time for the next generation cargo aircraft, as well as improve strength, weight, and mission utility over current legacy aircraft. For example, we replaced an aircraft metallic fuselage with a composite one, reduced weight, went from 3,000 metallic parts to 300 composite parts, and went from 40,000 fasteners to 4,000. We are developing advanced lift technologies to address special operations' need for a highly survivable transport for clandestine infiltration/exfiltration and mobility needs for a theater airlifter that can carry larger vehicles to forward locations.

SPECIAL OPERATIONS

One of the Air Force's five Strategic Priorities is to 'Partner with the Joint and Coalition Team to Win Today's Fight.' The Air Force S&T Program is supporting multiple joint initiatives to

get technologies to the Combatant Commanders faster to 'win today's fight,' including deployable force protection, ISR, lightening the warrior's load, and linguistic, regional, and cultural abilities. We continue to enhance technologies to conduct precise, timely, and effective missions across the full spectrum of special operations to include close air support and air interdiction.

Electrochemical hybrid power technologies have been used to extend the persistence of forward operating units. The Air Force S&T Program has developed and transitioned a fuel cell/battery hybrid power system to the United States Special Operations Command, which can extend the duration of small Remotely Piloted Aircraft (RPA) missions from two hours up to more than nine hours, enabling sustained observation of high valued targets and providing essential ISR information to protect Army, Navy, and Air Force Special Forces. Within the Air Force S&T Program we are also developing technologies to lighten the load and improve agility for Special Operations Forces who often carry up to 170 pounds of separate, non-integrated pieces of equipment for missions. Technologies from the Battlefield Air Operations kit, designed to reduce the load of equipment and increase the mission effectiveness, have led to a wearable information display management system and a hand-held Internet Protocol-capable radio, enhancing information management and decision making, streamlining displays, networking forces with RPAs, weapons, and tactical error, while reducing weight by 35 pounds.

GLOBAL INTEGRATED ISR

Long-dwell RPAs, such as the Predator, Reaper, and other systems, have proven to be invaluable for monitoring activities in contested areas, enhancing situational awareness, protecting our forces, and assisting in targeting enemy fighters. We are exploring ways to enhance the effectiveness of our fleet of ISR aircraft by developing innovative sensor technologies, efficient propulsion systems, support infrastructures, and operating concepts to include novel technologies to process, exploit, and disseminate multi-intelligence data. This year, we began evaluating a rapid response RPA package supporting force protection of Central Command forward operating bases.

The RPA package contains a day/night multi-spectral imaging sensor and a fully autonomous operating capability for launch and recovery, particularly useful in route clearance operations.

Globally integrating our ISR capabilities requires an increased focus on joint collaborations, which we continue to emphasize. Our Global ISR activities also involve investigating methods to integrate multi-sensor biometrics with dynamic human modeling to find, fix, track, and identify human subjects anywhere, at any time. Significant progress has been made on continuous, real-time, 24/7 situational awareness in all weather for tracking, fingerprinting, and identification of vehicles in an urban environment, as well as the continuous tracking of dismounts. Combining our progress in global air, space, and cyber ISR technologies and precision weapons, we are integrating tracking into the equation — both forward tracking and the ability for the warfighter to track backwards and perform forensic analysis on any event. We continue to emphasize persistent sensing technologies through a layered and flexible sensing architecture, and on developing new research to detect and track moving targets on the ground. One jointly funded effort will integrate ground moving target indicator technology onto the Joint Improvised Explosive Device Defeat Organization-funded Blue Devil system scheduled for deployment to Afghanistan in summer 2010. This system will detect and track vehicles, and later dismounted personnel, over a wide area.

COMMAND AND CONTROL

The growing sophistication of electronic warfare methods and techniques dictates that we improve the protection of our communications and data links from degradation and even denial. Many command and control operations rely on space assets to include the ground station infrastructure. We recently demonstrated an advance antenna technology to support the Air Force Satellite Control Network that has an average effective capacity equivalent to four similar size dish antennas with practically no maintenance down time. In support of Special Operations Forces, we recently transitioned an X-band satellite communications terminal that is a lightweight backpack unit, providing global reach to the tactical edge warfighter.

In addition, we are investigating wide bandwidth, multi-user space communication options that include lasers, advanced radio frequency, and reconfigurable communication technologies. Laser communications are not subject to spectrum allocation issues and will provide a capability that is robust against jamming and interception. In the RPA arena, we are exploring concepts for long-haul communications relay systems, allowing simultaneous, cooperative command and control of multiple RPAs. With the growing RPA population, we have been working with the Federal Aviation Administration to develop technologies to operate our systems safely in a demanding airspace through autonomous detection and avoidance of neighboring aircraft.

PERSONNEL RECOVERY

Personnel Recovery remains an imperative, fulfilling our promise to never leave an American behind. Highly skilled aeromedical transport teams swiftly evacuate combat casualties, ensuring our wounded warriors receive the best possible medical care. The S&T Program recently completed the development of a portable electronic power supply to address the problem of heavy and cumbersome power converters used to power medical equipment on aircraft. We reduced the weight and size of a previous 80-pound, aircraft-tethered unit into a small, lightweight, portable, 34-pound unit. The new unit also has zero emissions, fewer cables, and power independent of the aircraft, allowing the unit to travel wherever the patient goes.

BUILDING PARTNERSHIPS

The Air Force continues to seek opportunities to develop our partnerships around the world, and to enhance our long-term capabilities through security cooperation. The Air Force S&T community is very active in building partnerships with our coalition allies. We established a partnering agreement with the German Ministry of Defense in the area of conventional munitions to investigate high explosive sensitivities under high shock conditions, such as those induced as weapons penetrate hard targets. We are collaborating with Australian researchers in conducting

leading-edge research in next generation over-the-horizon radar and hypersonics, and the final demonstration of a six-year agreement with the United Kingdom on high cycle fatigue in our turbine engines is scheduled for this year. New tools and technologies from this program have nearly eliminated Class A mishaps attributed to high cycle fatigue. With these safety and other technologies being applied to all future turbine engines, total propulsion maintenance costs could be reduced by 50 percent.

We continue to adapt existing language programs and policies to develop the intellectual capital necessary to meet the challenges of operating in a changing and complex environment. We are looking at the foundational elements associated with computational and modeling approaches to study behavior of groups and communities with an eye towards understanding the interactions between demographic groups — both to support technology developments for enhanced cooperation, such as operational decision making with coalition partners, and to explain and predict outcomes between competing factions within geographic regions. The goal of our research and technology development is to improve the Air Force's operations with our joint and coalition partners, and better understand enemy intentions and objectives.

AGILE COMBAT SUPPORT

Underpinning all Air Force Core Functions are the capabilities and technologies included in Agile Combat Support – these efforts affect the entire Air Force cutting across activities to include energy, manufacturing capabilities, and our industrial base, as well as the previously discussed development and training of our Airmen and the revitalization of our processes in the acquisition enterprise. In addition, it includes our focus on sustaining legacy capabilities during these times of austere budgets and fewer new system developments.

Petroleum usage continues to be an area of great concern given the Air Force is the United States Government's largest consumer of petroleum, leaving us the most susceptible to energy price volatility and disruption of logistics lines. In order to reduce its reliance on oil, the Air Force will

continue to field innovative technologies to provide energy to its bases, reduce its logistical footprint and energy-intensive base infrastructure in the continental United States and elsewhere, and invest in S&T on transformative propulsion systems for future energy efficient platforms.

The Air Force is aggressively addressing both the supply and demand components of energy. Alternative fuels lie at the intersection of efforts to improve fuel supply security, reduce dependency on foreign fuel purchases, and reduce the environmental impact of Air Force operations. The Air Force has had notable successes in evaluating and certifying alternative aviation fuels from biomass, coal, and natural gas for use in aircraft turbine engines. Biomass-derived fuels are the current focus of Air Force test, evaluation, and certification activities for both legacy and advanced engines.

To reduce energy demand, the Air Force and industry are investing considerable S&T resources to develop and demonstrate technologies for turbine engines that can automatically adjust for optimal performance and fuel efficiency at all flight conditions. Benefits of increased fuel efficiency also benefits performance, including increased range, loiter time, and speeds. These technologies have pervasive system benefits that will enable transition to a wide range of future platforms with greater mission endurance requiring fewer operational aircraft and a reduced logistics footprint in the theater.

The Air Force Manufacturing Technology (ManTech) program has a long record of achievements in addressing pervasive industrial base needs where affordability, technology maturity, and manufacturing readiness are the main concerns. ManTech's mission is to create an affordable, world-class industrial base manufacturing capability responsive to the warfighter's needs. Towards this end, ManTech develops, demonstrates, and transitions advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. ManTech objectives are conducted through partnership with laboratory,

acquisition, and sustainment programs working through all industry levels from large prime contractors to small businesses. This way, appropriate strategic issues and emerging innovative manufacturing technologies and transformational opportunities are identified that bring about dramatic improvement to Air Force industrial base capabilities. Based on this process, examples of current ManTech programs include affordable Active Electronically Scanned Array radar for airborne platforms, advanced ceramics for fuel efficient turbine engines, out-of-autoclave advanced polymeric composites for structures, affordable space solar cells, affordable microelectromechanical components for tactical missiles, rapid prototyping for RPAs, high velocity maintenance, and advanced precision robotics for various assembly operations. These Air Force ManTech investments help ensure manufacturing advancements are in place to enable affordable, producible Air Force systems now and into the future.

CONCLUSION

The mission of the United States Air Force is to — fly, fight, and win…in air, space and cyberspace — as an integral member of the Joint team that ensures our Nation's freedom and security. Guided by the Air Force Strategic Priorities and our service core functions, our S&T Program provides the balance necessary to ensure support of today's warfighter, while posturing for success against tomorrow's complex and uncertain future. Innovation is a competency that we must continue to nurture as a potent mechanism against uncertainty — and, it can only be realized by nurturing a strong, robust and well-educated S&E workforce. The Air Force continues to show a strong commitment to its S&E workforce through a myriad of STEM outreach programs and initiatives and also continues to show a strong commitment to its S&T Program. This commitment is clearly shown through the Air Force Fiscal Year 2011 President's Budget request of $2.2 billion for S&T efforts.

With this commitment of people and resources, the Air Force S&T Program will continue to be a trusted and reliable joint partner with our sister Services and Agencies, known for integrity in all of our activities to include supporting the joint mission first and foremost. The S&T Program will provide compelling air, space, and cyber technologies, ensuring capabilities for use by the Combatant Commanders, while providing innovative technologies to support Global Vigilance, Reach and Power for the Nation.

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