NOT FOR PUBLICATION UNTIL RELEASED BY
SENATE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON EMERGING THREATS AND CAPABILITIES
U.S. SENATE

DEPARTMENT OF THE AIR FORCE

PRESENTATION TO THE SENATE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON EMERGING THREATS AND CAPABILITIES
UNITED STATES SENATE

April 17, 2012

SUBJECT: Status and Health of the Department of Defense (DoD) Science and Technology (S&T) Laboratory Enterprise

STATEMENT OF: Dr. Steven H. Walker, SES
Deputy Assistant Secretary
(Science, Technology and Engineering)

NOT FOR PUBLICATION UNTIL RELEASED BY
SENATE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON EMERGING THREATS AND CAPABILITIES
U.S. SENATE

INTRODUCTION

Ms. Chairwoman, Members of the Subcommittee and Staff, I am pleased to have the opportunity to provide testimony on the Air Force Science and Technology (S&T) Program and on the status and health of the Air Force Research Laboratory (AFRL), our Service's premiere research organization.

To protect our nation amidst a myriad of current and future security challenges, the Air Force must be an agile, flexible, ready and technologically-advanced part of the Joint team. The Air Force S&T Program plays a vital role by creating compelling air, space and cyberspace capabilities for precise and reliable global vigilance, reach and power.

Directed by Air Force senior leadership, our S&T Program is based on several enduring tenets. First, we must prepare for an uncertain future and investigate game-changing technologies to affordably transition the art-of-the-possible into military capabilities. To support the Air Force Service Core Functions, we must create technology options across a wide spectrum ranging from institutionalizing irregular warfare capabilities to providing new capabilities to operate effectively in cyberspace and across all domains. We must demonstrate advanced technologies that address affordability by promoting efficiencies; enhancing the effectiveness, readiness, and availability of today's systems; and addressing life cycle costs of future systems. In keeping with our Service heritage, we must continue to foster an appreciation for the value of technology as a force-multiplier throughout the Air Force. We must maintain the requisite expertise to support the acquisition and operational communities and modernize and improve the sustainability of unique research facilities and infrastructure. Finally, we must leverage and remain vigilant over global S&T developments and emerging capabilities to avoid technological surprise and exploit art-of-the-possible technologies for our military advantage.

To accomplish this in a constrained fiscal environment, it is critical that we make the wisest investment decisions possible with the precious taxpayer resources afforded us. We've used this opportunity as a catalyst to holistically examine our S&T portfolio by considering several fundamental questions guided by our tenets. Where should the Air Force lead the Department of Defense (DoD) from a technology development perspective? Where should we be an integrator of technologies developed by others, and where should we follow the pace of technology being led by our sister Services, other agencies, academia, or Industry?

Recognizing that wise investments are rooted in sound strategies, we embarked more than a year ago on the deliberate and collaborative development of an S&T Strategy. This strategy, which codified our enduring tenets and current overarching priorities, led to the creation of an S&T Plan, published in June 2011. This capstone document describes how AFRL implements the Air Force S&T Strategy.

In light of the defense strategic guidance released in February, we ensured our current strategies and plans were appropriately aligned with new and enduring emphasis areas. Our S&T Program supports the Air Force capabilities fundamental to the major priorities of the guidance, such as deterring and defeating aggression, projecting power in anti-access and area denial (A2/AD) environments, operating in the space and cyberspace domains, and maintaining a safe, secure and effective strategic deterrent. Our Air Force S&T Strategy, along with the defense strategic guidance, provided valuable vectors and helped the Air Force make some very challenging investment decisions.

AIR FORCE S&T FISCAL YEAR 2013 PRESIDENT'S BUDGET REQUEST

The Air Force Fiscal Year 2013 President's Budget request for S&T is approximately $2.2 billion, which includes nearly $200 million in support of devolved programs consisting of High

Energy Laser efforts and the University Research Initiative. These investments support a robust and balanced foundation of basic research, applied research, and advanced technology development that will provide demonstrated transition options to support future warfighting capabilities. This year's budget request represents a decrease of $64 million or a 2.8 percent reduction from the Fiscal Year 2012 President's Budget request. This reflects a more modest reduction than that taken across the total Air Force budget and indicates the strong support for Science and Technology from our leadership in this challenging fiscal environment.

Our nation depends on the Air Force to counter a broad spectrum of threats that could limit our ability to project global reach, global power, and global vigilance. In turn, the Air Force relies on its S&T program to provide the technical edge to affordably meet these threats across the spectrum of many years. Within the S&T portfolio, significant adjustments were made to focus investments in the most promising technologies to develop future warfighting capability. The most dramatic adjustment is an increase of $55 million in our propulsion portfolio in support of new DoD emphasis on A2/AD and energy savings. We were able to maintain stable investments in basic research, directed energy, munitions, and human effectiveness technology areas. Based on our strategy, we reduced our investments in airborne active denial, strategic relay mirrors, and high speed laser communications development in the directed energy portfolio and laser threat warning and small remotely piloted aircraft sensing technologies in the sensors technology portfolio. Finally, we are divesting our investment in deployed airbase technology development and thermal sciences technologies. In these and other technology investment areas, we shifted investment priorities in order to best deliver on our strategic priorities.

AIR FORCE RESEARCH LABORATORY BALANCED PORTFOLIO

As our single full-spectrum research organization, AFRL executes the Air Force's investment portfolio in basic research, applied research and advanced technology development. AFRL is unique among the Services as this one laboratory houses all Air Force efforts to discover, develop and integrate affordable aerospace warfighting technologies. Two decades ago, the Air Force laboratory system spread research across 14 different locations nationwide. In 1990, these locations were merged into four "superlabs." Finally, in 1997, the current single, unified AFRL structure was completed, bringing Air Force S&T to a new level of efficiency, collaboration and innovation.

AFRL works collaboratively with key S&T stakeholders to maintain a balanced portfolio responsive to current warfighter needs while simultaneously creating the technical foundation for the future force. The Laboratory is able to provide this critical support to the Air Force by balancing near-, mid- and far-term research, coordinating with and leveraging efforts across academia, industry and the other Services; maintaining an efficient and effective laboratory infrastructure; and retaining and developing a world-class cadre of scientists and engineers.

Basic research (science and knowledge) is the foundation of the Air Force S&T Program and the cornerstone of the future force. Based on visions of the future established by Air Force leadership, Air Force scientists and engineers identify, nurture and harvest the best basic research to transform leading-edge scientific discoveries into new technologies with substantial military potential. These technologies transform the art-of-the-possible into near-state-of-the-art and offer new and better ways for the acquisition community to address far-term warfighter needs. While it can be more of a challenge to quantify long-term basic research, with the scientists and engineers at the Air Force Office of Scientific Research within AFRL actively engaged in worldwide technical

communities, the Air Force has leveraged significant investments made by other defense and federal agencies, as well as non-defense and international laboratories, in its on-going efforts to advance basic science. These long-term efforts have led to promising opportunities such as cold atoms, which may enable development of an inertial navigation system on a chip that is jam-proof and highly accurate; self-healing structures, which may lead to more durable and longer-lasting aircraft structures; and bio-energy, which may lead to renewable bio-hydrogen techniques to propel vehicles. Two projects were even identified by Time Magazine last year as "best inventions" for 2011. First, in conjunction with the University of Texas at Dallas, researchers developed a multi-walled carbon nanotube sheet that when rapidly heated effectively "cloaks" objects beneath it. And, second, in conjunction with the Massachusetts Institute of Technology, scientists developed a new method to split and store hydrogen and oxygen using solar energy without any external connections.

Our core technical competencies also allow us to transition applied research activity directly to the user. One example is in the space technical area. The Space Weather Models developed by AFRL are used throughout industry today for spacecraft design and the GEOSPACE Model of the Space Environment is now commercially sold as part of the Satellite Tool Kit. Another example is in our Low Observables (LO) Maintainability area. From this area, the Air Force transitioned multiple improvements in LO maintainability that allow us to restore the LO characteristics of the platform and do so more rapidly. For example, the transitioned Hot Melt Gap Filler project provides the capability to do on-the-spot repairs in the field while maintaining the electromagnetic performance of the F-35.

AFRL helps the Air Force maintain a winning edge by continuously transitioning critical products that strengthen Air Force Core Functions by managing high-risk with high-return science and knowledge, maturing affordable technologies that address specific warfighter needs, and

demonstrating high-value S&T capabilities at reduced acquisition risk. Flagship Capability Concepts (FCCs), Air Force-level integrated technology demonstration efforts, are matured by AFRL with the intent to transition to the acquisition community for eventual deployment to an end user. Key factors in commissioning an FCC include having a well-defined scope and specific objectives desired by a Major Command (MAJCOM). These FCCs are sponsored by the using command and are vetted through the S&T Governance Structure and Air Force Requirements Oversight Council to ensure they align with Air Force strategic priorities.

The High Velocity Penetrating Weapon FCC was established to demonstrate critical technologies to reduce the technical risk for a new generation of penetrating weapons to defeat difficult, hard targets. The ultimate goal is to demonstrate 5,000-pound-class weapon penetration capability in a 2,000-pound-class weapon.

We commissioned a new FCC for Precision Airdrop in response to a request from the Commander of Air Mobility Command for technologies to improve airdrop accuracy and effectiveness while minimizing risk to our aircrews. AFRL, the Aeronautical Systems Center, and Air Mobility Command members established a working group to explore all aspects of the airdrop missions—from re-supplying our warfighters in the field to providing humanitarian aid to people in need across the globe.

The Selective Cyber Operations Technology Integration (SCOTI) FCC is executing smoothly toward providing cyber technologies capable of affecting multiple nodes for the purposes of achieving a military objective. The standardized delivery platform being developed is scheduled to be complete in Fiscal Year 2013 and will serve as a baseline for current and future integrated cyber tools.

Developing technologies to equip our forces of tomorrow is the primary objective of any S&T portfolio. Yet, our dedicated scientists and engineers are equally motivated to contribute to the current fight by getting their technologies into the hands of our warfighters today. AFRL supports the current fight through its Rapid Reaction and Innovation Process. By capitalizing on AFRL's expertise and tightly integrating it with operator knowledge, this process harnesses leading-edge knowledge, commercial off-the-shelf parts and mature technology efforts to rapidly deliver innovative solutions to the warfighter's most urgent needs. Its successful rapid-response development efforts have included a small, lightweight infrared emitter for friendly aircraft to identify joint terminal attack controllers on the ground, a wind-measuring dropsonde that unmanned air vehicles can pre-deploy to enable single-pass airdrop for Air Mobility Command aircraft and a maritime unmanned aerial system with wide-area search radar for low-cost, long-range coalition maritime surveillance for U.S. Pacific Command.

Air Force S&T has played a significant role in developing and delivering combat capability to our warfighters engaged in the United States Central Command (CENTCOM) Area of Responsibility through the deployment of Blue Devil. Blue Devil Block 1 is a persistent intelligence, surveillance, and reconnaissance (ISR) capability demonstrating the first-ever integration of wide area field-of-view and narrow field-of-view high definition day and night sensors cued by advanced signals intelligence sensors. Imagery is transmitted in near-real-time to a Blue Devil ground station or to individual soldiers on the ground. Blue Devil Block 1 satisfies a number of CENTCOM Joint Urgent Operational Needs. Warfighter feedback on the situational awareness provided by Blue Devil Block 1 has been overwhelmingly positive. Since December 2010, Blue Devil ISR has been instrumental in identifying a number of high value individuals and

improvised explosive device emplacements. In Fiscal Year 2013, Blue Devil Block 1 will continue to support CENTCOM with four sorties per day.

In the realm of technology transition and transfer, we are managing a number of initiatives that are yielding positive results. For example, the Air Force is engaging with small business to execute the Rapid Innovation Fund (RIF). The Air Force received 730 white papers in response to the RIF broad agency announcement, 88 percent of which were submitted by small businesses.

The Air Force asked submitters to focus on key technology areas in their white papers. These included support to current contingency operations, particularly in the areas of precision air delivery, low-metal or non-metallic detection devices, persistent wide-area airborne surveillance and exploitation capability, combat search and rescue, and man-portable fire suppressant. We also asked for ideas in cyber operations and mission assurance, improved system sustainment, and power generation and energy for platforms.

In addition to the technical approach and cost, a primary consideration in our evaluation of white papers was transition potential. We also considered the degree to which the technical approach was relevant to our need, whether it enhances or accelerates the development of an Air Force capability, and if it reduces development costs of acquisition programs or sustainment costs of fielded systems. We anticipate making approximately 55 contract awards this fiscal year meeting the RIF intent to rapidly insert innovative technology into programs of record to meet critical national security needs.

FOCUS ON COORDINATION AND COLLABORATION

The Air Force Research Laboratory actively collaborates at all levels with other Service laboratories and the Defense Advanced Research Projects Agency (DARPA). This collaboration starts at the most basic level. We engage each other to stay current with the evolving "state-of-the-

art" and to work to eliminate duplication of effort. AFRL researchers coordinate at the scientist and engineer level to share their scientific discoveries and the very latest scientific and technological breakthroughs through informal opportunities such as technical conferences and symposiums which take place throughout the world.

More formally, we are also increasing disciplined joint planning, which accelerates technology maturation and ensures taxpayer resources are best utilized. For example, the DoD service laboratories coordinate their S&T efforts through technology forums, such as the fixed wing vehicle program effort. Led by AFRL, the forum provides sharing of capability-focused technology investment roadmaps, as well as independent research and development industry plans among its members (including Boeing, Lockheed-Martin, Northrop Grumman and NASA). Similar forums also led by AFRL have addressed engines, hypersonics and the more electric aircraft initiative.

Tactical technical coordination also occurs at the laboratory level which typically includes memorandums of agreement or understanding between specific Service laboratories or larger Communities of Interest (COIs). For example, in December 2011, AFRL established new initial collaboration areas with the Army's Research, Development and Engineering Command to coordinate command, control, communication, computers, intelligence, surveillance and reconnaissance (C4ISR), autonomy/robotics, and power/energy at the laboratory level. Other AFRL agreements with Army Materiel Command have included sensor-seeker exploitation technology and common cooperative leveraging of technology efforts.

In addition to sharing technologies, the Service laboratories also share unique facilities. For instance, the Navy recently conducted validation testing on its new intercontinental ballistic missile (ICBM) motor on AFRL test stands at Edwards Air Force Base, California. The Army also used AFRL's vertical wind tunnel to test the V-22 Osprey and several other helicopter configurations.

The Air Force's relationship with DARPA is critical as about one-third of the DARPA program is executed with AFRL contracts because of our laboratory leadership in key technology areas, unique facilities and strong ability to form world-class teams spanning industry, academia and other government laboratories. This close relationship between AFRL and DARPA promotes significant data sharing between organizations and has naturally led to integrated planning of key efforts.

The Air Force's coordination with DARPA is formalized through sponsored direct work, partnerships and memorandums of understanding. There are several examples of AFRL and DARPA collaborations including the testing of new hypersonic glide vehicles, the Vulcan constant volume combustion (CVC) power generation turbine engine, the Autonomous Real-time Ground Ubiquitous Surveillance (ARGUS) imaging system – chosen for the Air Force's Gorgon Stare's electro-optical imager—and the Cognitive Assistant that Learns and Organizes (CALO), a DARPA program technically managed by AFRL and incorporated into popular applications for iPhones.

LABORATORY INFRASTRUCTURE

To meet the S&T demands of the current and future warfighter, we must translate Air Force S&T priorities into mission-ready facilities and infrastructure. The laboratory infrastructure is a cornerstone for enabling the required research and development necessary to maintain our technological superiority. AFRL is a world-class laboratory with more than 40 sites worldwide which includes AFOSR offices in Europe, Asia and South America, 539 primary facilities on 10 installations and 11.2 million square feet of technical space.

The 2005 Base Realignment and Closure (BRAC) effort successfully completed in September 2011 and provided several new, state-of-the-art facilities within AFRL. The Air Force strategy for BRAC 2005 was to consolidate and right-size operational and support units and, in the

process, reduce excess infrastructure and capacity. The Laboratory's BRAC realignments successfully realized the Secretary of the Air Force's priorities for BRAC 2005, including the goals of realigning Air Force infrastructure with the future defense strategy, maximizing operational capability by eliminating excess physical capacity, and capitalizing on opportunities for joint activity.

Encompassing nearly 80 percent of Air Force Materiel Command's BRAC program, the $665 million AFRL program required a movement of 1,380 manpower authorizations, construction of more than 1.2 million square feet of new laboratory space, and delivery of over 340 truckloads of equipment to the gaining installations. The BRAC-directed consolidations created new S&T centers of excellence in human performance, sensors and space. For example, the 711 Human Performance Wing's Armstrong Complex was completed at Wright-Patterson AFB, Ohio, and included the addition of classrooms for the U.S. Air Force School of Aerospace Medicine, new laboratories, a centrifuge and altitude chamber and a Warfighter Readiness Center. This move consolidated geographically separated assets from the Brooks City Base, Texas, and Mesa Research Site, Arizona, enabling AFRL to build up technical synergy for human performance and exploit a center-of-mass of scientific, technical and acquisition expertise. In addition, the co-location of AFRL's combat casualty care research with similar activities at Brooke Army Medical Center on Fort Sam Houston Texas, promotes the rapid application of research findings to health care delivery, with synergistic opportunities to bring clinical insight into bench research.

At Wright-Patterson AFB, intelligence, research and reconnaissance (ISR) assets were consolidated from Rome, New York and Hanscom AFB, Massachusetts, to create the new Sensors Range Complex. This new outdoor range mission includes research and development of space and airborne radar sensor concepts, as well as cost-effective detection and tracking of small,

maneuvering airborne and ground-based targets. It will push the envelope for next-generation radio-frequency sensors. Through this consolidation, the Air Force will increase the efficiency in its operations with a multi-functional center of excellence in the rapidly changing technology area of C4ISR.

While the last round of BRAC provided us an opportunity to consolidate and improve many laboratory facilities, the Air Force still has prioritized needs for military construction (MILCON) projects in other areas of AFRL. We recognize that we must continue to be vigilant and upgrade our S&T infrastructure in a timely manner so that major research and programs are not put at risk due to aging facilities. Maintaining high-quality laboratory facilities is critical to remaining on the cutting edge of S&T and supporting the innovation necessary for the future.

WORLD-CLASS WORKFORCE

Ensuring the Air Force continues to have war-winning technology requires the proactive management of our current Science, Technology, Engineering, and Mathematics (STEM) workforce and a deliberate effort to grow the laboratory scientists and engineers of the future. Having the most state-of-the-art laboratory facilities is futile without the right people to conduct the research inside the walls. We must attract, access and retain our nation's best and brightest, and equip them through education, training and experience. The success of the Air Force S&T Program depends on an agile, capable workforce that leads cutting-edge research, explores emerging technology areas, and promotes innovation across government, industry and academia.

Published in 2010, the Air Force *Technology Horizons* report presented our vision of the key areas of science and technology the Air Force must focus on over the next two decades to maintain a winning edge against a variety of threats. As a follow-on effort, we published the *Bright Horizons* STEM workforce strategic roadmap last year. This roadmap addresses the "people" dimension of

delivering and operating required technology by having the right STEM qualified people in the right place, at the right time, and with the right skills.

Retaining our current world-class, highly-skilled workforce is an important part of the roadmap. The Air Force Laboratory Personnel Demonstration Project (Lab Demo), adopted in 1997, has done much to ensure AFRL's ability to attract and retain personnel. This flexible system has helped to achieve the best workforce for the mission, adjust the workforce for change and improve overall quality. Initially, the project covered approximately 2,500 scientists and engineers. By expanding the coverage to non-bargaining unit employees in Business Management and Professional, Technician, and Mission Support occupations, the project now encompasses approximately 3,300 AFRL employees.

Several key flexibilities within the Lab Demo system have played a role in our ability to successfully retain personnel. For example, simplified, delegated position classification, broadbanding and a Contribution-based Compensation System (CCS) provide Laboratory leadership greater management capability of their workforce by transferring decision-making authority from a generally inflexible personnel hierarchy to front line supervisors who have firsthand knowledge of what is needed to accomplish the mission. Positions can be classified into one of four broadband levels, instead of one of 15 grades, and the classification process takes only hours at the local level instead of weeks or months at the personnel center level. The broadband levels enhance pay progression and allow for a dual-track system where employees can advance through the levels based on contribution and technical merit. Finally, the CCS provides AFRL leadership the ability to manage employee expectations, focus employee efforts toward mission accomplishment and compensate employees appropriately based on contribution to the Laboratory. According to a recent survey conducted at the Laboratory, 94 percent of AFRL supervisors are

positive toward the demonstration project initiatives and 70 percent of employees are satisfied with their pay and believe that top contributors are appropriately rewarded.

Recruiting our STEM workforce in today's world presents both challenges and opportunities. Domestic competition for this valuable resource is intensifying, while competition from the international science and technology community is simultaneously increasing. The rapid pace of global innovation has caused Air Force missions to evolve more quickly than before. For example, the rapid increase in cyber capabilities and vulnerabilities is driving the Air Force-wide mission evolution which necessitates changes in personnel requirements, including STEM.

The flexibility inherent in the Lab Demo system has allowed us to better address some of the recruitment challenges as well. The legislated authority to direct hire candidates with advanced degrees has been extremely helpful. This authority has enabled the Laboratory to hire qualified scientists and engineers who possess a master's degree or a doctorate in our most needed fields in less than half the time of traditional hiring methods. Applicants can apply directly to AFRL and be brought on board in approximately 25 days as compared to the standard 80 to 160 days outside of the direct hire authority. In addition, the delegated paysetting authority within the broadbanded Lab Demo system allows leadership to offer competitive salaries to perspective candidates based on experience, academic qualifications and local labor market conditions rather than abide by the typically more rigid personnel rules. While the direct hire authority for those with advanced degrees has worked well to attract highly-qualified candidates, the Laboratory could make excellent use of a similar expedited authority to hire entry and journeyman-level experienced candidates who do not yet possess an advanced degree or recent bachelor degree graduates with skills in new or emerging fields and to more successfully recruit high quality minority candidates who are aggressively pursued by private industry.

In addition to retaining and recruiting a workforce for today, the Air Force has also placed special emphasis on efforts to grow the laboratory workforce of the future. We recognize that pre-college (kindergarten through 12th grade) science and mathematics education has an important relationship to the future supply of U.S. scientific and technical personnel. We also recognize that global competition for STEM talent will undoubtedly intensify in the coming years. As such, we've set an outreach goal to aggressively pursue strategic partnerships and activities with our schools, universities, sister Services, professional associations, and other federal agencies in an effort to grow and develop future STEM talent. For example, the Air Force sponsors the Junior Science and Humanities Symposium, a tri-Service collaboration where students (grades 9-12) compete for scholarships and recognition by presenting the results of their original research efforts to a panel of judges and an audience of their peers.

The Air Force has also worked to appropriately target our outreach efforts in order to cultivate the skills we need to meet future requirements. For example, informed by the vision from *Technology Horizons*, the Air Force has identified over 100 key technology areas essential for current and future support to the warfighter. Air Force scholarships given through the Department of Defense (DoD) Science, Mathematics and Research for Transformation (SMART) program are aligned to support these technology areas. The Air Force supports four major commands (MAJCOMs) and over 40 individual facilities within those commands and selects approximately 100 students a year to meet requirements. SMART scholarship students maximize their time during 12-week internships during the summer and are doing truly amazing things for the sponsoring facilities. The SMART scholars continue to work with their respective facilities once they return to their colleges and universities.

To coordinate our efforts, we've also established an Air Force-level STEM office to act as a single focal point and better organize and synchronize outreach activities. The Air Force conducts over 150 STEM engagements each year, ranging from scientists and engineers volunteering to judge science fairs to the National Defense Science and Engineering Graduate Program providing scholarships to STEM students. These engagements encourage and leverage local, state, and federal STEM activities, affecting hundreds of thousands of students and teachers across the nation. Our new outreach office allows us to improve coordination with other Service and agency STEM programs and gives us a better understanding of the effectiveness and impact of our STEM investments.

IMPACT OF SECTION 219

The Air Force is critically dependent on technological advances to respond to emerging threats and to maintain a competitive advantage. However, since neither science nor threats are static, there is often a mismatch between defense planning, budget cycles and rapidly evolving threats and opportunities. The authority provided by Section 219 of the Duncan Hunter National Defense Authorization Act gives AFRL a degree of flexibility to rapidly exploit scientific breakthroughs or respond to emerging threats. This flexibility increases the rate of innovation and accelerates the development and fielding of needed military capabilities to address current and future problems.

In recent years, Section 219 funding has supported S&T in the areas of autonomous systems in contested environments, human performance augmentation, resilient cyber command and control networks, space situational awareness, assured operations in space, nanotechnology, directed energy protection, robust communications, cyber threats, laser technologies, and energy. For example, it has allowed AFRL to respond to rapidly evolving S&T projects such as investigating an insect

vision system for sense-and-avoid applications and all-solid-state lithium batteries. It has also funded transition of technologies that have been delivered in theater for operational evaluation, such as the Sand Dragon and Speckles projects.

Section 219 authority has funded 52 workforce development activities that cover a very wide range of opportunities related to the identification, hiring and recruiting of a quality science, engineering and technology workforce. For example, AFRL supports several outreach and development initiatives such as the Wright Scholar Research Assistant Program, which enables the Laboratory to hire approximately 40 top-quality high school STEM students to assist with in-house summer research. We've also used Section 219 funding for our Air Force STEM Outreach Coordination Office referenced earlier.

This authority is also being used by AFRL to fund upgrades to internal facilities, such as a hard-target fuse system research laboratory; an infrared/optical detector characterization and terahertz electronics laboratory for ISR and space situational awareness; and a combustion instability laboratory for liquid rocket engines. Overall, the Section 219 authority has generated a positive impact at AFRL for exploiting S&T for the warfighter.

CONCLUSION

The Air Force depends on its S&T Program to discover, develop, and demonstrate high-payoff technologies needed to address the ever-changing strategic and operational environment and to sustain air, space and cyberspace capabilities now and into the future. Today's Air Force stands as the most powerful air, space and cyber force in the world because of past technological advances that have been transformed into revolutionary new capabilities. AFRL has and continues to innovatively provide this critical support to the Air Force by balancing near-, mid- and far-term research, coordinating with and leveraging efforts across academia, industry and the other Services;

maintaining an efficient and effective laboratory infrastructure; and retaining and developing a world-class cadre of scientists and engineers.

Ms. Chairwoman, thank you again for the opportunity to testify today and thank you for your continuing support of the Air Force S&T Program and the Air Force Research Laboratory.