# Statement Testimony

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Madam Chairwoman, Ranking Member Portman, members of the committee, I am pleased to be here today on behalf of the dedicated men and women of the Department of Defense (DoD) who discover, develop, engineer, and field the critical technologies that form the foundation for a secure future. I would like to thank the members of Congress for your continued support of the Department's science and technology (S&T) program and our broader research and engineering (R&E) enterprise[1]. Your steadfast support has allowed the Department to field technologically-based military capabilities that provide the edge upon which our Soldiers, Sailors, Airmen, Marines and civilians rely.

I am honored to be joined today by Dr. Marilyn Freeman from the Army, Ms. Mary Lacey from the Navy, and Dr. Steven Walker from the Air Force. Their leadership has proven instrumental in ensuring our S&T investments provide compelling technology options and unmatched operational capabilities for the Department.

We testify today regarding the important role of the Department Laboratories and in support of the Fiscal Year 2013 President's budget request for DoD S&T; a request that has been thoughtfully prepared within the context of a challenging national fiscal environment. I can assure this committee that we are all mindful of the budget pressures facing our Nation. We have made a collective commitment to ensure that the taxpayers' dollars provided to the Department's S&T enterprise are invested wisely with a laser-like focus on needed capabilities for our national security.

As I discuss the status of the Department's Laboratories and paths to an integrated laboratory enterprise, I'd like to do so in the context of the Department's new strategic guidance, the FY 2013 President's Budget Request (PBR) and the Department's science and technology priorities.

## New Strategic Guidance

On January 5, 2012, the President released new strategic guidance for the Department[2]. The strategy builds upon developing partnerships and global alliances and rebalances our global posture and presence to emphasize Asia-Pacific and the Middle East. It sets a new path for the Joint Force of the future[3] - a force that will be smaller, leaner, agile and flexible, and rely upon advanced technical capabilities for mission success. The guidance outlines ten primary missions for a 21st century defense, which the Joint Force must be prepared to execute. The Department's S&T budget request was structured in scope and content to support these missions.

[1] Science and Technology (S&T) is defined as the sum of basic research (6.1), applied research (6.2) and advanced technology development (6.3). Research and Engineering is S&T plus Advanced Component Development and Prototyping (6.4). Both S&T and R&E are activities that occur before initiation of formal acquisition programs.

[2] Sustaining U.S. Global Leadership: Priorities for 21st Century Defense, January 2012 http://www.defense.gov/news/Defense_Strategic_Guidance.pdf

[3] Sustaining U.S. Global Leadership: Priorities for 21st Century Defense, January 2012 - cover letter from Secretary of Defense Leon Panetta, http://www.defense.gov/news/Defense_Strategic_Guidance.pdf

## FY 2013 President's Budget Request (PBR)

The FY 2013 Department-wide S&T budget request of $11.9 billion ($62 billion from FY 2013 - FY 2017) maintains a strong S&T posture. The FY 2013 PBR is above the FY 2011 enacted budget of $11.7 billion, and down modestly from the FY 2012 enacted budget of $12.2 billion. The FY 2013 S&T budget request:

- Maintains Basic Research at $2.1 billion - an investment that largely supports university based research;
- Funds the Defense Advanced Research Projects Agency at $2.8 billion to develop strategic concepts for the Department;
- Funds Counter Weapons of Mass Destruction S&T at $1.0 billion; and
- Maintains S&T funding in each of the Military Departments at approximately $2.0 billion.

In preparing the FY 2013 S&T Budget for the PBR request, I led a comprehensive review of the Department's R&E program elements and projects. This review, coupled with the Department's Strategic Guidance, has shaped the scope and content of the S&T budget request.

The FY 13 PBR S&T investment rebalances and aligns content to support the Department's strategic guidance. For example, $700M was added across the Future Years Defense Program (FYDP) to enhance the Joint Force's ability to operate across all domains. This funding is targeted to initiate an Air Force hypersonic cruise missile capability demonstration, accelerate the development of advanced electronic warfare (EW) concepts, accelerate technology development for the Long Range Anti-Ship Missile program, and launch technology development efforts in anti-jam precision guided munitions. Additional adjustments were made to increase funding in the Department's S&T priority areas of Cyber S&T, EW, Autonomy (Robotics), and Advanced Manufacturing by realigning funding in lower priority areas. The Department also increased investments in a next generation, high-efficiency turbine engine, the Adaptive Versatile Engine Technology (ADVENT), for an engineering and manufacturing decision in FY 2014.

The table below summarizes the FY 2013 budget request.

| Program ($Billions) | FY 2011 Enacted | FY 2012 Enacted | FY 2013 Request | FY12 – 13 Change |
|---|---|---|---|---|
| Basic Research (6.1) | **1.9** | **2.1** | **2.1** | **0.0** |
| Applied Research (6.2) | **4.4** | **4.7** | **4.5** | **-0.2** |
| Advanced Technical Development (6.3) | **5.4** | **5.4** | **5.3** | **-0.1** |
| **S&T Total** | **11.7** | **12.2** | **11.9** | **-0.3** |

Today's testimony by the Department's S&T leadership provides additional detail on key strategic initiatives in the FY 2013 budget request. The testimony will also describe initiatives underway to accelerate the transition of concepts into technologies that will be part of future acquisition programs.

## The Department's Science and Technology Priorities

In FY2010, we gathered over 200 scientists, engineers, operators and subject matter experts from across the Department and launched a comprehensive analysis of operational architectures, critical capabilities, and enabling technologies to support the Department's current and future missions. We took a broad look at cross-cutting areas that would have the greatest impact to the Department, even as the Department's New Strategic Guidance was being outlined.

That review resulted in the April 2011 announcement by Secretary Gates that the Department will consider seven science and technology areas as key priority areas. These priority areas are supported in the FY2013 budget request and provide the technical foundation for important future capabilities:

- **Cyber Science and Technology –** The focus of cyber S&T is on the development of technologies that enable system resiliency, agility, and mission effectiveness across the spectrum of joint operations. The research also addresses foundations of trust and development of new frameworks to more thoroughly assess cyber-security techniques.

- **Electronic Warfare / Electronic Protection (EW/EP) –** Pervasive advances in commercial and consumer electronics, challenge conventional U.S. electronic warfare capabilities. Investments in this area focus on new concepts and technology to protect systems and extend capabilities across the electro-magnetic spectrum.

- **Data-to-Decisions –** The Department relies upon the ability to analyze enormous data sets very quickly. Data-to-Decisions investments focus on investments in automated analysis techniques, text analytics, and user interface techniques to reduce the cycle-time and manpower requirements required for analysis of large data sets.

- **Engineered Resilient Systems** – The technically advanced systems our Joint Forces will need in the future must be adaptable to operate in dynamic, and sometimes unpredictable, environments. Research in Engineered Resilient Systems focuses on agile and cost-effective design, development, testing, manufacturing, and fielding of trusted, assured, easily- modified systems.

- **Counter Weapons of Mass Destruction (WMD)** – The Department is focused on crosscutting research in countering weapons of mass destruction, specifically directed at finding and tracking unsecured fissile material. Research focuses on

the development of novel detectors and processing algorithms for increased detection capabilities.

- **Autonomy** – The Department's investments in this area are focused on developing systems that can operate in complex real-world environments. Such systems will augment or substitute for human operators, particularly in hazardous environments, and to conduct missions that are impractical or impossible for humans.

- **Human Systems –** This goal of Human Systems is to advance the Department's technology capabilities for development of system interfaces and for training of personnel to increase productivity and effectiveness. Training research focuses on realistic, adaptive, and interactive scenarios, and persistent, affordable integrated training. Personnel training research concentrates on human-machine teaming; intelligent, adaptive human aiding; and intuitive interaction.

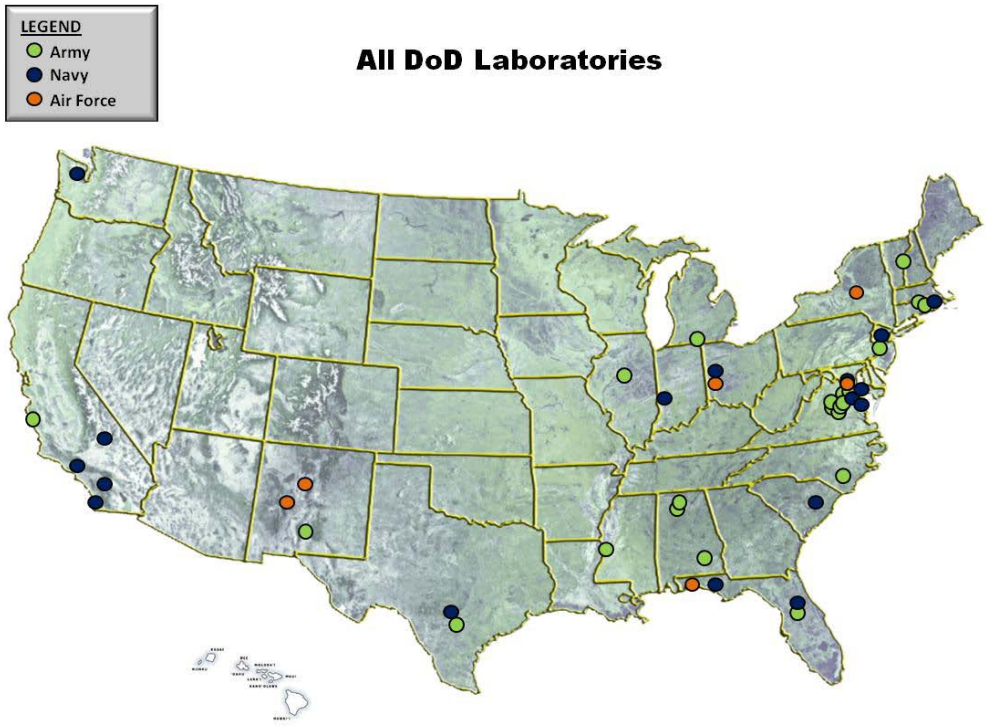
The seven DoD S&T priorities represent an integrated effort by the Department to focus technical staff and budgetary resources on a set of primary topics important to the Joint Forces. Roadmaps are being developed for each S&T priority to focus near-term project investment portfolios and experimentation campaigns.

## Department of Defense Laboratories

The Department's Laboratories engage in activities ranging from basic research through defense system acquisition support to direct operational support of deployed warfighters. These Laboratories are comprised of dozens of facilities across 22 states, and employs tens of thousands of scientists and engineers, both civilian and military, public employees and contractors[4]. Included are facilities known as research centers, systems centers, laboratories, engineering centers, institutes, and development centers. Each of the military Services configures and characterizes its laboratories in unique ways to most effectively accommodate service-specific missions and organizational structures. The common thread through all of these facilities is responsibility for conducting first rate research and development, both in-house and through external contracts that directly benefit the warfighter.

The Department Laboratories execute a substantial fraction of the Department's S&T accounts, particularly in budget activities 6.2 and 6.3. In addition, they conduct substantial amounts of reimbursable research and development (R&D) for DoD and Intelligence Community customer organizations. Altogether, the Department Laboratories execute approximately $30B annually.

[4] For the purposes of this testimony, the definition of a Laboratory is derived from Department of Defense Instruction 3201.4 In-House Laboratory Independent Research (ILIR) and Independent Exploratory Development Programs, (8 Oct 1993): Paragraph 3.2 Definition - R&D Laboratory - a facility or group of facilities owned, leased or otherwise used by the Department of Defense, a substantial purpose of which is the performance of research, development, or engineering by employees of the Department of Defense. The term "laboratory" is used here and throughout to apply as well to Warfare Centers, Research, Development and Engineering Centers, and other such entities.




Most critical to the success of the Laboratories and their ability to support the Department's mission is the workforce. This workforce is highly educated; nine percent of the Department's scientists and engineers possess Ph.D.'s and 26 percent hold Master's Degrees[5]. This workforce maintains competence in areas of technology specific to military needs and includes electronics engineers, mechanical engineers, computer scientists and engineers, aerospace engineers, electrical engineers as well as chemists, physicists and mathematicians. These degreed scientists and engineers conduct DoD-relevant research leading to key technology demonstrations and publish thousands of reports and peer-reviewed technical papers. In many cases, this community defines a technical field with seminal work and leads the industrial base in their respective areas. This enterprise is a unique environment for advanced technology development and concept incubation.

The Department's Laboratory infrastructure has an estimated total property replacement value of $38B and a total building footprint in excess of 140M $ft^2$. The facilities include unique resources for design, development and testing used by both the Department and industry.

- The Navy's principal laboratory, the Naval Research Laboratory (NRL), was founded in 1923 on the recommendation of Thomas Edison and is the primary performer of the Navy's basic research program. NRL possesses the only organic government capability to design and build space satellites. Areas of emphasis

[5] Department of Defense Laboratory Civilian Science and Engineering Workforce - 2011, ASD(R&E)/RD Laboratory Office, May 2011

include ocean and atmospheric science, autonomous systems, and materials science.

- The Army's primary provider of basic research is the Army Research Laboratory (ARL) with primary sites at Adelphi and Aberdeen, Maryland. ARL areas of expertise include life sciences, network science, robotics, physical science, weapons technology and warfighter protection.

- The Air Force Research Laboratory (AFRL) consists of ten individual directorates located across the United States with headquarters located at Wright-Patterson Air Force Base, Ohio. The AFRL is the Air Force's primary provider for basic research through advanced development for Space Vehicles, Information Systems, Air Vehicles, Propulsion, Directed Energy, Materials and Manufacturing, Sensors, Human Performance and Munitions. The Air Force Office of Scientific Research is a directorate that serves as the basic science program manager for all Air Force basic science programs.

The Department Laboratories comprise a balance of these corporate research laboratories, which maintain basic science as an area of emphasis, and engineering centers, such as the Navy Warfare Centers and the Army's Research and Engineering Development Centers that maintain the Department's in-house development and engineering expertise. The Services align approximately one-third of their basic science budgets to in-house programs. A recent review of the Department Laboratories' basic research programs, conducted by the Defense Science Board (DSB)[6], concluded that the in-house basic research programs were technically strong and healthy.

## Technology Transition

The role of the Laboratories in supporting the mission of the Department is critical. The Department's Laboratories rapidly develop and transition defense technology to the field through knowledge of warfighter operational needs and knowledge of developments in industry and academia. They provide unbiased technology expertise to the Department in support of policy development and systems acquisition. The "products" the Laboratories deliver can be separated into three categories:

- **Rapid prototyping, systems development and deployment to support urgent operational needs.** The Department's Laboratories have provided critical engineering support to transition early concepts to operational use in theatre. The following are a few examples of many recent transitions that have had a significant impact.

  The Army Corps of Engineers Engineering Research & Development Center has fielded multiple capabilities including Radiant Falcon, Groundhog and Hard Impact, which provide deterrence, defense and defeat of Improvised Explosive Devices.

[6] Report of the Defense Science Board Task Force on Basic Research (January, 2012)

The Naval Research Laboratory, in response to a request from deployed EA-6B squadrons supporting Operation Enduring Freedom (OEF), developed and delivered improvements to JUMPSTART III and STOPLIGHT III systems that provide a counter to an emerging threat in OEF.

The Air Force Research Laboratory has developed and is performing operational evaluations in Afghanistan of the Sand Dragon system. This 200 lb runway-independent, long-endurance Remotely Piloted Vehicle provides an economy of force capability for route surveillance and Improvised Explosive device detection.

The Air Force Research Laboratory also developed the Anubis Unmanned Aircraft Vehicle. This is a lethal weapon delivery system controlled at the company or platoon level. It provides an immediate, precise response to enemy fire and is successfully employed in support of OEF

The Army Research Lab's (ARL) Unmanned Ground Systems were integrated into the PGSS surveillance systems in support of OEF. In addition, weapon surveillance systems, developed by ARL, have been fielded together with Persistent Ground Surveillance System (PGSS) to determine location of enemy weapon fires. There are currently 59 PGSS fielded in Afghanistan.

- **Advanced concepts that support the Department's current or future acquisition programs.** For example, the Air Force Research Laboratory is continuing to mature critical components that will make High Speed Strike Weapon technology capabilities a reality. The program has had key demonstration successes and is progressing prudently to support future programs of record. Key technologies to be developed include air-breathing hypersonic engines; advanced materials and structures; guidance, navigation and control for GPS degraded and denied environments; advanced sensors and seekers; and selectable effects warheads.

  In another example, the Office of Naval Research supported, the Electro-magnetic Aircraft Launch System was developed and demonstrated jointly by the Naval Air Warfare Center Aircraft Division, Lakehurst, New Jersey and General Atomics. This technology was in turn transitioned to General Atomics as the lead contractor for installation of this new aircraft launch system in the Gerald R. Ford Aircraft carrier (CVN-78).

- **Transition of advanced technologies to the industrial base for use on current or future acquisition programs.** For example, the Air Force's Adaptive Versatile Engine Technology (ADVENT) program is developing multi-design-point engine technologies that will provide optimized fuel efficiency of up to 25 percent and performance capabilities over a wide range of flight regimes. This investment will help maintain a competitive industrial base in turbine engine technology, an area critical to our future military capability.

In response to specific requirements and operating models, each of the Services has established a unique approach to technology transition. The headquarters of AFRL is co-located with Air Force Material Command, the organization responsible for their acquisition programs. This proximity ensures that personnel are able to work closely

together. Laboratory personnel serve as subject matter experts to program managers and program executive officers (PEO) and provide support for technology development, requirements generation and system deployment.

The Army has taken a similar approach by co-locating PEOs and acquisition program managers at each of the Research and Development Centers to tightly couple advanced technology development programs with the acquisition process. The Navy's Future Naval Capability program integrates senior leadership, PEOs, industry and their laboratories in the rigorous identification of technology requirements, program development and technology transition into programs of record.

Integration of the Defense Laboratory Enterprise is performed by Defense Laboratory Office within the Office of the Assistant Secretary of Defense for R&E. This office works closely with each of the Services in the development and deployment of policies governing the enterprise. It is an entry point for the Department of Energy National Laboratories, Federally Funded Research & Development Centers (FFRDC) and University Affiliate Research Centers (UARC).

The Department has a broad and growing engagement with industry and academia to promote stronger transition paths. The basic research activities of the corporate laboratories facilitate relationships with academia and the much broader global research community. Relationships formed through basic science programs ensure our technology base is well-versed in the latest technology developments and provide a conduit for new ideas and innovations to flow into our Laboratories and advanced development programs. This coupling results in a robust path to mature basic research concepts to deployed weapon systems.

The Department's mechanisms for industry engagement include Cooperative Research and Development Agreements (CRADAs), which allow industry and universities to leverage the resources of the Laboratories to develop jointly owned intellectual property. In FY 2009, the Department engaged in approximately 2,900 CRADAs. In this same year, the Department's Laboratory staff filed 831 invention disclosures, 690 patent applications, were issued 404 patents and 57 new inventions licensed. CRADAs, and licensing of intellectual property open transition path to bring ideas into the Department, and an opportunity to transition concepts developed in Department Laboratories to commercial use.

In addition to engagement with industry and academia, the Department is assessing the capabilities and resources of other Federal organizations to identify areas for increased collaboration. The Department of Energy's (DOE) 16 National Laboratories represent a $29B investment in energy and weapons S&T and development. The Department is identifying DOE capabilities, which can be leveraged for future DoD mission support. This relationship is formalized in the DoD, DOE, Department of Homeland Security (DHS) and Director of National Intelligence Governance Charter, which is expected to promote an increase in the level of partnership and joint activities between our respective organizations. The DoD/DOE Joint Munitions Program, which has resulted in the

development of next generation weapons concepts, is a framework for future inter-agency engagement.

## Strengthening the Laboratory Workforce

The laboratory talent base represents a unique repository of core capabilities upon which the Department relies. The market for recruiting technical talent in the United States is challenging. DoD competes not only with industry and academia, but also with other government Departments and Agencies. Still, the DoD remains competitive in its ability to hire talented students and technical professionals into the Defense Laboratory workforce largely because the DoD environment provides opportunities that are not available anywhere else in the world, e.g., working side-by-side with world renown professionals; working in world-class facilities; or being part of a team that invents solutions to the challenges facing our national security. For areas where other agencies have a deeper technical base, we look to leverage that expertise, as illustrated by the Department's forging of a stronger relationship with the DOE. We have also partnered with the Intelligence Community and the DHS to extend our talent base and support Department objectives.

The Department continues to use the three key initiatives, supported by Congress, to attract and retain a highly skilled workforce.

- **S&T Reinvention Laboratory statutory authorities** (STRL, also known as "Demonstration Lab") provide Laboratory Directors with flexibility and tools for direct hiring of highly qualified graduates, training of technical personnel and pay for performance to retain the best and brightest performers. Under STRL, Laboratory Directors can send scientists and engineers to graduate schools for advanced degrees and specialized training courses and thereby retain a leading edge skill set.

- **Section 219 authorities:** The FY09 NDAA authorized laboratory directors to use up to 3% of available funds for the purpose of technology development, supporting the transition of technology developed by the lab, workforce development and minor construction for enhancement of laboratory capabilities. This discretionary investment program is expected to reach $150M this fiscal year, with each of the Services executing a vigorous investment program in workforce training, developing high risk high pay-off technologies, transitioning technology to programs of record and addressing minor construction needs.

  The Office of the Assistant Secretary of the Navy (Research, Development and Acquisition) established the Naval Innovative Science and Engineering (NISE) program to implement Section 219. The FY 2011 NISE program had a $48.9M funding level from Research, Development, Test, and Evaluation (RDT&E) Navy programs (BA1 through BA7) and was executed by 15 Department of Navy Laboratories as a mechanism to revitalize their Laboratories and re-build their world class capabilities.

The NRL's continuation of the Jerome and Isabella Karle Distinguished Scholar Fellowship (the "Karles Fellowship") is another example of a Navy Section 219 effort. This program provides hiring of highly accomplished scientists and engineers at any degree level within one year of receiving their degree and will provide funds to pay their salaries for two years.

The AFRL FY 2011 Section 219 program had a total of $58.077M for its budget. Of this budget, $36.658M supported 36 basic and applied research programs. This research included examinations of ionospheric impacts on the Global Positioning System (GPS), cyber vulnerability identification and mitigation, and expendable thermal energy storage materials for high power directed energy weapon systems.

The AFRL used the $7 million of the authority to transition 10 technologies into operational use. These programs included improvements to air drop operations, autonomous vehicle prototyping, and development of expeditionary airfield technology. Workforce development activities accounted for 26 programs that cost $5.375M. Activities include scholarships and grants for graduate, undergraduate, and high school students, teachers, and professors in the science, technology, engineering, and mathematics research realms. Six recapitalization and revitalization projects were supported by $9.044M. Facilities that received funding included an advanced high power microwave research facility, the Maui Space Surveillance Complex, and Fuze Industrial Research Facility, and the Combustion Instability Laboratory.

The ARL directors executed the implementation plan for Section 219 with seven Laboratories participating in FY 2011 and have additional Laboratories anticipated to participate in FY 2012. The Army Laboratories invested $53.5M funds from a total of $2.4B in FY 2011 funding as described by Section 219. These activities included $20.8M for infrastructure improvements, $17.5M for innovative in-house Basic and Applied Research, $13.2M for Workforce Retention and Development, and $1.7M for Transition of Technology Development.

**The Science, Mathematics, And Research for Transformation (SMART) Scholarship for Service Program** has shown great potential in attracting tomorrow's talent to the Department Laboratories. SMART is an opportunity to increase the number of civilian scientists and engineers in Department Laboratories by supporting undergraduate and graduate students who are pursuing degrees in STEM disciplines and then offering laboratory positions upon degree completion.

Since its inception in 2005, the SMART program has engaged over 270 institutions of higher learning and research organizations and has transitioned more than 430 young scientists and engineers into the Department. Overall, the SMART program benefits the Department and SMART scholars alike. SMART scholars receive a scholarship and a long- and full-term training, internships, and access to mentors from their respective fields. Our benefit is that the DoD's S&T mission is positively

impacted by some of the best and brightest scholars, initially during their schooling and afterwards, when they begin a career in the Department.

## Moving Towards an Integrated Laboratory Enterprise

In the 1950s, the Department led the R&D agenda for the Nation in areas ranging from aerodynamics and computation to advanced materials and microelectronics. Each of the Department's Laboratories was formed to support Service-specific needs and, through multiple realignments, each has evolved into a footprint of its own. Still today, these Laboratories have proven successful in providing technology solutions rapidly to the field, as well as in transitioning technology to industry.

To ensure that the Department's Laboratories remain relevant in the future environment where technology is increasingly globalized and new opportunities as well as threats emerge at an accelerated pace, the Department is launching an assessment of the current Department laboratory enterprise. The purpose of this assessment is to provide recommendations from acknowledged business management experts regarding the best options for operation of this enterprise. The assessment will consider the current models for in-house research, development, test, and evaluation against emerging models for innovation in academia, the industrial base, to include the small business community used to rapidly develop transition emerging technologies into new products or operational capabilities. The Department intends to specifically consider the long-term vision for the Enterprise, its role within the larger defense community, including FFRDCs and UARCs, the technical quality of the Laboratories and their workforce and operational models that promote technology transition. A key element of the assessment is to examine the balance between the laboratory responsibilities under U.S.C. Title 10 and the overarching integrated needs of the Department.

## Conclusion

The Defense laboratory enterprise is critical to our continued ability to support the mission of the DoD and our National Security. The Department Laboratories are uniquely suited to couple basic research concepts to early-use military applications and represent critical technical capability to address operational challenges. The Department is committed to shaping an Integrated Laboratory Enterprise to continue to provide this resource and meet the challenges of an increasingly globalized environment. Key to this integration is a talent base of scientists and engineers with the credentials, experience and resources to provide the Department with capabilities and new models to quickly transition those solutions to industry and the warfighter. I appreciate your continued support of our S&T efforts and I look forward to answering your questions.