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Good afternoon Chairman Hoeven, Ranking Member Shaheen, and distinguished members of the Committee. Thank you for the opportunity to testify before you today on the Department of Homeland Security's (DHS) Science and Technology Directorate (S&T). S&T's mission is to deliver effective and innovative insight, methods, and solutions for the critical needs of the Homeland Security Enterprise (HSE). Technology simultaneously enables both homeland security operators and malevolent actors and, as a result, has a significant and expanding impact on current and future threat environments. I look forward to discussing S&T's fiscal year (FY) 2017 budget request and how research and development (R&D) improves the operational capabilities of DHS Components and the first responder community.

Science and Technology Directorate's FY 2017 budget request

S&T's budget request is $758.7 million for FY 2017. This amount represents a decrease of $28.2 million, or 3.6 percent less than the $786.9 million provided to S&T in FY 2016. Over the last two years, the flexibility afforded to S&T has allowed better responsiveness to emergent needs and exigent circumstances in the Department and contributed to a more robust technical advisory role to the Secretary and Components for urgent projects, including countering Unmanned Aircraft Systems (UAS), aviation screening, and social media screening. The flexibility was also critical to S&T's expansion of Apex programs and creation of Apex Engines, which have already begun to benefit S&T and the Department. I thank the Committee for its partnership and assistance in expanding the profile of scientific and technical advice in the Department and for its continued support moving forward in FY 2017.

As part of DHS's new Common Appropriation Structure in FY 2017, S&T's request aligns funding within three of the Department's lifecycle-based appropriations fund types: Research and Development; Procurement, Construction, and Improvements; and Operations and Support. S&T's FY 2017 request includes no funding in the Department's fourth fund type, which is Federal Assistance.

The FY 2017 budget request includes $469.9 million for R&D, a $26.1 million decrease compared to FY 2016 funding. Within the requested amount, $33.0 million is for University Programs, an $8.6 million decrease, and $436.9 is for Research, Development, and Innovation, a $17.4 million decrease. By thrust area, the Research, Development, and Innovation request includes $79 million for Apex; $56 million for Border Security; $58.4 million for Chemical, Biological, and Explosives Defense; $65.7 million for Counter Terrorist; $71 million for Cyber Security and Information Analytics; $87.4 million in First Responder and Disaster Resilience;

and $19.4 million for salaries and benefits. The funding in these thrust areas is S&T's principal means for providing state-of-the-art technologies and solutions and meeting broad and diverse mission requirements from throughout the Homeland Security Enterprise.

The request also includes $65.9 million for Acquisition and Operation Analysis that includes $48.4 million to fund S&T's work to strengthen the DHS acquisition process, standards development work, the SAFETY Act, international cooperative research and development, interagency work, and technology transition support and $17.5 million for salaries and benefits. To support the DHS acquisition process, S&T provides test and evaluation oversight, systems engineering, operations research, and technical risk assessments of major DHS acquisition programs.

Finally, the budget request includes $133.9 million for Laboratory Facilities, which includes $111.1 million in operations costs and $22.8 million for salaries and benefits. The request includes funding to operate the now-under-construction National Bio and Agro-Defense Facility (NBAF) located in Manhattan, KS. As construction nears completion and as research programs and veterinary research staff begin to transition from the Plum Island Animal Disease Center, NBAF will continue to require funding for operations ahead of the Full Operational Capability planned by December 2022.

Support for the Department in FY 2017

The FY 2017 funding request is vital to ensuring S&T delivers the technology knowledge products and capabilities DHS needs to improve operational effectiveness and efficiencies. In supporting end users across the broad and diverse mission areas of the Department, S&T maximizes value within a comparatively modest pool of funds. As the technical and research center for the Department, an investment in innovation through S&T has a significant, lasting impact on improving and maturing DHS operational capabilities and technology solutions for the HSE.

S&T is providing technology to strengthen border security. FY 2017 funding for border security technology will provide needed capability to U.S. Customs and Border Protection (CBP) and U.S. Coast Guard (USCG). In FY 2017, S&T will:

- Demonstrate a southern border capability with CBP to detect, track, and classify low flying/low observables aircraft along difficult terrain on the borders;
- Transition to CBP a covert and inexpensive capability to detect personnel, aircraft, and vehicles crossing the border with classification algorithms that significantly reduce nuisance and false alarms;
- Demonstrate a capability mounted on USCG Search and Rescue aircraft that will permit higher altitude/higher speed searches for people in the water, enabling larger coverage areas and a greater probability of detection, resulting in saved lives; and
- Pilot new or improved traveler inspection tools and processes to strengthen CBP's screening and inspection of travelers entering the United States.

S&T is testing new and existing capabilities to counter the terrorist threat. S&T is examining how to counter behavioral aspects of terrorism and how to counter emerging technology threats.

S&T will evaluate mitigation technologies designed for protection at point, perimeter, and wide area venues against UAS as part of a multi-agency team. The resulting testbed will deliver an urban test environment where DHS and its partners can evaluate countermeasure systems and score them against their specific operational use cases.

S&T is improving DHS acquisition programs. S&T has become an integral player in DHS improving acquisition oversight. Work in FY2017 includes:

- Technical assessments of 13 major acquisition programs in support of the Acquisition Review Board (ARB);
- Operational Test and Evaluation (OT&E) engagement with 45 major acquisition programs;
- Operations research studies in support of four DHS Components; and
- Continuous support for the Joint Requirements Council's (JRC) Portfolio Teams.

S&T is improving cybersecurity and cyber-physical systems. S&T is working to mitigate fundamental weaknesses in cyber systems. In FY 2017, S&T will attack the following issues:

- Government networks retain significant cyber security weaknesses that are being exploited, and the National Cyber Protection System (NCPS) and Continuous Diagnostics and Mitigation (CDM) programs need rapid and adaptive capabilities to address these weaknesses over a 12 to 24 month timeframe. FY 2017 will address key elements needed to support Einstein 3A (E3A) and CDM, such as classified signatures evaluation, E3A/CDM integration, measurement infrastructure, treatment of key Internet traffic protocols and communications, and red-team capabilities.
- The government automotive fleet remains vulnerable to cyber hacking. FY 2017 funding completes the establishment of the technical development consortium between DHS and major automotive companies and suppliers; it also supports Phase I development of secure purchasing guidelines for government automotive fleet management (General Services Administration, DHS including CBP, Department of Justice, state and local law enforcement, etc.).

S&T is developing better baggage scanners for aviation checkpoints. S&T is integrating new technology and more sophisticated technical approaches to create scanning machines that are faster and more dependable. In FY 2017, S&T will demonstrate a carry-on baggage screener that provides better capability with higher throughput and substantially fewer false alarms. This will support the Transportation Security Administration's (TSA) efforts to secure luggage and identify threats in a less obtrusive way in the future.

S&T is supporting first responders with better communications, decision making tools, and enhanced capability. S&T is working with first responders to address their most pressing capability gaps and help them do their jobs more safely and effectively. In FY 2017, S&T will:

- Demonstrate a system with the Los Angeles Fire Department that uses artificial general intelligence to help responders navigate unpredictable conditions and improve situational awareness;
- Collaborate with U.S. Immigration and Customs Enforcement (ICE) Homeland Security Investigations to decrease the time it takes agents to identify child abuse victims and their perpetrators using imagery analytics related to facial and object recognition; and

- Operationalize a Hurricane Evacuation Planning tool with Federal Emergency Management Association (FEMA) that will streamline and automate updates for storm surge risk maps, evacuation zones, and evacuation clearance times ultimately helping local communities make faster, more efficient, and more informed evacuation decisions and save lives from hurricanes.

S&T is supporting countermeasures that protect the public from biological attacks. S&T helps our interagency partners understand the risk of potential pathogens to guide development and acquisition of countermeasures for the Strategic National Stockpile. In FY 2017, S&T is delivering three material threat assessments of filoviruses, smallpox, and botulism toxin to the U.S. Department of Health and Human Services to support potential acquisition of medical countermeasures and keep the American public safe from harm.

Better connecting S&T within the Department

A significant accomplishment this year as part of the Secretary's Unity of Effort Initiative was the re-establishment of a departmental Integrated Product Team (IPT) process. In August 2015, the Secretary established mission-focused IPTs for the purpose of identifying and prioritizing technological capability gaps and coordinating R&D to close those gaps across the mission areas of the Department. The overall effort is led by S&T, but the individual IPTs are chaired by senior representatives from the operational Components, with representation from operational and HQ Components as well as the Joint Requirements Council.

The first cycle of IPTs addressed the following five topic areas: Aviation Security, Biological Threats, Counterterrorism, Border Security, and Cyber Security. S&T also continues its existing IPT supporting our Nation's first responders through the First Responder Resource Group, and additional sub-IPTs were created that address sub-topics (e.g., maritime security for border security) and key issues (e.g. resilience). This intentionally broad and inclusive approach also has helped us address some of the concerns voiced by the U.S. Government Accountability Office and Congress that R&D in the Department is insufficiently coordinated. We are on schedule to deliver results of the inaugural process to the Secretary later this year, and I am proud of how quickly S&T and our partners in the Department came together to establish and execute the process.

As they mature moving forward, IPTs will be the primary vehicle for the Department to identify, coordinate, prioritize, and validate R&D efforts supporting DHS priority missions. Most importantly, IPTs are connecting S&T more closely with the offices in Components trying to fill capability gaps and acquire technological solutions to meet operational needs. This will strengthen the applicability of S&T's deliverables and enhance the effectiveness of operational solutions for the Components.

Meeting operational needs and closing capability gaps

I previously mentioned the flexibility afforded to S&T by the Committee, which has allowed better responsiveness to emergent needs and exigent circumstances in the Department. In areas such as countering Unmanned Aircraft Systems (UAS), aviation screening, and social media

screening, S&T has been able to use its resources to support a more robust technical advisory role.

Last year, the Secretary requested that S&T work with the White House as interagency lead in developing a capability to counter the growing UAS threat. S&T's initial role was to lead the interagency working group including U.S. Capitol Police, U.S. Park Police, Washington DC Metropolitan Police Department, Department of Justice, Federal Aviation Administration, and DHS Components that produced the *National Capital Region Gyrocopter Incident Intergovernmental After-Action Report*, released June 2015, and subsequent whole-of-community response plan. Concurrently, S&T began cataloging relevant existing technology and developmental work across government including the Department of Defense. This became the basis for an R&D plan that, as it unfolds, will help drive private sector development of a capability or capabilities to meet our customers' diverse needs. Perhaps as importantly, the effort will inform our customers, to make them smarter consumers of existing and future technology, as well as the decision makers responsible for the future policy and legal framework for use of UAS.

S&T was also able to support the TSA's response to last year's results of covert testing of passenger screening operations by the DHS Office of the Inspector General. At the Secretary's request and with TSA's full cooperation, S&T was tasked to evaluate the current screening process as a risk-based "system of systems" and consider innovative or disruptive technologies, policies, and operating procedures that could improve overall screening performance and reduce risk. This effort was a horizon-focused effort that was complementary to TSA's own internal, immediate-term evaluation. With the aviation screening effort as a basis moving forward, S&T and TSA continue their close partnership in exploring and implementing innovative approaches to securing the transportation sector.

Finally, last December after the events in San Bernardino, CA, the Department stood up a Social Media Task Force led by the DHS Office of Intelligence and Analysis to assess social media policies, processes, and capabilities and to develop recommendations to leverage departmental authorities and capabilities to exploit social media during the vetting process. As one of three supporting efforts, S&T's Data Analytics Engine initiated a pilot supporting U.S. Citizenship and Immigration Services (USCIS) to address K-1 visa (i.e., fiancé/e visa) and refugee screening requirements using social media. S&T and USCIS are experimenting with leading-edge commercial tools to understand how publicly-available social media can inform the immigration vetting process. S&T has also reviewed hundreds of tools through a Request for Information and an Industry Day to determine technical capabilities available in the marketplace relative to all DHS use cases—screening and vetting, investigations, and situational awareness. S&T plans to continue to work with industry to identify and/or further develop social media analytic capabilities for DHS missions. The core technical capabilities that constitute the Apex Technology Engines help DHS rapidly develop and deploy new technologies in high-profile and high-risk events.

The technical advisory role described here is an important and sometimes under-appreciated aspect of S&T's value to the Department. The immediacy of the work and difficulty to anticipate funding requirements in advance also uniquely strain our ability to marshal resources.

For this once again, we are grateful to the Committee for the flexibility it affords, which augments this ability for S&T to contribute to the Department's most immediate emergent needs as they arise.

Refinement and innovation in S&T's approach to R&D

One of my first priorities after joining S&T was establishing visionary goals that would help orient S&T's investments toward longer horizon, leap-ahead capabilities. As demonstrated above, S&T continues to work closely with Component partners and other stakeholders on immediate needs, but the organization at the time lacked comprehensive, far-reaching visionary goals looking 20 or more years into the future and driving toward ambitious improvements. S&T shared draft goals in the Department and with the public through a crowd-sourcing website where we received more than 1,000 comments and suggestions from all of S&T's major stakeholder groups inside and outside government. The final S&T Visionary Goals, with input from the entire HSE, are the following:

- Screening at Speed: Security that Matches the Pace of Life
- A Trusted Cyber Future: Protecting Privacy, Commerce, and Community
- Enable the Decision Maker: Actionable Information at the Speed of Thought
- Responder of the Future: Protected, Connected, and Fully Aware
- Resilient Communities: Disaster-Proofing Society

To achieve these goals, we recognized that S&T needed to augment its approach to working with the private sector, and another of my earliest priorities at S&T was energizing a Homeland Security Industrial Base. DHS more than many federal agencies and much more than the Department of Defense as one example, is dependent on commercially-available, off-the-shelf products to achieve its mission. Because of this, partnership with industry, specifically in product development, is essential. R&D projects can yield isolated, one-off solutions, but a truly successful portfolio must strategically shape the shelf by inserting homeland security applications, if not as primary use cases or applications, at least as considerations during companies' product development cycles.

I am proud to say that this is an area where we have enjoyed considerable success over the last two years. We launched innovative accelerator and prize competition platforms to reach innovators and communities that may have never heard from or worked with government before. S&T piloted an innovative program in Silicon Valley that aims to maintain constant, face-to-face contact with venture capital and start-up communities outside the Beltway including the Silicon Valley area. We developed a fresh public face by overhauling S&T's website to be more informative and transparent. Combine all of this with an updated Strategic Plan publication and willing partners within the Department including in the Management Directorate and Office of the General Counsel, and we are beginning to see real interest in the private sector in participating in a Homeland Security Industrial Base.

Accelerators

Identifying and tapping into sources of innovation is critical to our ability to support frontline operators keeping the nation safe, and accelerators (i.e., seed funding and mentorship for entrepreneur teams and start-up companies to help them attract investment) are a valuable tool to

do just that. Last year, S&T piloted a business accelerator program to see if accelerators would work in the homeland security mission space. The inaugural effort, named *EMERGES*, focused on commercially-available wearable technology that could be adapted for first responders. More than 100 startups applied to the inaugural class, and 18 were selected and eventually featured last September at a Demo Day in San Francisco. *EMERGE* passed each of our initial tests, demonstrating interest in the start-up community in participation and graduation from our accelerator as well as the ability for companies to successfully develop products that attract private investment and still meet homeland security needs. More than half of *EMERGE* participants received interest from new private venture capital and strategic investors, three already offer commercially-available products, and one was even featured on "Shark Tank." Moving forward, we hope to build on this success in future iterations of homeland security accelerators in additional areas of work where the start-up community is ready to contribute.

Prize Competitions

Last year, S&T launched its InnoPrize program to assist DHS planning and executing prize competitions. InnoPrize utilizes America COMPETES Act authority to execute part of President's updated 2015 *Strategy for American Innovation*, which made it easier to use competition programs to encourage innovation, solve tough problems, and advance the core missions of the Department. This is a fresh approach to operational challenges, problem solving, and innovation aimed at problem solvers and solution makers uninterested in the burdens of traditional business with government but who otherwise are capable of helping.

S&T conducted two prize competitions in our first year of implementation, one for fresh approaches to the enduring problem of tracking first responders in GPS-degraded or denied environments and a second to seed development of a community of interest around the new National Bio and Agro-Defense Facility. Our third competition drew 58 submissions to help USCG improve navigational buoys by minimizing harmful impact to the ocean floor in environmentally-sensitive areas. Our experimentation with prize competitions in the last year has demonstrated their clear potential for widening our base of solvers and finding fresh approaches to some of the Department's enduring challenges, and I am excited to see wider use moving forward to continue infusing fresh perspective into some of our hardest problems.

Silicon Valley Presence

Building upon our existing work and partnerships in Silicon Valley, S&T is leading a departmental pilot initiative to cultivate a pipeline of non-traditional partners (e.g., start-ups) to accelerate research and innovation around homeland security priorities. Ultimately, DHS is trying to incentivize developers to widen the aperture of earlier in their development roadmaps to include homeland security solutions, again with the effect of shaping the shelf of end products available to our operators and first responders.

S&T worked closely with the DHS Office of Procurement Operations, including their Procurement Innovation Lab staff, to create an R&D-appropriate model that would keep pace with the innovation community in places like Silicon Valley. The first S&T Innovation Other Transaction Solicitation cycle focuses on securing the Internet of Things and promoting novel ideas and technologies that improve situational awareness and security for protecting domains including the 16 critical infrastructure sectors monitored by DHS. It began with an ideation

workshop connecting government end users and operators with participants from the private sector (large companies, manufacturers, venture capital, researchers, and small businesses) to frame the problem and jointly shape a path forward. The first award in February, only 30 days after the solicitation, went to a team aiming to secure Internet of Things infrastructure by improving visibility and providing dynamic detection as components connect or disconnect from a system. The Internet of Things solicitation is still open, and if our Silicon Valley presence continues to benefit the Department, S&T could use it as a model to launch a similar presence in communities like Austin, Boston, and Chicago around the country.

Empowering the S&T workforce

One final aspect of S&T I ensured was not overlooked when I joined the Directorate was our organizational health and internal organization. It was clear based on conversations with S&T staff, in addition to a record of below average Federal Employee Viewpoint Survey (FEVS) scores that empowering the workforce would be critical moving forward. We performed an organizational health assessment and complementary root cause analysis to identify the most pressing areas for improvement. We stood up an S&T Employee Council to guide implementation and serve moving forward as a springboard for communication and advice for staff to leadership. Poor organizational health takes time to turn around, but improvements in S&T's most recent FEVS scores, including substantial increases in several key indices, demonstrate that S&T is moving in the right direction.

Recent examples of Science and Technology Directorate successes

To conclude, here are a few examples from the *Results of Fiscal Year 2015 Research and Development* report, recently delivered to Congress, that illustrate some of the strong work in S&T's portfolio supporting DHS Components and first responders:

- In FY 2015, ICE operationalized its Big Data network architecture and tools, built by S&T's Data Analytics Engine and delivered to ICE as part of the Border Enforcement Analytics Program (BEAP) Apex, for agents in three major cities. These capabilities look across multiple data sets and increase the probability of detecting illicit activity. They led to new insights and investigations and raised ICE's profile within the counter-proliferation community, creating collaboration opportunities with other agencies and partner countries.
- For first responders in FY 2015, S&T licensed the Radio Internet-Protocol Communications Module (RIC-M) to two commercial partners to manufacture and sell in commercial markets. RIC-M as a low-cost interoperability solution that allows agencies to incrementally upgrade and affordably connect legacy systems with newer ones, averting a costly need to refresh entire systems at once and saving the first responder community millions of dollars. S&T was awarded a patent for the RIC-M technology and received its first royalties from RIC-M sales (seven percent of each sale made). The S&T-developed Finding Individuals for Disaster and Emergency Response (FINDER) technology also saw real-world operational use in the April 2015 Nepal earthquake response where it helped save multiple victims trapped beneath collapsed structures.
- In FY 2015, S&T continued progress on the Integrated Maritime Domain Enterprise-Coastal Surveillance System (IMDE-CSS) Program for port and coastal surveillance for CBP and USCG. A Chesapeake node integrated with Maryland State and local law

enforcement was linked to the original, operational Air and Marine Operations Center IMDE-CSS node in Riverside, CA. S&T continues to take major steps with its partners in USCG and CBP toward a functional, integrated system for situational awareness across all federal, state, local, tribal, territorial, and even private sector assets.

- S&T's ten university-based Centers of Excellence continue to deliver capabilities to homeland security end users. USCG, which continues to be one of the strongest supporters and beneficiaries of the Centers, received a Social Media Analytics and Reporting Toolkit (SMART, which helps alert to emerging threats in a geographically-focused stream of social media during major events) and a new, more sophisticated version of the Boat Allocation Module (BAM II, which helps save resources and deploy more effectively across stations). FEMA received the now-operational Risk Estimator for Embankment Structures to assess and maintain levees and dams to prevent failure during future storms.
- TSA received S&T-developed systems in FY 2015 that will aid implementation of classroom-based training in visual search and detection training and cross-gender empathy through appropriate hand placement and position. S&T also delivered vulnerability assessments of suicide bombers in commercial aircraft to inform in-flight emergency protocols for response and mitigation, and S&T's explosives detection canine program transitioned an S&T-developed non-detonable training aid that is considerably more affordable and effective than previous methodology at improving canine detection proficiency.
- FEMA purchased 10,000 device license subscriptions for MobileIron, effectively covering its entire inventory of working mobile devices and making MobileIron its solution of choice moving forward. MobileIron is a mobile configuration manager that improves policy enforcement and assists enterprise users in keeping their mixed-use mobile devices secure. S&T enhanced and delivered the product as part of an In-Q-Tel collaboration.
- In FY 2015, S&T's Transition to Practice piloted, transitioned, or licensed five cybersecurity technologies to the marketplace. These are federally-funded tools and technologies that S&T is converting from laboratory tools to commercially-available products that will be used to strengthen our networks. S&T also continues to provide cybersecurity tools to law enforcement and delivered three tools last year that ensure computer incident evidence integrity, protect records from illicit access or modification, and verify physical location of law enforcement network-enabled mobile devices.
- In addition to technology development for Components, S&T also supports the Department's efforts to improve and integrate internal processes. In FY 2015, S&T provided technical staff and support to the Joint Requirements Council (JRC) that included assistance with process development and technical subject matter expertise reach back for the JRC's Portfolio Teams. S&T also re-established the Department's Integrated Product Team process to coordinate the Department's R&D and began a process for technical assessments of DHS major acquisitions to increase integration of acquisition and R&D activities.
- During the Ebola response in FY 2015, S&T directed research at its National Biodefense Analysis and Countermeasures Center (NBACC) laboratory to determine the stability of Ebola in blood and other body fluids under relevant environmental conditions and surfaces including personal protective equipment and airline carpet. This effort, along

with previous research on Ebola virus, was adopted by the White House's Ebola Task Force and influenced the approach and procedures of multiple federal agencies during the response. USCG is also using the information to update its operational protocols for decontamination of Ebola-contaminated surfaces.

- S&T provided technical assistance to the Secret Service during the Pope Francis's September 2015 visit. S&T's Modeling and Simulation Engine generated technical oversight for crowd ingress, egress, and emergency evacuation during the Pope's visit including the outdoor mass at the Basilica of the National Shrine of the Immaculate Conception and surrounding areas. S&T's models enabled informed adjustments to congestion and bottlenecks for evacuation planning and resource positioning for the events.

I thank you again for your support and for the opportunity to testify before the Committee today on R&D in the Department and S&T's FY 2017 budget. I look forward to your questions.