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S. HRG. 113–465, PT. 5

DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEAR 2015 AND THE FUTURE YEARS DEFENSE PROGRAM

HEARINGS

BEFORE THE

COMMITTEE ON ARMED SERVICES
UNITED STATES SENATE

ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

ON

S. 2410

TO AUTHORIZE APPROPRIATIONS FOR FISCAL YEAR 2015 FOR MILITARY ACTIVITIES OF THE DEPARTMENT OF DEFENSE, FOR MILITARY CONSTRUCTION, AND FOR DEFENSE ACTIVITIES OF THE DEPARTMENT OF ENERGY, TO PRESCRIBE MILITARY PERSONNEL STRENGTHS FOR SUCH FISCAL YEAR, AND FOR OTHER PURPOSES

PART 5
EMERGING THREATS AND CAPABILITIES

MARCH 11; APRIL 1, 8, 2014

Printed for the use of the Committee on Armed Services

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DEPARTMENT OF DEFENSE AUTHORIZATION OF APPROPRIATIONS FOR FISCAL YEAR 2015 AND THE FUTURE YEARS DEFENSE PROGRAM

TUESDAY, MARCH 11, 2014

U.S. SENATE,
SUBCOMMITTEE ON EMERGING
THREATS AND CAPABILITIES,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

U.S. SPECIAL OPERATIONS COMMAND

The subcommittee met, pursuant to notice, at 2:14 p.m. in room SR–222, Russell Senate Office Building, Senator Kay R. Hagan (chairwoman of the subcommittee) presiding.

Committee members present: Senators Hagan, Reed, Nelson, Manchin, Kaine, Fischer, and Graham.

OPENING STATEMENT OF SENATOR KAY R. HAGAN, CHAIRWOMAN

Senator HAGAN. Good afternoon. Today, the subcommittee welcomes the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict (ASD(SO/LIC)) the Honorable Michael D. Lumpkin, and the Commander of U.S. Special Operations Command (SOCOM), Admiral William H. McRaven, USN, to receive testimony on the posture of U.S. Special Operations Forces (SOF) and Department of Defense (DOD) programs, policies, and operations with respect to countering emerging terrorism threats, in preparation for the subcommittee's markup of the National Defense Authorization Act (NDAA) for Fiscal Year 2015. We look forward to your testimony.

Time permitting, today's hearing will have both an open session and a closed session. At the conclusion of this open portion, it is our intention to reconvene in room SVC–217 in the Capitol Visitor Center for the closed portion.

The Quadrennial Defense Review (QDR) released last week describes the continuing threat posed by al Qaeda and the associated groups this way, and let me quote: "Although core al Qaeda has been severely degraded, instability in the Middle East and civil war in Syria have enabled al Qaeda to expand its global reach and operate in new areas."

The QDR also highlights the role of SOF in addressing these challenges. While DOD protects SOCOM from some of the deeper

cuts required by Congress in its fiscal year 2015 budget request, SOF are not immune from budget pressures. Specifically, I understand the growth of SOF will now level off at 69,700 personnel, rather than the approximately 72,000 personnel that had been called for by previous QDRs.

Additionally, SOF rely heavily on enabling capabilities provided by the Services, including intelligence, logistics, and other support, that may be impacted by cuts to their respective budgets.

Lastly, I am concerned about the lack of a plan by DOD to transition appropriate funding for SOCOM from the Overseas Contingency Operations (OCO) budget to the base budget in future years to protect the enduring SOF capabilities built over the last 12 years. Admiral McRaven, you recently testified that, "SOCOM relies heavily on OCO funding today, with the National Mission Force in particular funded with 67 percent of OCO." The subcommittee looks forward to hearing both of your perspectives on these issues and the level of risk you believe DOD is assuming under the current budget pressures.

Of course, the ability of SOCOM to carry out the full range of missions it has been assigned does not solely rely on the size of its budget, but also on the authorities available to SOF. Last year, the office of the ASD(SO/LIC) completed a report which raised a number of concerns about the "patchwork of authorities used by SOF to engage with partner nation security forces." With Secretary Lumpkin here, I hope we can hear your assessment of these authorities and what, if any, changes we should consider as we prepare for the NDAA for Fiscal Year 2015.

I also plan to ask for your assessment of recent changes to the human rights vetting requirements, the so-called Leahy vetting, and the impact of those changes on DOD security assistance programs carried out by SOF. The subcommittee is particularly interested in hearing about the process for remediating foreign forces once they have been flagged under the Leahy vetting.

A particular area of focus for this subcommittee this year is the intelligence, surveillance, and reconnaissance (ISR) assets, given DOD's decision to reduce its planned capacity for around-the-clock unmanned combat air patrols. This decision, when coupled with our combatant commanders' comments about the small percentage of their ISR requirement that is currently being supported, is concerning and I think we will all be eager to hear your assessments.

Admiral McRaven, let me take this opportunity to applaud you for the Preservation of the Force and Families Initiative and I also look forward to hearing your thoughts on what the subcommittee can do to better support SOCOM in this regard.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chairwoman, and I join you in welcoming our witnesses and thank them and the men and women of the Special Operations community for their continued service to our Nation. Their testimony today will play an important role in informing the development of the NDAA for Fiscal Year 2015.

As instability and violence spreads across the Middle East and North Africa, terrorist groups like al Qaeda are taking advantage of that chaos. Today, al Qaeda and other terrorist organizations

now operate in more countries and control more territory than ever before. At the forefront of our efforts to combat global terrorism are the men and women of SOCOM. As noted by Admiral McRaven in his prepared remarks, our special operators are engaged in more than 70 countries at any given time and are often our first line of defense against an evolving and increasingly dangerous terrorist threat.

However, demand for these elite troops continues to far exceed supply, placing enormous strain on the readiness of the force. Further, budgetary constraints are placing added pressure on our SOF and the enablers they depend on to accomplish their missions.

I look to our witnesses to update the subcommittee on the status of these forces, as well as outline efforts to ensure that these forces maintain the readiness and capabilities required to operate in an increasingly complex and challenging global security environment.

Thank you, Madam Chairwoman.

Senator HAGAN. Thank you, Senator Fischer.

I am going to ask both of you to keep your opening statements 3 to 5 minutes. We do have copies of your prepared statements. So, Secretary Lumpkin, if you will begin, please.

STATEMENT OF HON. MICHAEL D. LUMPKIN, ASSISTANT SECRETARY OF DEFENSE FOR SPECIAL OPERATIONS/LOW-INTENSITY CONFLICT

Mr. LUMPKIN. Chairwoman Hagan, Ranking Member Fischer, distinguished members of the subcommittee: Thank you for your steadfast support to our special operators in the SOCOM. The authorities and appropriations Congress has provided DOD have allowed us to prosecute the current fight and ensure we are prepared to confront emerging threats and to protect the Homeland. I am pleased to testify with Admiral Bill McRaven, who has expertly led SOCOM for the past 3 years.

The threat we face, especially from al Qaeda, is continuing to change. Although the scale of the threat to the Homeland has diminished, threats to our interests overseas are increasing. With their leadership depleting, al Qaeda still retains sanctuaries in remote areas of Afghanistan, Pakistan, Yemen, and Somalia. Terrorist organizations are also expanding in Syria, North Africa, and the Sahel. The threat continues to evolve. We must maintain our pressure on terrorist organizations to protect the Homeland.

We are in a time of transition. We face a yet undetermined drawdown in Afghanistan and new fiscal realities. It may be more difficult to maintain pressure on al Qaeda in the traditional safe havens. I closely monitor how the cuts to the Services impact the readiness of SOCOM. We are assessing the impact on the critical enablers. For example, we are ensuring the cuts to the ISR fleet will not erode our ability and capability to find, fix, and finish targets. As we transition in Afghanistan and redistribute SOF to other theaters, we need to ensure our operations and maintenance (O&M) accounts are resourced to support operations.

In accordance with the NDAA for Fiscal Year 2014, ASD(SO/LIC) and the Under Secretary of Defense for Acquisition, Technology, and Logistics are strengthening our roles in the oversight of SOCOM to maximize efficiencies and maintain oversight respon-

sibilities of Major Force Program 11. These include routine interactions between my staff and SOCOM and frequent dialogue between me and Admiral McRaven. We owe the President the best strategic options to accomplish our national strategic objectives.

This is conducted in close coordination and honest discussion with Congress as you exercise your oversight, authorization, and appropriations responsibilities. We are moving from a state of perpetual war to perpetual engagement, engaging with partners to build their capacity, engaging problems before they become too big to fix, and engaging in direct and indirect action to disrupt and destroy our enemies.

As we move towards a globally networked perpetual engagement, our efforts are grounded in the experiences that demonstrate the success of this approach. Colombia and the Philippines are case studies in how a small investment of SOF, resourced for an enduring time frame, can have positive results. In the Philippines, a task force of about 500 special operators and supporting general purpose forces helped degrade a serious transnational terrorist threat from Abu Sayyaf and Jemaah Islamiyah. In Colombia, we provided counterinsurgency training and humanitarian assistance to prevent narcotraffickers from developing sanctuaries. This effort in Colombia not only resulted in a far more secure and prosperous nation now, it has emerged as an exporter of regional security.

We have the same opportunities in Africa and the Middle East. Our support to the French in the Sahel has been critical in stemming the tide of extremism in Mali. Modest support to African Union Mission to Somalia (AMISOM) in the Horn of Africa has helped to reverse the trajectory of Al Shabaab. These discrete activities and operations constitute the global SOF networks required for perpetual vigilance.

I am proud to represent the soldiers, sailors, airmen, marines, and civilians of SOCOM. Their sacrifices in this war are immense. Since October 2001, 385 special operators have been killed in action and another 2,160 have been wounded. I am committed to doing everything I can to ensure these warriors have the best training, equipment, and support we can provide. Working closely with Congress, we will surely have the right strategies and policies in place to employ them effectively.

Thank you for your continuing support. I look forward to your questions. Thank you.

[The prepared statement of Mr. Lumpkin follows:]

PREPARED STATEMENT BY HON. MICHAEL D. LUMPKIN

INTRODUCTION

Chairwoman Hagan, Ranking Member Fischer, and distinguished members of the subcommittee, thank you for allowing me to join you today, and for all your steadfast support for our Special Operators and the U.S. Special Operations Command (SOCOM). I am very pleased to be before you with Admiral Bill McRaven, who has expertly led SOCOM over the past 3 years. I say without reservation that Admiral McRaven has made a strong command even better. He's been a visionary leader for decades. The programs and initiatives he's put in place to provide premier special operations capabilities to our geographic combatant commands, to oversee and synchronize global counterterrorism operations, and to take care of our special operators and their families, will serve the Nation for years to come.

EVOLVING THREATS

The nature of the threat that we are facing, especially regarding al Qaeda, is changing. Pressure from the United States and our allies has altered al Qaeda's campaign plan. Al Qaeda has been forced to relinquish control over its affiliates, which allows threats from these groups to develop more quickly. Although the scale of threat to the U.S. Homeland has diminished, threats to U.S. persons and interests overseas are increasing. We're also seeing an increase in the use of technology, perhaps a function of a younger generation of terrorists who are more adept with smart phones and social media services.

Although their leadership cadre has been depleted, al Qaeda and its affiliates retain sanctuaries in the Afghanistan-Pakistan border region and in remote areas of Yemen and Somalia. It is also working to co-opt insurgent movements and violent extremists in Syria, North Africa, and the Sahel. From these regions, the threat of al Qaeda attacks against U.S. interests and personnel overseas has grown. Al Qaeda is a resilient organization that has become adept at exploiting lapses in security during and following political transitions, civil wars, and periods of unrest. This is particularly true across the Middle East and in Africa. The threat posed by al Qaeda and like-minded groups will continue to evolve and it is essential that we remain vigilant, prepared and resourced the meet the threat. We must maintain pressure on al Qaeda and its affiliates to ensure they cannot reconstitute a capability to attack the homeland.

The threats we face are not limited to al Qaeda and terrorist organizations. North Korea continues to present a threat by proliferating weapons of mass destruction. As we have seen play out over the past few months in the Central African Republic and South Sudan, political instability exacerbated by ethnic and or religious differences can escalate into violence requiring international intervention. We are also called upon to support regional issues, such as the effort to eradicate the Lord's Resistance Army from Central Africa. These demands will continue and we must be prepared to conduct a wide range of operations, often with little notice.

TIME OF TRANSITION

The Department of Defense is in a time of transition. We are ending the longest prolonged period of war in our Nation's history. The future of Afghanistan—as we go through negotiations on the Bilateral Security Agreement—is yet to be determined. If we are unable to achieve an acceptable agreement and withdraw our forces, it will be much more difficult to maintain pressure on al Qaeda in Kunar and Nuristan, which are the traditional al Qaeda safe havens. Secretary Hagel has told us to plan for all contingences and the department is doing just that.

We are at the end of a long period of historic growth in military budgets and manpower, and must increase our effort to make the most efficient and effective use of the taxpayer dollar without diminishing America's safety. The President's budget submission for fiscal year 2015 levels SOF growth at 69,700 servicemembers. Admiral McRaven and SOCOM have done an excellent job finding efficiencies within the Headquarters and realigning billets and capabilities to support the seven Theater Special Operations Commands that are under the combatant command of SOCOM, but operate in direct support of the geographic combatant commanders.

As Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict (ASD(SO/LIC), I watch very closely how cuts to the Services impact the readiness of SOCOM. As the Department continues to review and make adjustments to size the force correctly, we are closely monitoring and assessing the availability of critical enablers. For example, we are working with the Services to ensure that cuts to the current ISR fleet will not erode our core capability to find, fix, and finish targets. At the same time, we are continuing to balance our organic enabler capabilities to allow SOF to deploy with speed, precision, and lethality to a broad range of contingencies anywhere in the world.

After some very tough decisions during this year's budget review, SOCOM's base budget request for fiscal year 2015 is less than the levels projected in the 5-year budget plan submitted by the President last year but greater than the amount enacted for fiscal year 2014. As we transition operations in Afghanistan and redistribute SOF into other theaters, we will need to ensure that our operations and maintenance (O&M) accounts are sufficiently resourced to support these deployments.

We will also watch our Investment accounts carefully. We must maintain the ability to recapitalize and update current platforms such as the efforts underway with both the MC–130J and MC–130P tanker fleets, and to develop and procure SOF specific platforms and systems for both ground and maritime mobility. We must also ensure we invest in the future. Investment in research and development is much

like investment in education; the benefits are most often seen a decade down the road. A critical element in the research and development enterprise for special operations is the Combating Terrorism Technical Support Office (CTTSO) which is part of SO/LIC. CTTSO brings together, SOF, the interagency, industry and the Services to find the best solutions to existing and future requirements. Their efforts complement and enhance those of SOCOM's Special Operations Research, Development and Acquisition Center.

IMPROVING OUR OVERSIGHT

It is imperative from an oversight perspective that SO/LIC look across the department and find material, acquisition and manpower options that ensure our Special Operations Forces are trained, ready, and postured to meet the rapidly evolving threat.

We have reinforced our supervisory capabilities by leveraging the subject matter expertise of the Joint Staff and the Office of the Secretary of Defense (OSD) Staff to include the offices of AT&L, P&R, Comptroller, OUDI and Cost Assessment and Program Evaluation. This effort reflects the National Defense Authorization Act for Fiscal Year 2014 which calls on ASD(SO/LIC) and the Under Secretary of Defense for Acquisition, Technology, and Logistics to strengthen their defined roles in the oversight of SOCOM.

We have a number of established processes that bring SOCOM, the Joint Staff, and the OSD Staff together to ensure we maintain proper oversight of SOCOM strategy and policy initiatives and maintain oversight responsibilities of Major Force Program 11 (MFP–11) funds. These include, but are not limited to routine interaction between my staff and the SOCOM Washington Office, daily coordination with the Joint Staff on operations—ongoing and planned, senior level SO/LIC attendance at the monthly SOCOM Commander's Decision Round Table, and frequent dialogue between myself and Admiral McRaven.

The oversight responsibilities of my office take on added importance in an environment of fiscal constraint and technological growth. By partnering with OSD(AT&L) through a SOF acquisition senior level forum, we are enabling the Department to share technology information with the Services, resolve issues, and provide opportunities to leverage technology and resources for SOF.

STRATEGIC OPTIONS

In times of uncertainty, we owe the President and the Secretary of Defense the best strategic options to accomplish our national security objectives. This is conducted in close coordination and honest discussion with Congress as you exercise your oversight, authorization and appropriation responsibilities. In the best case, we develop options in advance of crisis, but we must also maintain the ability to quickly react to and support national defense objectives during the heat of crisis.

We must develop options that allow SOF to operate forward in this increasingly population-centric fight that centers not on terrain, but within the human domain. We are moving from a state of "perpetual war" to "perpetual engagement"—engaging with partners to build their capacity; engaging with problems before they become too big to fix without breaking the budget—and, yes, engaging in action, direct or indirect, whenever necessary to keep our enemies off-balance or eliminate continuing/imminent threats.

We must build upon our existing network of bilateral alliances and partnerships and seek opportunities to develop additional partnerships. We must address the sources of potential conflict before they create larger problems. This new network approach involves interagency support to foster bilateral ties.

This work—which focuses on security cooperation, building partner capacity, and a keen awareness of local conditions—relies heavily on the capabilities of our Special Operations Forces. The ability of SOF to operate with a small footprint in the human domain and in contested environments will only become more important in a future of globally dispersed and irregular threats.

As we build networks with our willing partner nations, SOF is very reliant upon congressionally authorized and properly appropriated programs. I want to thank Congress for continued support for Section 1208 and 1206 authorities. Section 1208 is a critical tool that extends the reach of our forces by allowing them to work more closely with foreign forces, irregular forces, groups or individuals supporting U.S Special Operations to combat terrorism. The demand for programs under these authorities from the geographic combatant commanders is high and we are approaching the $50 million annual authorization cap. With the challenges and limitations of U.S. unilateral direct action operations, we believe the need for 1208 authority—

as a complementary force multiplier—will extend past its' current expiration at the end of fiscal year 2015.

Section 1206 authority allows the Secretary of Defense to build the capacity of foreign military forces to conduct counterterrorism or stability operations. Section 1206 has had notable successes in Afghanistan as we prepared our NATO partners for combat operations. The challenge before us now is to attain the same level of success we have enjoyed through this authority in Afghanistan in other parts of the globe. Programs under this same authority are now focused on the terrorist hot spots of Yemen, East Africa and North Africa.

Programs under both of these authorities are examples of our continued close cooperation with the Department of State. Programs under 1208 must have concurrence from the relevant Chief of Mission and 1206 must have concurrence from the Secretary of State. We have already notified Congress for the first two tranches of 1206 authority programs for this fiscal year.

The Global Security Contingency Fund (GSCF), a pilot authority entering its third year, was established as a joint Department of Defense and Department of State administered program. The fiscal year 2014 Appropriations Act provided $30 million for GSCF, the first time money was appropriated for the authority. We appreciate your support for this, as it will greatly improve our ability to execute GCSF programs. Along with the Department of State, we are committed to identifying high priority programs for GSCF.

PAST OPERATIONS AND FUTURE SUCCESSES

As we move towards a state of globally-networked perpetual engagement, increased reliance on partner nations, and reduced footprint operations, our efforts are grounded in experiences that demonstrate the success of this approach. Colombia and the Philippines are case studies in how a small investment of SOF, resourced for an enduring timeframe, can have positive results.

In the Philippines, with a task force of about 500 SOF and general-purpose force enablers, we helped degrade what was once considered to be a serious transnational terrorist threat from Abu Sayyaf and Jamaah Islamiyah. Our efforts helped deny al Qaeda a strong regional presence in Southeast Asia, and made if harder for terrorists to carry out high profile attacks such as the 2002 Bali bombing.

In Colombia, we provided significant military aid, counterinsurgency training, and humanitarian assistance in a broad-based initiative to prevent narcotics traffickers from developing sanctuaries in that country. Plan Colombia was a sustained commitment to building the capacity of an important partner. It involved long-term efforts to help Colombia build a more professional, more accountable, more capable military—giving that nation the ability to solve its own security challenges, and to take ownership of the vital process of eliminating terrorist and insurgent sanctuaries within its own borders. Plan Colombia was an interagency effort to assist the Colombians in eradicating narcotics and building stronger financial institutions.

This work has paid off. Colombia is not only a far more secure and prosperous nation now; it has emerged as an exporter of regional security.

We have the same opportunities before us now in Africa and parts of the Middle East. As we did in Colombia and the Philippines we must be willing to accept the risk of placing small numbers of specially trained forces forward to develop the trust of our partner forces and enable them over the long term to adequately deal with violent extremists and terrorists that threaten our mutual security goals. These relatively small investments come in many forms and can be tailored to support U.S. security objectives. Our logistical, intelligence and, when required, operational support to the French and African partners in the Sahel has been critical in stemming the tide of violent extremism in Mali. Modest investments supporting AMISOM troops in the Horn of Africa have helped to reverse the trajectory of al-Shabaab. In Yemen, we have had successes but require a more robust and sustained effort to turn the tide of al Qaeda in the Arabian Peninsula's expansion.

These discrete activities and operations, in support of geographic combatant commanders, in close concert and with the concurrence of Ambassadors and country teams, anchored through liaison with the interagency and in partnership with willing allies is what comprises a global SOF network. What we do in Yemen has effects across the Gulf of Aden in Somalia. Our activities in the Sahel to support regional armed forces efforts to interdict smuggling and resupply lines have effects in Mali and Libya. We do not always have to take unilateral direct action, but the nature of the threat does require that we must always be engaged.

CONCLUSION

Within SOF, we have five axioms that we call the SOF Truths. The first of which is, "Humans are more important than hardware." The SOF operator is our primary weapon system, and it is my goal and the goal of all in SO/LIC to ensure they are resourced and prepared for today's fight and the battles we will face in the future. The same can be said of taking care of our families. SOCOM's Preservation of the Force and Family program, takes a whole-person approach to the mental, physical, spiritual and psychological welfare of the force. With the great demands we place on our SOF operators, the pro-active nature of this program builds resilience and strength both for the SOF operator and for our families.

As ASD(SO/LIC), I am proud to represent the soldiers, sailors, airman, marines, and civilians that are assigned to SOCOM. Their sacrifices in this war are immense—since October 2001, 385 Special Operators have been killed in action, and another 2,160 have been wounded. We have asked a lot of the men and women assigned to our SOF formations since September 11, and we will continue to ask much of them in the future. I am committed to doing everything I can to ensure these brave warriors have the best training, equipment, and overall support we can possibly provide and to work closely with Congress and my senior policy colleagues across the government to ensure we have the right strategies and policies in place to employ them effectively.

I thank Congress for your continuing support to our men and women in uniform and look forward to your questions.

Senator HAGAN. Thank you, Secretary Lumpkin.

Admiral McRaven.

STATEMENT OF ADM WILLIAM H. McRAVEN, USN, COMMANDER, U.S. SPECIAL OPERATIONS COMMAND

Admiral McRAVEN. Thank you. Madam Chairwoman, Ranking Member Fischer, distinguished members of the subcommittee: Thank you again for giving me the opportunity to address you. This is the third hearing I have been to with this subcommittee in my time as the Commander of SOCOM.

I would also like to recognize my friend and colleague, Assistant Secretary Michael Lumpkin. We have a great partnership and I value ASD(SO/LIC)'s oversight and support of SOF.

Madam Chairwoman, I am pleased to say that since my last hearing, SOCOM has made some great strides in dealing with the current conflicts, preparing for the future conflicts, and, most importantly, taking care of our people. SOCOM continues to provide the world's finest warriors to the fight in Afghanistan. As we approach the end of 2014, your SOF will be ready to adjust to whatever decisions are made regarding our future employment in that country. Globally, we are developing plans to better serve the geographic combatant commanders, who, owing to the past 12 years of engagement in Iraq and Afghanistan, have gone underresourced with SOF.

SOCOM, as the DOD synchronizer for the war against terrorism, is also working hard to better coordinate our activities locally, regionally, and globally with both the geographic combatant commanders and the U.S. Ambassadors. I believe the future of special operations will be in helping to build partner capacity with those willing nations who share our interests. This will mean strengthening our existing allied relationships and building new ones. No nation alone can stem the rise of extremism and we need our friends and allies more now than ever before.

Our future SOF are also inextricably linked to the general purpose force and the interagency. The past 12 years have shown us that a whole-of-government effort is required to be successful

against extremism, and in SOF we have always relied heavily on our fellow soldiers, sailors, airmen, and marines for support around the globe.

Finally, we have gone to great lengths to take care of our most precious resource, our people. The Preservation of the Force and Families (POTFF) Initiative has already seen a marked improvement in the morale and the wellbeing of those who serve in SOF. While we still suffer from the tragedy of high suicide rates, I believe we have laid the foundation for keeping our force and their families strong and resilient into the future.

Once again, thank you for your interest and your unwavering support for the men and women in special operations. I look forward to your questions.

[The prepared statement of Admiral McRaven follows:]

PREPARED STATEMENT BY ADM WILLIAM H. MCRAVEN, USN

Madam Chairwoman and distinguished members of the subcommittee, thank you for this opportunity to address you, the third in my tenure as the 9th commander of U.S. Special Operations Command (SOCOM).

SOCOM is one of nine Unified Combatant Commands, yet distinct in its numerous Service, military department, and defense agency-like responsibilities. Under title 10, U.S.C., sections 164 and 167, it is my legal responsibility, as SOCOM Commander, to organize, train and equip my force. This includes building a strategy that supports the goals and objectives of the Defense Strategic Guidance and providing combat ready forces to the President and the Secretary of Defense. Our mission remains to provide trained, equipped, ready, and regionally aligned Special Operations Forces (SOF) in support of geographic combatant commanders (GCCs), and through unified action, conduct sustained special operations to eliminate threats to U.S. interests and protect the American people. I am greatly appreciative of the continued support from Congress and this committee in particular. We welcome the opportunity to update the members of the Senate with our current posture.

As it stands today, my force is comprised of 66,000 men and women. On any given day, our SOF are deployed in over 75 countries, in many cases working side-by-side with multiple interagency and international partners. Our unique contribution to national security emanates from our superb SOF warriors, who time and time again demonstrate their dedication to duty, tenacity, and unwavering commitment to the security of our Nation. Since September 11, our operations, ranging from peacetime engagement and building partner capacity, to direct action raids and irregular warfare, have contributed significantly to not only our own national security, but global stability at large. As their commander, I will forever be grateful for the contributions of these fine men and women and their families who support them.

GENERATIONAL CONFLICT

Our Nation and its allies are engaged in a generational conflict. Our most extreme adversaries largely consist of individuals and organizations that are irreconcilable to a non-violent ideology. Terrorism and extremism are problems that we will have to deal with for some time to come. We face unprecedented challenges from an increasingly complex operating environment filled with agile, rapidly adapting belligerents—adversaries that we expect to be even more innovative and asymmetric in their approach to conflict in the years ahead.

Complicating the global situation are some key trends shaping the strategic security environment: the redistribution and diffusion of global power; the rising role of non-state actors; the easy access to advanced technology—especially information technology; shifting demographics—specifically the rapid growth and expansion of the urban environment; and the improving, yet still fragile economic health of the United States and its partners. Modern interconnectivity ensures that instability and conflict will not often be constrained by geographic boundaries. There is no such thing as a local problem. Local issues quickly become regional, and regional issues inevitably have global influence.

Afghanistan is a prominent example of this. Their security infrastructure is still fragile, and under constant threat from multiple groups. Although the Afghan Army is leading operations there, and the Afghan Local Police have grown in size and capability to foster stability in dispersed villages, there is more work to be done.

In Yemen, al Qaeda in the Arabian Peninsula continues to find ungoverned spaces from which to operate and from which to stage attacks and promote their violent ideology. In Northwest Africa, al Qaeda in the Islamic Maghreb, al-Murabitun, al-Shabaab, Boko Haram, and other violent extremist groups are fighting to expand their influence, destabilize communities, and discredit weak governments.

In the Levant, the flow of foreign fighters into Syria is unprecedented, even compared to what we saw in Iraq. The experience they gain will threaten future regional stability and feed violent extremist organizations as they flow back out of that civil war and threaten our allies and partners in the Middle East, Europe, and beyond. In the Pacific, growing tensions between regional powers raise the risk of miscalculation.

In the Western Hemisphere, alliances between transnational criminal organizations, violent extremist organizations, and state leaders create corruption and threaten governments' stability. Growing relationships between terrorist organizations and human smuggling networks present new opportunities to move terrorists and contraband around the world undetected via smuggling routes. The challenges the United States and its allies face from transnational violent extremist organizations require a global approach and a global perspective to counter a global threat.

PERSISTENT ENGAGEMENT

Active, forward engagement is the foundation of this global Special Operations approach, and represents the comprehensive, layered defense required to isolate violent extremist networks and prevent adversaries from conducting successful operations against the homeland, U.S. interests, and our allies. In accordance with Presidential and Secretary of Defense guidance and in coordination with the Department of State, we continue to forge relationships with partner nations, where augmenting the capability of local forces equates to perhaps the most cost-effective way of deterring adversaries worldwide and protecting American citizens abroad. While doing so, we remain committed to human rights vetting and the safeguarding of civil liberties throughout these military and strategic alliances.

Our SOF engagement takes place in the Human Domain—the totality of the physical, cultural, and social environments that influence human behavior in a population-centric conflict. The Human Domain is about developing an understanding of, and nurturing influence among, critical populaces. SOF is uniquely suited for operations that win population-centric conflicts, oftentimes, and preferably, before they start.

Chairman Dempsey has said that successfully confronting tomorrow's national security challenges requires "building a stronger network to defeat the networks that confront us." Networks are rooted in relationships, and building global relationships requires trust. At its foundation, relationships can only be achieved by persistently engaging with willing partners. Increased understanding, trust, and influence are vital to preventing miscalculations and protracted conflicts. Proactive, relationship-based approaches grow through effective, enduring partnerships and globally-agile, forward-deployed or forward-based SOF. SOF can achieve these strategic ends with a small footprint, while not constituting an irreversible foreign policy decision.

However, no matter how much we engage regionally and globally and seek peaceful paths to stability, we will inevitably find ourselves facing irreconcilables, bent on organizing and executing operations against our Homeland, interests, and allies. Defeating organizations like al Qaeda, its affiliates and adherents, requires persistent pressure against their critical requirements, capabilities, and resources. It requires the removal of key leaders, denying/disrupting safe havens, severing connectivity between extremist nodes, challenging violent ideology, and offering alternatives to potential recruits. When we remove pressure, we see them metastasize, regionally and globally. To that end, we must maintain the world's premier capability to conduct global, full-spectrum direct action—unilaterally if required. Our ability to proactively apply pressure and, when required, respond quickly with decisive action requires access; and access requires active forward engagement by the interagency team.

ORGANIZED FOR SUCCESS

In order to have persistent engagement, we need to be organized for success. Our organization must be prepared to employ the guidance we receive from the President, the Secretary of Defense, and the Chairman. In his May 2013 speech on U.S. Counterterrorism policy, the President said, in part:

> "Beyond Afghanistan, we must define our effort not as a boundless global war on terror, but rather as a series of persistent, targeted efforts to dismantle networks of violent extremists that threaten America."

Our strategy is further informed by the current Defense Strategic Guidance, which directs the Joint Force of the future to be agile, flexible, ready, and use innovative, low-cost, and small footprint approaches. The Secretary and the Chairman also issued guidance for SOCOM to develop a campaign plan to achieve strategic end states and persistently align SOF capability and provide SOF support to GCC requirements.

Additionally, the "Forces For" Unified Commands Memorandum (which assigns forces to U.S. commands across the globe), signed by the Secretary of Defense in 2013, gives SOCOM Combatant Command authority over the Theater Special Operations Commands (TSOCs)—units assigned to each of the seven combatant commands (e.g., U.S. European Command, U.S. Pacific Command). SOCOM's management of the TSOCs establishes the global agility necessary to support the GCCs with the correct mix of SOF capabilities at the right time and place. It is with this national-level guidance that we have sought to strengthen our global SOF network of allies and partners.

In September 2013, SOCOM hosted a Global Synchronization Conference. The GCCs gathered in our headquarters to review and discuss SOCOM's plan to align capability and support their steady-state requirements and national objectives; the visiting commanders' feedback was overwhelmingly positive. Our plan aims to protect the American homeland through an active, layered defense by sustaining special operations forces forward to engage partners and proactively deter, prevent, and when necessary, defeat threats to the United States.

In order to meet these objectives, we are taking four specific actions. First, as we draw down from Afghanistan, we are redistributing those forces across the combatant commands to better meet the needs of the regional military commanders. Second, we are in the process of realigning our CONUS-based forces to focus more closely on regional problem sets, ensuring that our personnel are true experts in the terrain, languages, and cultures in their respective areas of responsibility. Third, we are establishing subordinate task elements who have a high-end counterterrorism capability under each Theater Special Operations Command. Finally, to tie it all together, we have implemented a daily coordination system of enterprise-wide video teleconferences to share information across the global network and synchronize effects. The network is now truly beginning to perform to its potential. As the global synchronizer for the planning of global operations against borderless terrorist networks, SOCOM can provide a sustained level of effort regionally and link those efforts to create global effects.

None of this can be accomplished without resources, and we are pleased that the recent passage of the Bipartisan Budget Act (BBA) safeguards both Command readiness levels and SOF's current capabilities; we thank you for this stability. After a rigorous Program Budget Review, SOCOM's budget is not expected to reach the levels projected in the 5 year budget plan submitted by the President last year. But, despite current fiscal austerity and force drawdown, the Office of the Secretary of Defense has recommended that SOF grow to 69,700 personnel from roughly 66,000 today. These numbers reflect Congress' and the Department of Defense's (DOD) intent to rebalance the Nation's defense, which began with the 2006 Defense Quadrennial Review.

In order to maintain a global SOF network compatible with Defense Strategic Guidance, SOCOM's programmed manpower plan is essential. Preserving our current level of resource flexibility within investment accounts cannot be overstated. SOCOM relies heavily on Overseas Contingency Operations (OCO) funding today, with the National Mission Force, in particular, funded with 67 percent of OCO. In addition, we remain reliant on the Services for logistics, installations services, combat service support in forward deployed locations, and institutional training and education. We look forward to working with Congress to maintain a sustainable long-term funding stream.

We are engaging with the conventional forces as they adapt to strategic guidance in their own ways. We are coordinating with the Army's effort to regionally align their forces, the Navy's push to revitalize the maritime proficiency of their SOF after over a decade of land-centric operations, and the Air Force's focus on development of Intelligence, Surveillance, and Reconnaissance (ISR) capabilities. We are collaborating with the Chief of Naval Operations and the Commandant of the Marine Corps to provide special operations forces liaison elements to deploying Marine Expeditionary Units/Amphibious Readiness Groups. These teams will provide enhanced capabilities to the GCCs by leveraging our enduring partnership with the U.S. Marine Corps.

We continue to strengthen our relationships with our interagency partners, whose collective support is absolutely essential to our operations. Special Operations are but one part of a tremendous team of interagency partners, including the Depart-

ments of State, Justice, Homeland Security, Treasury, the Federal Bureau of Investigation, the Intelligence Community, and many others that are keeping our Nation safe. One of our most significant partners is the National Security Agency (NSA). We could not perform our counterterrorism mission without the NSA—period! The work these incredible professionals do every day in defense of this Nation is inspiring. I could not be more proud to be associated with these great Americans. In order to ensure SOCOM's actions are fully coordinated with this interagency team, we maintain a robust network of special operations support teams with many of our partners, as well as maintaining liaison officers from those agencies at our headquarters in Tampa.

Our ability to organize for success would be impossible without my unique authority, by law, to equip my force with SOF-unique capabilities through my Acquisition Executive and Special Operations Research, Development, and Acquisition Center. SOCOM is developing several acquisition programs needed to carry out the strategic guidance we have been given. Our priorities in fiscal year 2014 will include equipping SOF operators as a system; recapitalizing and procuring new air, ground, and maritime platforms; and ensuring we have the communications infrastructure and equipment to sustain operations.

SOCOM will build upon our ability to provide 24/7 ISR throughout the full spectrum of operations. We continue to modify our wide variety of manned aircraft with the latest in sensor technologies. For unmanned systems, to meet current and emerging threats, SOCOM will rely on longer endurance platforms which include a fleet of extended range MQ–9 Reapers. We will use our rapid acquisition capabilities to ensure they are responsive to the needs on the battlefield.

We are recapitalizing our venerable C–130 fleet. The AC–130J program, which will eventually give the entire fixed-wing gunship fleet the latest in close-air support capabilities, started flight test. In 2013, the multi-mission MC–130J program delivered nineteen aircraft and is on track to replace our aging MC–130H penetrator and MC–130P tanker fleets.

Also, to ensure the SOF operator has the required agility for future security environments, we have initiated the procurement of a new Ground Mobility Vehicle. This vehicle can negotiate challenging terrain and, importantly, is internally transportable via our SOF rotary-wing aircraft. We are fielding a new fleet of surface maritime mobility craft, including the continued deliveries of the Combat Craft Assault platforms, and the down select to the final Combatant Craft Medium platform. Additionally, we continue the development of new subsurface maritime craft through the Shallow Water Combat Submersible and Dry Combat Submersible efforts.

Enterprise-wide, we recognize a need to expand communications infrastructure, especially with respect to ISR data. Spurred by conflict over the last 13 years in the U.S. Central Command area of responsibility, the United States has invested heavily in a robust terrestrial network of fiber optic cables and other equipment that transports massive amounts of information to and from Southwest Asia. As we draw down in Afghanistan, SOF Airborne ISR assets will likely shift to areas lacking that robust terrestrial network. In response, we continue to pursue a DOD-wide, joint airborne ISR data transport enterprise that is both cost efficient and capable of supporting any ISR asset, independent of platform or sensor.

SOCOM also continues to pursue game-changing technologies, utilizing a process that allows better synchronization of SOF-related technology initiatives with government agencies and other technology developers. For fiscal year 2014, SOCOM is focusing on strategic, long-term technology development efforts in order to enhance protection and survivability for our operators through advanced materials and methods. This includes hardware that augments human physical and sensory capabilities, improves the precision and lethality of existing weapon systems, and improves situational awareness.

For instance, the Tactical Assault Light Operator Suit (TALOS project—referred to by some as the "Iron Man Suit") represents our Nation's outstanding efforts to leverage emerging technology to ensure that our SOF operators are protected to the maximum extent possible. Equally important, the project has the potential to drive improvements in how we do acquisitions by fostering new collaborative development models within industry. By teaming with a wide range of corporations, government agencies, universities and national laboratories, the TALOS project is leveraging the expertise of leading minds throughout the country to redefine the state of the art in survivability and operator capability. SOCOM continues to streamline its acquisition processes to achieve maximum outputs at lowest acquisition cost, while maintaining its reputation as the DOD's premier rapid acquisition organization. We appreciate Congress' support for these programs so we can accomplish the strategic goals the President has set for us.

PEOPLE—OUR MOST IMPORTANT RESOURCE

We will never be able to organize for success if we don't take great care to preserve our force. Perhaps our most enduring and important SOF truth is that "humans are more important than hardware." While the high-tech gear is critical to our success, we are also masters of the low-tech—the operator who can be cold, wet, miserable, and in harm's way, but persevere to accomplish the mission. Everything we do as a command is entirely dependent on those highly-skilled people that make up the Special Operations community, and those highly-skilled people rely on strong family support in order to operate forward in complex environments.

Preservation of the force and families, commonly known as POTFF, is therefore our number one priority here at home! The welfare of these brave servicemembers and their families is critical to our command's readiness and our ability to accomplish the mission. It is also a moral imperative. We demand the best from our people and in return have an obligation to provide the best care, education, equipment, and training to them. We are grateful to Congress for passing into law section 554 of the National Defense Authorization Act for Fiscal Year 2014, which authorizes us to support family programs by finding innovative solutions to meet their unique needs.

Over the past year, SOCOM has made tremendous strides in developing an integrated series of capabilities to build and preserve the fighting strength of the SOF warrior and assure the well-being of their families. We are approaching this endeavor via multiple lanes, combining mental, physical, social, and spiritual aspects into a holistic approach. Building and preserving the resilience of our warriors and their families ensures SOF mission readiness and functional capability.

Looking to leverage innovative ways to not only care for our warriors, but improve their performance, we have expanded our evidence-based Human Performance Program (HPP) to the entire force. This is not a separate medical system—far from it. We continue to get outstanding medical support from our Service partners.

The HPP is designed to meet the unique physical needs of SOF operators, who operate in a variety of austere environments with harsh terrain and carry specialized equipment that requires peak physical conditioning. Our SEALs and special boat operators may parachute into the ocean and conduct an over-the-horizon swim in 60 degree water temperatures while dragging heavy equipment one day, then patrol several miles through dense jungle to conduct a reconnaissance mission the next. Our Green Berets may be called on to infiltrate independently into a denied area and traverse rugged terrain at altitudes of over 8,000 feet with over 100 pounds of gear on their backs in order to link up with an indigenous force. Our special mission units often conduct high-altitude low-opening parachute jumps from over 18,000 feet, with oxygen, and then assemble and conduct a ground movement to the target area. These unique, varied activities tax the human body in extraordinary ways and require tailored physical conditioning, before, during, and after their operations.

This conditioning is accomplished in part through a comprehensive "prehabilitative" physical training program, developed and led by certified professionals. It involves focused strength and conditioning, performance nutrition, and physical therapy. The idea is to provide a "tunable" program that can deliver specific, enhanced areas of performance to individual SOF units. Where it previously existed as a conceptual model, it is now available to all SOF operators. We continue to develop best practices and metrics to support the validity and effectiveness of the program. The net result is improved readiness and reduced healthcare costs through early intervention, rapid rehabilitation, and injury reduction. This program is vital to the readiness and resiliency of our force and ensuring mission success in the most demanding environments.

The Command's Psychological Performance Program has also developed substantially over the past year. We have embedded behavioral healthcare professionals throughout the SOF enterprise and this proximate presence has made a tremendous difference to the servicemembers and their families. Commanders have related how the skill and accessibility of these professionals has saved lives and they now view these care providers as integral members of the command's staff. The constant, embedded presence of the behavioral health staff is also breaking the stigma associated with seeking care.

We need these specialists more than ever because suicides continue to be a challenge. While the Department saw a marked decline in suicides this past year, the SOF community's rate remained tragically steady. Accordingly, we are redoubling our efforts to ensure that our leaders are fully engaged with their personnel. As such, we are working with DOD and academia to provide additional training and resources to arm leadership, providers, and chaplains with the knowledge and un-

derstanding they need to help prevent further loss of life. Full application of the POTFF initiative will build within our operators the resilience they require to deal with the stress we put upon our force.

In addition to our focus on psychological, physical, and mental health, we are striving to provide the GCCs the most educated SOF operators possible to support their objectives. Our operators require the ability to rapidly think, assess, and respond at the tactical level while always considering strategic implications. In addition, they require advanced cognitive skills that enable them to interpret regional activities in the context of a complex world.

These skills are developed through advanced education, in concert with language training and regional proficiency, providing the SOF operator with comprehension and reasoning abilities that enable true regional expertise. We continue to work with our Service partners to ensure these education efforts are not duplicative, but are "SOF specific." One way in which we achieve this is through Joint Special Operations University, which last year taught over 8,000 students, to include SOF and non-SOF, military and civilian, international partners and U.S. members alike, through both resident and distance learning SOF education programs.

Lastly, we are in the process of implementing the Secretary of Defense's guidance to integrate women in all combat military operational specialties no later than January 2016. We have had women attached to our combat units for several years, serving with Cultural Support Teams, Civil Affairs, Military Information Support Teams, Intel, and a host of other occupational specialties and they have performed magnificently. While we are still assessing the feasibility of including women in certain combat specialties, we have already begun to fully integrate them into our SOF aviation career field.

WE CAN'T DO IT ALONE

Even as we produce and develop a force that is organized for success, capable of persistent engagement, and prepared for enduring conflict, we can't do it alone. While we must maintain unilateral capabilities, a partnered approach with local civilian and military forces will always be the most effective bulwark against global, borderless threats. To that end, we are working to engage with the right partners, with the right training, connected and enabled in the right way.

We are expanding our network of foreign liaison officers to create a sense of community with the interagency, allies, and partner nations. Currently, ten partner nations are integrated into the SOCOM headquarters and are working side-by-side with our staff on global SOF network matters. These officers serve as the "connective tissue" to our allied counterparts. Our ability to collaborate with partners must be supported by a robust communications infrastructure, and we need to seek opportunities and approvals to expand tactical intelligence sharing with those partners willing to pursue like-minded objectives.

In 2013, joint exercises with Kenyan and Ugandan forces led to increased counterterrorism capabilities in their fight against al-Shabaab. Similarly, SOF assistance to Jordan and Lebanon lessened the impact of Syrian refugees on host communities. In Latin America, SOF contributed to efforts to counter transnational criminal organizations in Colombia and El Salvador.

Additionally, Section 1208 authority has been absolutely critical to our current and future efforts against al Qaeda and organizations of their ilk. It provides us the ability to apply a modest portion of our annual budget to deliver critical enablers to select irregular forces, groups or individuals, directly involved in the terrorism fight. This authority uniquely provides SOCOM with access and skill sets in locations where we may not otherwise be able to operate, subject to the Secretary of Defense granting specific operational authority. This authority uniquely provides SOCOM with access and skill sets in locations where we may not otherwise be able to operate, subject to the Secretary of Defense granting specific operational authority. The strategic value of enabling and leveraging such forces to carry out tactical operations alongside, or even in-lieu of, U.S. forces cannot be overstated. We are appreciative of Congress' support for this authority since 2005, and are hopeful for continued support.

In summary, I believe we are involved in a generational conflict, one which requires persistent forward engagement to provide a layered defense and the ability to respond rapidly if a regional crisis occurs. To be successful in our fight against extremism and other threats to the United States, we must be organized for success, we must partner with those allies and friends who have mutual interests, and above all we must take care of our people—now and in the future.

I thank you for your continued support of our entire SOCOM family—individuals committed to the safety and security of our great Nation. These proud warriors and

their families rely on your support to accomplish the great things they do each and every day to ensure our Nation's security and way of life.

Senator HAGAN. Thank you to both individuals. Thank you so much for your statements and what you do for our country.

I do want to go ahead and begin the questions and we will have 6-minute rounds.

While efforts were made to protect the SOF capabilities in the fiscal year 2015 budget, I understand SOCOM did sustain significant cuts in relation to what it had planned prior to the Budget Control Act and the Bipartisan Budget Agreement, possibly most notably in your opening testimony the leveling off of the SOCOM growth from currently 69,700 personnel, almost 3,000 fewer than had been previously planned.

Admiral McRaven, what is the impact of these cuts to the SOF capabilities, particularly with regard to the organic enabling capabilities like combat support and combat service support? Under the Opportunity, Growth, and Security Initiative, DOD has proposed $26 billion above the fiscal year 2015 budget request for various readiness, acquisition, and installation support activities pending the availability of additional funds. So in conjunction with both of those, how much of that $26 billion would be for SOCOM versus other purposes?

Admiral MCRAVEN. Yes, ma'am. The leveling off at 69,700 will mean that we are going to have to prioritize our efforts globally. We had built a plan based on 72,000, so now it is just a function of making sure we can continue to meet the priority demands globally. I think we can do that with the current level of effort of 69,700.

The initiative you were referring to as the passback, we will get approximately $400 million for SOCOM and most of that money I will place back into readiness. So it is important for us to make sure we are maintaining our readiness as we continue to project forces around the world. As was mentioned earlier, I think this week we are actually in 84 countries around the world. We have approximately 7,000 people deployed globally right now, and we think that, and possibly more, is going to be an enduring requirement.

I will add one more thing, ma'am. The cuts to us or the leveling, if you will, to 69,700 is important and again I think we can prioritize our efforts. Where I am concerned is the cuts to the broader services. As you pointed out in your opening comments, ma'am, we get our enablers, most of our enablers, from the Services. We get a lot of our readiness support from the Services as well, so they will provide us F–18s for our joint tactical air controllers to work, they will provide us our ship steaming hours for our SEALs to go underway. So the cuts to the Services absolutely affect SOCOM.

Senator HAGAN. Thank you.

Over the past 12 years, DOD has built and sustained a number of enduring capabilities using OCO. Without a transfer of funding from OCO to the base budget in the coming years, much of these capabilities could be lost. The problem is especially acute for the SOF. Admiral McRaven, you testified that SOCOM relies heavily

on OCO funding today with the National Mission Force, in particular funded with 67 percent from OCO.

To both of you, given the downward pressures on the base budget, how does DOD plan to transition funding for SOCOM's enduring requirements from the OCO budget to the base budget in future years?

Mr. LUMPKIN. Ma'am, I work regularly with the Comptroller and the leadership in DOD to make sure not only that they, one, understand the reliance of SOCOM on the OCO funding, but to do whatever possible we can to transition OCO moneys to base moneys to support long-term operations. So we are working through the issue. It is quite complicated, as you are aware, but it has everybody's attention. We are doing what we can to make it.

Senator HAGAN. Can you put that in dollars to me versus the percent? How much money are we talking about?

Mr. LUMPKIN. Do you know, Admiral?

Admiral MCRAVEN. I do, yes, ma'am. We have about $2.4 billion of OCO that goes on top of our about $7.8 billion in base.

Senator HAGAN. That's 2.4 billion?

Admiral MCRAVEN. $2.4 billion is what we get in terms of OCO that goes into our total budget. So, yes, ma'am, that does become a concern when that money is not available. As you pointed out, the majority of that—I will qualify that. The National Mission Force, about 60-plus percent of their readiness, their O&M money, comes from that OCO.

Senator HAGAN. Admiral McRaven, in your opening comments you talked about POTFF. You have focused a great deal on that effort, which I appreciate, and I am sure it certainly has made a difference to the stress on our special operators and their families. I am proud that in fiscal year 2014 we authorized $5 million for up to three pilot programs to assess the feasibility and benefits of SOCOM by directly providing this family support services.

Do you believe the families of the special operators face specific SOF challenges when compared to other military families?

Admiral MCRAVEN. Ma'am, I would say the challenges that the SOF families face are very similar to the Services' families. I wouldn't distinguish between the two. But what we have looked at is, we are partnered with the Services in all of our family programs, so we work very closely to make sure that if a Service has a family readiness program or a family resiliency program in the area we will absolutely send our members there.

However, what we are finding is, because of the increase and the sustained rate of deployment for our SOF servicemembers, their families, I think, over time will face additional stresses as their servicemembers continue to be deployed for the foreseeable future.

Senator HAGAN. Of the pilot programs, how are they working? Do you have any examples?

Admiral MCRAVEN. Ma'am, we have not started those yet. We will start those now. This year we are beginning to take a look at the pilot programs. Now, we have a number of resiliency programs with other organizations. We are tapping into some of the resiliency programs within the Services. So with this money we are building the programs and we are beginning to implement them this year.

Senator HAGAN. Thank you. I do think that OCO funding is going to be a huge issue.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chairwoman. If I could, I would like to follow up on a number of the points that you brought up.

Admiral, when we talk about the size of the force from the projected 72,000 to the 69,000, where do you accept the greatest risk when you're looking at not meeting that original number?

Admiral MCRAVEN. Yes, ma'am. Over the course of the last few years we, SOCOM, have been working with the geographic combatant commanders and recognizing that the war in Iraq was over and that we were drawing down in Afghanistan, we have worked with them to develop a plan to reapportion the forces that are coming back from Iraq and Afghanistan to support their needs.

So, as we look at the areas where we are centering most of our effort, we will continue to be heavily focused in the U.S. Central Command (CENTCOM) region. We are probably putting more effort now into Africa than we have in the past. We are reinforcing our efforts in Latin America and in Europe. Then, of course, we are continuing to pivot as best we can to Asia.

What I am having to do, of course, is to prioritize our resources. What I would tell you, though, is that prioritization is sometimes dependent upon the host nation's desire to accept available force. So, I will have the available force, I think, even with the 69,000. The challenge is going to be whether or not the host nation wants to have an SOF footprint in their country. That, of course, is all about the geographic combatant commanders and the Chiefs of Mission and how they are able to work with the partner nations to make that happen.

But I will have an available force of about 12,000 to 13,000 that we can deploy globally for 365 days a year, and that is the force that has been built up really since 2001. We have been fortunate that as we have doubled the size of the force from 33,000 now to coming up on 69,000, so there is available capacity out there.

We will still have to prioritize. I do not want to mislead you.

Senator FISCHER. But you are talking about how you are going to prioritize. When you look at the other Services and the proposals there to sacrifice manpower—you folks are very dependent on the other forces. You alluded to that in your earlier comments about the planes. We need the guys with the planes, we need the guys with the bases. When we look at the other Services that are going to be cutting manpower, how does that affect you guys and the added risk that your forces are going to face because of the enablers?

Admiral MCRAVEN. Yes, ma'am. Great question. To be honest with you, I am not sure we know just yet. I think we will have to see how the Services take their cuts and how those cuts influence support to SOCOM. Intuitively, we recognize that as the Services begin to draw down there will be less of some specific military operational specialties (MOS) that we think we will need. I have a tremendous partnership with the Service Chiefs and with the geographic combatant commanders. So as they draw down and the geographic combatant commanders make their demands known for

SOF and for the conventional forces, we are all partnered together to make sure that we are shaping the force as best we can to meet the demands of the geographic combatant commanders.

Senator FISCHER. You are continuing to coordinate with the other Services as well?

Admiral MCRAVEN. Yes, ma'am, absolutely. Almost daily.

Senator FISCHER. When they're looking at their future plans, they are tying in your prioritization as well?

Admiral MCRAVEN. Yes, ma'am.

Senator FISCHER. So that you can still meet the mission that you have?

Admiral MCRAVEN. Yes, ma'am. To clarify, though, my priorities are really based on the priorities from the geographic combatant commanders. So I do not prioritize the force. What I do is I request input from the geographic combatant commanders. My job as the supporting commander is to provide them forces.

Now, there does come a time when I run out of forces, and so I have to work with the geographic combatant commanders and the Services to do the best we can. But the priority is from the geographic combatant commanders.

Senator FISCHER. Do you look at those guys and do you discuss with them what that level is that they need to have in order for you to perform your mission?

Admiral MCRAVEN. Yes, ma'am, absolutely.

Senator FISCHER. You feel confident that the numbers that are being put forward now, that those missions can still be performed?

Admiral MCRAVEN. Yes, ma'am. I am confident right now that with the 69,000 we will be able to meet the majority of those missions. Now, again, it depends——

Senator FISCHER. But also with the other Services?

Admiral MCRAVEN. With the Services. Yes, ma'am.

Senator FISCHER. With their cuts in manpower are you going to be able to meet this?

Admiral MCRAVEN. I think it is unknown at this point in time. Again, I would tell you that intuitively I would say we are going to be strained on some of the key enablers, but empirically I am not sure I can give you an answer just yet until we see how those cuts manifest themselves.

Senator FISCHER. If you are constrained that is going to determine then where your forces are going to be deployed. You mentioned not just the Middle East, but also Africa and the pivot to the Far East as well.

Admiral MCRAVEN. Yes, ma'am.

Senator FISCHER. So, that will affect your mission.

Admiral MCRAVEN. Yes, it will, yes, ma'am.

Now, what we are doing is we are partnering very closely with the respective Service components in a region. For example, I have a Theater Special Operations Command in Africa who is partnering with Army Africa to make sure that we are able to give General Rodriguez the very best capability that he needs. So we are exchanging things. I may not have enough special operations helicopters, but Army Africa has a combat aviation brigade that has helicopters that will do the job. So again, we are partnering in

those areas where we have a delta and they have a surplus, to get the best package available.

Senator FISCHER. Thank you, sir.

Thank you, Madam Chairwoman.

Senator HAGAN. Senator Nelson.

Senator NELSON. Thank you, Madam Chairwoman.

Gentlemen, thank you for your service to our country.

Following up on Senator Fischer's comments, take for example the Air Force's plan of 55 steady-state drone patrols. Is that going to be enough for you for your ISR needs?

Mr. LUMPKIN. If my understanding is correct, the SOCOM requirement is 44 what they call Combat Air Patrols (CAP). These are the orbits. The reduction is going to have an effect, the Air Force reduction, on support of SOCOM. They can source 15 CAPs organically, SOCOM, based on reprioritization of aircraft and movement. But that puts a significant burden on the Air Force, and their downsizing will have an impact.

We are still looking through what that will look like and the scope and regionally where it will be. One of the challenges we see as the threat disperses globally and takes on farther reaches, it makes it harder to get places. Basing for those remotely piloted aircrafts (RPA) becomes more difficult as you spread them across the globe. Your orbits do not always have the same impact as they do in a more concentrated area.

Anything you'd like to add, Admiral?

Admiral MCRAVEN. No, thank you.

Senator NELSON. When we pull out of Afghanistan, do you feel confident that you can keep enough SOF in the area so that if, for example, something happened that we had to go back in, that we can do it on a quick turnaround and get back in?

Mr. LUMPKIN. Thank you, Senator. From a policy perspective, as we look at the absence of a Bilateral Security Agreement (BSA), is what I am understanding you are asking the question about, the absence of one will make things significantly more difficult to conduct the counterterrorism operations that SOCOM and CENTCOM work in conjunction with the interagency.

Options are being looked at on what that would look like. But it becomes significantly more problematic on how we would do business and to meet the threats to this Nation without a BSA.

Senator NELSON. With the new demands that you have spoken of with regard to Africa, Latin American, and so forth, how can you take the reduction from some 70,000 down to 69,000? How can you deploy those forces in a way that you're meeting these expanding threats?

Admiral MCRAVEN. Yes, sir. Again, it comes to prioritization and access. These are the real two issues. So if a geographic combatant commander has a priority and I have the available force, which at 69,000 I will have the available force, then I can obviously prioritize it to him. One of the areas where again it becomes a little bit of an unknown for us is the access that we may be granted by a particular nation. The great thing about SOF is we are a small footprint, we are low cost. You can put a small Special Forces detachment in there or a SEAL platoon in there that I think gives you great return on your investment. If the policymakers decide

that they do not like the direction we are heading, it's pretty easy to reverse the decision and pull them out.

So that is fungible across the globe. Having said that, there are a lot of nations where we are prepared to provide forces to that may or may not be willing to accept them. The plan we have developed makes the assumption that a lot of these nations will be willing to work with us and partner with us, and that is how we have built our plan for the future.

If that turns out to be a bad assumption in some cases, then we may have more or less depending upon what the demand signal is of SOF.

Senator NELSON. Have some of the rough patches of several years ago between SOF and the Central Intelligence Agency (CIA) being in various locations around the world where the question was a conflict and how all of that relates to the Chief of Mission, has that been smoothed out in the last 2 or 3 years?

Mr. LUMPKIN. From my personal experience, to see where we were when I was in uniform in 2001 to where we are today, the relationship has grown significantly and we are in lockstep, especially when you get outside the Beltway. Things get better. When you are forward in the operational areas, the relationship is good. There is natural tension here in the Beltway, but our relationship with CIA leadership is good. I see more things playing out in the press than the tensions I feel working with the leadership here in the city.

Senator NELSON. Thank you.

Admiral MCRAVEN. Sir, I would even go so far as to say our relationship with the CIA is fabulous. I have been on the ground with the Agency continuously for the last 10 or 12 years and I will tell you they have magnificent intelligence officers. We are partnered not only at the Chief of Station level, but at the Chief of Mission level, in many of the nations we talked about. We have personal and professional relationships that were brought together under fire. I have never seen them this good and I have a great personal and professional relationship with Director John Brennan.

So it is the best I have ever seen in my 37 years of doing this business, sir.

Senator NELSON. Thank you.

Senator HAGAN. Senator Graham.

Senator GRAHAM. Thank you both.

If we went to the zero option in Afghanistan for whatever reason, Admiral McRaven, what do you think would happen?

Admiral MCRAVEN. Sir, I am not really in the business of speculating, but if we go to a zero option I am concerned that we will have a rise of al Qaeda. So I think we need to be clear-eyed about the fact that al Qaeda still operates, admittedly in a much less virulent strain, in the Federally Administered Tribal Areas. Of course, we see some al Qaeda pockets up in the northern provinces of Kunar and Nuristan.

I think we are doing a pretty good job right now, both the military and the interagency, of keeping them at bay, keeping their heads down. I think that requires continuous pressure. I would be concerned that if we went to a zero option, as Secretary Lumpkin said, it would make that a lot more challenging. Does it mean that

we could not do it? No, sir. I think we would find a way to keep the pressure on. But it would make it significantly more challenging.

Senator GRAHAM. I agree with President Obama when he says that we cannot leave any troops behind without a BSA. That is just a terrible spot to put our folks in. So I hope we can get a BSA.

If we don't have a significant capacity for at least a while in Afghanistan, I could see this thing turning pretty badly against us, and I hope we can avoid that.

Secretary Lumpkin, do we have the authority legally under the Authorization for Use of Military Force (AUMF) or other authorities to deal with al Qaeda threats that are emerging throughout Africa and in Syria?

Mr. LUMPKIN. If it is, again, one of those al Qaeda affiliates, then the AUMF gives us the authority to act, as necessary.

Senator GRAHAM. Are we locked in by their organizational structure? Can the enemy use their organizational structure and naming to deny us the capabilities to protect the country? Do you know where I am coming from?

Mr. LUMPKIN. I think that if there is an affiliate, an associate, and it's been recognized, regardless of what they call themselves in the relationship, I think that—of course, we would go to the lawyers' group, but my sense is that we would probably be in a good place to use the AUMF.

Senator GRAHAM. Does Congress need to do anything from your point of view to enhance your legal standing?

Mr. LUMPKIN. The AUMF has served us very well and gives DOD the ability to do what's necessary. However, at some point we need to relook at the AUMF to make sure it serves us the best way. I look forward to working with Congress if the decision is made to go down that road.

Senator GRAHAM. From a general perspective, Admiral McRaven and Secretary Lumpkin, is al Qaeda diminished, about the same, or on the rise?

Mr. LUMPKIN. I think that if we were to change the way we look at it maybe, is that it is much broader. It is spreading. So it is expanding. However, as it is doing that, as it fills security vacuums globally, it takes a while for it to take hold and to have the ability to organize and to attack the Homeland.

So to answer your question, I would say currently, today, it is spreading globally, but its ability to attack the Homeland is diminished.

Senator GRAHAM. Are you sure about that?

Mr. LUMPKIN. I believe that to be true.

Senator GRAHAM. Libya is an example of it spreading and being lethal to those in Libya who served our country.

Director of National Intelligence Clapper said that the 26,000 al Qaeda affiliate members, whatever you want to call these folks, in Syria are beginning to present a direct threat to the Homeland. Do you agree with that?

Mr. LUMPKIN. Let me take one step back, if I may. When I mentioned specifically the Homeland, as it being a threat, its ability to attack the Homeland is diminished.

Senator GRAHAM. Right.

Mr. LUMPKIN. It remains a regional threat.

Senator GRAHAM. He said they were engaging in plans to eventually attack the Homeland, that these are Europeans and people from all over the world that are going to Syria to get the experience, and they will go back to Europe, some may come back to America; that he thought that the al Qaeda presence in Syria represented a threat to the Homeland. Does that make sense to you?

Mr. LUMPKIN. The threat of the number of foreign fighters in Syria—if we get into specifics, I would rather shift it to the closed session.

Senator GRAHAM. Sure.

Mr. LUMPKIN. But it does make significant challenges and increase the threat to Europe and the Homeland.

Senator GRAHAM. Admiral McRaven, you have been at this for a very long time and our country owes you, and people like you, really the best among us, a great debt. If you could, could you give us a sense of where the world is headed in terms of danger and threats to the United States? I cannot imagine that sequestration is a good thing, but we all imposed it upon ourselves and many of us would like to fix it. Is the world more dangerous in terms of the threats that we face as a Nation?

SOF are just super men and women, but you do have your limits. What worries you the most at night about the threats we face?

Admiral MCRAVEN. Sir, I am concerned about the second- and third-order effects of terrorism as much as I am about the first-order effects. The first-order effects obviously are tragic and another strike on the Homeland is something that we need to expend a lot of resources to ensure it does not happen.

But you raised the issue a few moments ago about the Islamic State of Iraq and the Levant, about al Qaeda in Iraq and Syria, and Al-Nusra and some of the bad actors that are in Syria. My concern there is that Syria is becoming an area where people are coming to get their jihad and, more importantly than that, it is creating pressure on the Levant in ways that we have never seen before. So the number of refugees that are flowing into Lebanon, the number of refugees that are flowing into Jordan, a lot of this has created second- and third-order effects by the al Qaeda and al Qaeda affiliates that are in Syria.

I think it is easier to explain of someone like al Qaeda in the Arabean Peninsula (AQAP). We know that AQAP is probably the number one threat to the Homeland in terms of plots that we may see generating from there. But I think we also have to be very cautious and concerned about what the extremists can do to create regional effects that have global dynamics and global effects related to them.

Senator GRAHAM. Thank you.

Senator HAGAN. Senator Manchin.

Senator MANCHIN. Thank you very much, and thank both of you for your service. I am going to go preside on the floor, so I will be very quick.

Admiral McRaven, I am concerned about the Special Forces within the National Guard, the 19th and 20th Groups. I know there was a movement, let us say, a few years back to eliminate those groups.

Admiral MCRAVEN. Not on my watch, sir.

Senator MANCHIN. How are they performing?

Admiral MCRAVEN. Sir, they perform magnificently. I tell the story, on one of my very first trips to Afghanistan I got on a helicopter in Bagram, went down to Kandahar, picked up a couple of soldiers, spent most of that evening talking with a Special Forces soldier. He had a Special Forces tab on. We got chatting. It was not until the end of the evening that I realized he was a 20th Special Forces Group guy.

The work that they did for us in Afghanistan was tremendous. No, sir, there is certainly no move afoot on my end.

Senator MANCHIN. I am sorry, I did not refer to your end. There has been a move afoot before.

Admiral MCRAVEN. Sir, they bring great value to what we do.

Senator MANCHIN. That is all. We needed to get that on record. Thank you.

Let me just talk about and ask questions briefly about the bitcoins in cyberspace, what is going on, the ability to use this new form of currency, if you will, to support terrorists, arms sales, things of that sort. Are you following that pretty closely? Do you have concern about that?

Mr. LUMPKIN. Yes, we do track that. The counter-threat finance program is a tremendous return on investment for the small amount of money we can put to follow the money of terrorist organizations. We have cells that focus on this. Each of the geographic combatant commanders have this and there is one at SOCOM, and it is a very tight-knit group that works together to address issues.

Senator MANCHIN. The digital currency like Bitcoin, does that cause you concern about how this money, how this currency moves?

Mr. LUMPKIN. How any currency moves between terrorist organizations, those who want to do us harm, causes us concern.

Senator MANCHIN. But Bitcoin seems to be the hottest thing right now.

Mr. LUMPKIN. It is, it is the trend, absolutely.

Senator MANCHIN. I have been very outspoken on this. I am very concerned. I serve also on the Senate Banking Committee and I am very concerned about what we see and a lack of oversight, if you will, and also the volatility of this and the ability to be able to use it for—the unscrupulous people using it for the wrong reasons. I would say that would be a great concern for our security.

Mr. LUMPKIN. Absolutely. Thank you, sir.

Senator MANCHIN. I am going to have to run, but I thank you so much. I am sorry to leave.

Senator HAGAN. Senator Reed.

Senator REED. Thank you, Madam Chairwoman.

Admiral McRaven, can you just give us a response to how you are adapting SOCOM to a battlefield that is increasingly dominated by cyber operationally, in terms of interfering with equipment that you have a huge superiority in, the whole spectrum? Can you give us a sense of that?

Admiral MCRAVEN. Yes, sir. Our approach really has been to stay closely partnered with the National Security Agency (NSA) and now U.S. Cyber Command (CYBERCOM) as we look at our cyber requirements. The NSA and CYBERCOM have done a great

job for the last 12 years that I have spent time intimately with the cyber support teams that come from CYBERCOM, that come from NSA in supporting us.

What we do is we provide our demands. So if we are looking for a particular individual, then we will make sure that we are linked with the NSA. They will through their technical means figure out how to identify that person. So instead of us in SOCOM building an additional capability to conduct cyber operations, we use the experts at CYBERCOM and at NSA to do that.

What we do have is we have a small element at all of the combatant commands now that help us with the planning and the access to NSA and the CYBERCOM.

Senator REED. You have, I think, emphasized the defensive aspects of CYBERCOM. Can you comment on any planning or consideration of offensive operations that would involve SOCOM and cyber threats?

Admiral MCRAVEN. Sir, I would prefer to hold that to a closed meeting, if I could.

Senator REED. That is more than fair.

The other issue is that we are at a transition point in many places. One transition point might be shifting from active preemption activities that SOCOM undertakes against threats either to our forces or to the Homeland, to more training of indigenous forces so that they can be capable of that. Can you comment upon how you are trying to navigate that transition point?

Admiral MCRAVEN. Absolutely, sir, and I appreciate the question. As we look forward for SOCOM and what we are trying to provide the geographic combatant commanders, we are looking for how we balance the two. Our thrust, if you will, is building partner capacity so that the host nation can take care of its own security problems. But we should never forget that if we need to, we need to be postured to conduct unilateral or partnered operations that only we and potentially our partners have the capability to do.

At the end of the day, my feeling is we need to continue to keep pressure on al Qaeda and the associated movements, on the extremists that are out there. We do that by partnering with the host nations where there is an extremist problem or where they are bordering on an extremist problem and being postured to conduct direct action if authorized to do so by the President.

Senator REED. This also raises a question that Senator Fischer and others have raised, which is the resources that you need from the non-SOCOM commanders to do that, the training, running ranges, all those things that would help you train local forces and also train your own forces. Again, you've commented on that, but do you see that as a particular concern in terms of your mission to train local forces?

Admiral MCRAVEN. Sir, most of the training that we will do with the host nation will be in their own country. So when we go down we use their range facilities. If they don't have range facilities, through various authorities, 1206, 1207, or 1208, we help build those. It is a modest military construction (MILCON), minor MILCON approach. The bulk of our training is done in-country. So we don't have a conflict with the big Services in terms of ranges for training the locals.

Senator REED. Let me ask you a question that was a concern of Senator Graham, too, and he asked me to mention it. You might want to take this one for the record but it might require a more extensive answer. That is, if you or your forces detain an individual in Afghanistan there's a pretty clear pathway to get that person through our system and ultimately into the Afghan system. Outside of that area of operations, can you comment on the policy or the obstacles to successfully detaining someone who is a threat?

Admiral MCRAVEN. Sir, I am going to take your advice and take that one for the record.

[The information referred to follows:]

As a general matter, Department of Defense (DOD) policy (DODD 2311.01E) requires that members of the DOD components comply with the law of war during all armed conflicts, however such conflicts are characterized, and in all other military operations. Therefore, regardless of the location, detention of individuals pursuant to a military operation must remain in compliance with the law of war (law of armed conflict). In terms of detention of civilians, considerations include compliance with domestic law and customary international law as well as treaty obligations (EX: Geneva Conventions of 1949).

Special Operations Forces generally operate under the operational control of the geographic combatant commander and would thus follow the policy direction of the geographic combatant commander for detention operations. The geographic combatant commander policy would necessarily comply with DOD policy.

The current DOD policy on detainees (2310.01E) states that all detainees shall be treated humanely and in accordance with U.S. law, the law of war, and applicable U.S. policy.

Further, DOD personnel shall observe the requirements of the law of war, and shall apply, without regard to a detainee's legal status, at a minimum the standards articulated in Common Article 3 to the Geneva Conventions of 1949, as construed and applied by U.S. law in the treatment of all detainees, until their final release, transfer out of DOD control, or repatriation.

Whether detention of an individual is appropriate in a given operation would most likely be a top down case-by-case decision and would depend greatly on the context of the mission (Authorization for Use of Military Force, self-defense, U.N. Security Council Resolution, bilateral security operations, law enforcement support), the characterization of the conflict, the threat presented at the time, et cetera.

Potential obstacles to successfully detaining someone who is a threat include access to the area in question, physical location of planned detention, host nation support, length of detention, repatriation concerns, decisions on prosecutorial merit as determined by the interagency, et cetera.

Senator REED. Thank you. That is a thoughtful response.

Let me ask a question that is very narrowly focused. Joint Improvised Explosive Device Defeat Organization (JIEDDO), which we are all familiar with, has been a critical institution in terms of protecting our forces against improvised explosive devices (IED). They are being reformulated. In your role particularly, not only protecting your forces in the field, but training and protecting forces as this threat evolves, and unfortunately it's going to evolve, what do you see the relationship with JIEDDO? Could you take that into your command? I know there have been several posed. It is an Office of the Secretary of Defense (OSD) office, so it could just go away, or it could get distributed. Do you have any views on that, because I think you would be, no pun, the point of the spear when it comes to these weapons.

Admiral MCRAVEN. Yes, sir. We have not done any looking into bringing JIEDDO into SOCOM, so I am not prepared to answer that just yet in terms of an organizational change. Having said that, we work daily with JIEDDO. I have liaison officers up there, they have liaison officers with us. They are embedded with all of

our forces in Afghanistan. They have done a tremendous service for this Nation over the last decade-plus.

What they ended up doing, of course, with the same methodology that they used to find IEDs, a network analysis methodology, is very helpful as we look at bad actors and other networks around the globe. So as they have, rightfully so, I think, begun to shift their focus—they continue to focus on IEDs, but they also have this ability to look at networks. We are tapping into the great expertise they have to make sure we understand what the problem on the ground looks like. They are a very valued partner.

Senator REED. Just a final comment. Given the fact that your forces are the most forward deployed of any forces we have and will be more so in the future, you're probably the first to see different developments in IEDs, different developments in network behavior, disguising networks, et cetera. So you will, I assume, have a feedback loop wherever JIEDDO ends up or if it ends up anyplace.

Admiral MCRAVEN. Yes, sir, I expect, sir.

Senator REED. Thank you.

Senator HAGAN. Senator Kaine.

Senator KAINE. Thank you, Madam Chairwoman, and thanks to our witnesses.

Just a report back from the field. Senator King and I participated in a Congressional Delegation recently to Israel, Lebanon, and Egypt, and heard a lot of real positives about the work of Special Forces, especially in the training mission that you have described. For purposes of a massive budget, even a massive defense budget, I think the training that we do with other nations might be one of the best investments we make, not only in the short-term, building capacity, but in long-term relationship-building. The folks we train end up being defense ministers and prime ministers and presidents. That is an investment that really works. So I wanted to praise you on that.

Secretary Lumpkin, I just wanted to look at page 3 of your testimony. You had a statement that caught my eye: "We are ending the longest prolonged period of war in our Nation's history." Is that your personal opinion or is that the administration's position, or both?

Mr. LUMPKIN. When I look at just the number of years that we have been engaged in conflicts, direct conflicts, since 2001 until today, if you are looking at those long periods, I used that as an absolute from my perspective.

Senator KAINE. The word I was interested in was "ending." I know it is the case that administration witnesses before this committee—and I am not sure if it was you or not, but we had a hearing on the AUMF in May where we were asking how long will this war go on that was initiated September 14, 2001, through that authorization. There was some testimony that it would go for a decade more. There was some testimony that it might go for another 25 or 30 years.

But the way I read this testimony, it sounds like there is a suggestion that at the end of our 2014 activities in Afghanistan, as we move to the next level, that the war is ending. Is that how the administration now sees the end of the Afghanistan theater of operations, that the war is ending?

Mr. LUMPKIN. The President has given very clear guidance that he sees us coming off of a wartime footing, that we are moving forward. The threats will be there, but direct conflict in the sense of a traditional war, we see that coming to an end.

Senator KAINE. Just wrestling with what Congress should do, if the war is ending at the end of our 2014 activities in Afghanistan, then should the authorization expire?

Mr. LUMPKIN. Again, as I mentioned to Senator Graham earlier, I think we are at a point where, while the AUMF has supported the needs of DOD in order to execute the missions at hand in order to protect the Homeland and American interests, I think we are at an inflection point that it may be a time to look at the AUMF to see if it does need adjustment to better serve this country.

Senator KAINE. Whether there might be a need to consider a chapter two version?

Mr. LUMPKIN. Potentially, and I look forward to working with Congress as they consider and shape these issues.

Senator KAINE. It was interesting, this morning we had a hearing about a nominee, a very qualified nominee, I am proud to support him, Admiral Rogers to be head of Cyber Command and the NSA. It was an interesting hearing because he is the nominee, not the acting. But we were running into a lot of terminological questions that I think revolve ultimately around this question of what are we in? Is it a war or is it a counterinsurgency?

For example, he testified that Edward Snowden, his activities were clearly wrong, violated the law, had cost American lives, but he was not sure whether he would label him a traitor. Senator Graham asked him a question about whether we were at war and he originally said we are in an engagement, not sure it is a war. But then he clarified: we are not in a cyber war right now.

When pressed about what cyber activity has to do with whether we are at war, he initially testified that if cyber activity led to the need for armed conflict, then that would be a war. But then when I asked him, what about a cyber activity that would knock out our power grid and disrupt our economy and then we do the same thing to the other side, with no armed conflict, is that not a war, he acknowledged these are pretty big, important questions that we don't have a current definition of.

My chair and ranking member and Senator Graham and I have talked a lot about these issues. I am very troubled that the AUMF of September 14, 2001, has no temporal limitation, no geographic scope or limitation. I think it is being used in ways that I think might be appropriate for the Nation's defense, but I think were clearly beyond the contemplation of the Members of Congress who voted for it at that time.

I think the end of U.S. operations in 2014 in Afghanistan, hoping that there will be a second chapter because of the successful negotiation of a BSA, I think that is an excellent time to try to devise a chapter two, because I think continuing to leave an AUMF that is just completely open-ended, I think it poses real significant challenges for our oversight. If members who are qualified to do great jobs have a hard time with the terminology about what it is we are doing, I think it creates challenge on the battlefield. I think it cre-

ates significant challenges for our citizens to try to understand what we are in.

I think some of the controversies about programs like NSA are less about the four corners of the NSA program than they are about what is it, in fact, that this particular program is supporting, is it a war, is it a half-war engagement, is it counterterrorism, is it something else. I think the SOF side of our military are going to be probably uniquely necessary to be at the table to try to determine what, in fact, this chapter two is.

One last question, if I might, Madam Chairwoman. I know my time is almost up. But if the AUMF were to expire, obviously the President would still have significant powers, the traditional powers, the Commander in Chief powers, to defend the Nation, the powers created by international law. There are separate statutes that deal with counterterrorism activities. Has there been work done, to the extent of either of your knowledge, to determine, in the absence of the current AUMF, would the DOD, more broadly our defense establishment, have the tools necessary to wage the battle against terrorism that is needed circa 2014?

Mr. LUMPKIN. Clearly, the President does have constitutional authorities as the Commander in Chief. Al Qaeda prior to September 11 has been engaged in the past, so it can be done.

I think that we are at a natural inflexion point. I think it is a good time to sit back and look and see where we are at, look at the threat in the future, and make sure we clearly craft something that has left and right flanks, that has a program time to relook to make sure it serves our interests, and gives us the ability to engage the threats that face us not only today, but also tomorrow.

Senator KAINE. Admiral McRaven, would you have any additional thoughts on that?

Admiral MCRAVEN. No, thank you.

Senator KAINE. Thank you very much for that.

Thank you, Madam Chairwoman.

Senator HAGAN. Thank you.

We are going to do one more quick round of 6 minutes and then if necessary, we will proceed to the closed session.

I wanted to ask about section 1208. Admiral McRaven, you pointed out that 1208 authority has been an enabler for our military operations against foreign terrorist organizations. Why is this authority so important to the counterterrorism operations and do you believe that an increase of the authority above the $50 million is necessary, and if so, why?

Admiral MCRAVEN. Yes, ma'am. I can tell you that wherever we are training forces to conduct counterterrorism operations, host nation forces, surrogate forces, to do that, we are using the 1208 authority. It is just an authority, of course, so it is an authority right now for me to use up to $50 million to be able to provide training, equipping, minor MILCON, important things, as we build this surrogate force.

I will defer to Assistant Secretary Lumpkin. I know that ASD(SO/LIC) is requesting an increase in that authority for all the reasons you just laid out. We are finding that our execution rate in that authority already this year is closing in on $50 million because the demand signal out there for this kind of training and

support is so great. Frankly, I think as we move forward and we find that we need to continue to put pressure on extremist groups that are out there, we will need more training and probably more authority. But I will defer.

Senator HAGAN. Secretary Lumpkin, let me ask you, as part of that. How do you differentiate support provided to the partners under section 1208 versus other support provided under more traditional security force assistance authorities?

Mr. LUMPKIN. Thank you very much. Let me go back to the 1208 first and then I will come back to that. As you are probably aware, I am not only the ASD, but I am also performing the duties of Under Secretary of Defense for Policy. So I have the ability to look across the entire policy enterprise, just beyond this SO/LIC world and domain. When you have that kind of view, you truly see the benefits of the 1208 program and what it does to create operational forces in support of U.S. interests. It is a tremendous capability.

We do have other authorities, and this goes back to the comment in your opening statement about the patchwork. We also have section 1206, which does the global train-and-equip in support of counterterrorism operations and things of that nature. We have counternarcotics authorities. We have section 1004, which gives us the ability to help U.S. law enforcement in support of their operations in counternarcotics operations, which is this real nexus between narcoterrorism and even al Qaeda and how they merge the fungible moneys and how it passes across the different bodies.

We have the global security contingency fund, which is a new fund that we have available that we are working. It is dual key authority with the Department of State (DOS). We are in the nascent stages and we are working through it.

But one of my jobs is to grab these different authorities and to make sure we are leveraging them to the best of our ability to support U.S. interests. That is truly no small endeavor, to make sure we are getting the best bang from the buck and the best return on investment for the American people.

Senator HAGAN. You mentioned the global security contingency fund. Do you think that Ukrainian assistance will come under that area to help build the capacity of the security forces?

Mr. LUMPKIN. Because this is a dual key authority in conjunction with DOS, I personally have not engaged with folks at DOS on this issue. But I am more than willing to do so, absolutely.

Senator HAGAN. In the fiscal year 2014 Defense Appropriations Act, it included an expanded human rights, or Leahy, vetting requirement for the DOD training, equipping, and assistance programs. To both of you: Do you agree with the intent of the Leahy vetting requirements, and will the changes that have taken place impact training and other engagement activities conducted by the combatant commanders?

Mr. LUMPKIN. At DOD, we fully support both the letter of the law and the intent of the Leahy legislation. Most of our programs involve a training component as well as an equipping component. The equipment addition for the most recent legislation is not going to have a significant impact on what we are doing.

Just for a scope, I was just briefed that DOS does about 170,000 Leahy vetting line items per year. So it is a massive undertaking.

I have had some initial discussions with them to make sure they can accept this additional——

Senator HAGAN. How many more additional do you think it might involve?

Mr. LUMPKIN. I am trying to quantify that now, but from DOD and within SO/LIC, I do not think it is going to be that significant, to be honest with you as we go forward, because again most of our pieces already have a training component. So the equipping component usually comes along with it.

Senator HAGAN. In my opening remarks, I mentioned something about the remediation process. Do you have any recommendations for improving the vetting process or for a remediation process, and what do the other partnering nations actually do for remediation?

Admiral MCRAVEN. Yes, ma'am. The remediation process is an area where we have an interagency working group that is getting together to see how we can improve the process. As Secretary Lumpkin said, I am fully supportive of the Leahy human rights vetting, always have been. My concern has always been in the process and how expeditious the process is for us to get to a solution whether or not a particular unit has, in fact, committed gross human rights violations or has not and therefore we can either continue on with training or not.

That process, I think, needs improving between DOS and DOD and actually Capitol Hill. We are working with all three of those in an effort to figure out how do we adhere to the letter of the law and the spirit of the law, but do so in a manner that allows us to get back into a training venue as rapidly as possible if we can confirm that no gross human rights violations have occurred. So I think there is a good faith effort going on amongst the interagency to get to that point.

Senator HAGAN. Of the 170,000, do you have any idea a percent or number that people don't make the vetting? Then, you mentioned gross human rights violations. Is domestic violence included in any of these?

Mr. LUMPKIN. If I may, my understanding is that 2 percent do not pass the vetting requirement of the 170,000. I do not have the answer on the domestic violence piece, but I can take that one for the record.

[The information referred to follows:]

Although the term "gross violation of human rights" is not defined in the Department of Defense Leahy law, the definition in section 502B(D) of the Foreign Assistance Act has been used as the accepted working standard in the Department of State Leahy vetting process. It states: "the term 'gross violations of internationally recognized human rights' includes torture or cruel, inhuman, or degrading treatment or punishment, prolonged detention without charges and trial, causing the disappearance of persons by the abduction and clandestine detention of those persons, and other flagrant denial of the right to life, liberty, or the security of person." Although domestic violence is not a specifically enumerated category, cases of domestic violence are sometimes highlighted for review by State Department regional bureaus and embassy teams. As a matter of policy, we could withhold DOD assistance in such a case.

Senator HAGAN. Thank you.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chairwoman.

Admiral, you used the term "irreconcilable" to characterize the most extreme elements of our adversaries, the terrorists. How do

you separate those who you believe are reconcilable with those who are irreconcilable? What is the difference here?

Admiral MCRAVEN. Yes, ma'am. I think it requires thorough analysis. We do not take any steps to go after anyone unless we know for a fact that they are on the irreconcilable number on the counterterrorism part of direct action. I am not sure I can give you a great example, but I know who we think is irreconcilable. Whether or not they are irreconcilable, I think, remains to be seen.

But we do look at a body of people—AQAP, some of the most virulent members of AQAP, core al Qaeda, al Qaeda in the Islamic Lands of the Maghreb. We know that the leadership there I would contend is irreconcilable, that no amount of negotiations, no amount of placation, is going to put them in a position where they are prepared to support universal values as we know them.

So as we look at all of the threats out there, I know a determination is made as we go through the process of determining whether or not an individual needs to have action against them. That is, again, a very well-defined, thorough process to get to that point. But there are a lot of irreconcilables out there.

Senator FISCHER. Thank you.

Mr. Secretary, do you have anything to add to that?

Mr. LUMPKIN. No, ma'am, I do not.

Senator FISCHER. Last week, I discussed the growth of extremists in Syria who want to attack us here in the United States with General Austin at a hearing. His response was, and I quote here: "They've grown at an exponential rate and unless we do something to retard that rate a bit and prepare ourselves to counter this threat going forward, then I think we are going to have a significant issue."

To both of you: Do you agree with his assessment?

Mr. LUMPKIN. I do. Left unchecked, the problem is only going to get worse.

Senator FISCHER. Admiral?

Admiral MCRAVEN. Yes, ma'am, I do.

Senator FISCHER. At what point do you see these extremists in Syria becoming a threat to the United States, to the Homeland?

Mr. LUMPKIN. I think that the threat is already bleeding over beyond the borders of Syria, as we are having a spillage into the surrounding nations, which increases, as Admiral McRaven mentioned earlier, the pressure in the Levant. So I cannot give you a definitive date when the Homeland is in direct threat, but it is not in the too distant future.

Senator FISCHER. Admiral?

Admiral MCRAVEN. Yes, ma'am, I would agree with Secretary Lumpkin. Again, my concern about the threat and Syria, while we can talk about some of the threats in the closed session, I do think one of the greater threats is the pressure that they are putting on the Levant and the pressure on Lebanon and the pressure on Jordan and how that will have a cascading effect across that area, which will have a cascading effect across both North Africa and Southern Europe and eventually the United States.

Senator FISCHER. Can you speak in open session about how we are preparing for those threats?

Mr. LUMPKIN. I cannot. I am sorry, ma'am.

Senator FISCHER. Thank you.

Also, General Rodriguez last week described eastern Libya as the fastest-growing area of extremism, and also stated that his biggest intelligence gap was from northern Mali to eastern Libya. Can you describe the extremist threat that we are seeing now in eastern Libya, either of you gentlemen?

How does that compare to other regions? Where does that fall on a scale there?

Mr. LUMPKIN. I think that is the important part, is where does it fall on the scale. My sense is that Libya is not where Syria is today, but again, left unchecked, left without the proper engagement and building the partnership capacity with the nascent Libyan forces, that we could end up in a situation where it is not too dissimilar if no attention is paid to it.

Admiral MCRAVEN. Yes, ma'am, I would agree with the Secretary.

Senator FISCHER. Where do you see, I guess, our gaps in this region? Can you speak about that in open session?

Mr. LUMPKIN. Again, I would prefer to do that in closed session.

Senator FISCHER. Thank you very much.

Thank you, Madam Chairwoman.

Senator HAGAN. All right. I had about one or two more quick questions.

Senator FISCHER. You can have my time.

Senator HAGAN. I do not need to take your time. You can have time, too, but I did want to just mention, going back to the Leahy vetting, this is an area that I know that Chairman Levin is interested in, looking at the remediation process. So I hope that SOCOM is going to continue this conversation with us.

One question on the rapid acquisition authorities. Admiral McRaven, SOCOM is unique among the combatant commands in that it not only generates requirements, but also performs acquisitions to provide solutions to these multiple needs and problems. For urgent requirements, I understand the Capabilities and Developments System-Urgent, can be used when the SOF units identify a time-sensitive capability gap or requirement related to the possible loss of life or mission failure. Do you believe it would be advantageous for SOCOM to have additional or more flexible rapid acquisition authorities, and if so, what would you suggest?

Admiral MCRAVEN. Yes, ma'am. The combat mission needs statement is what a soldier downrange will submit through the process if he has a requirement that is, again, very urgent, loss of life, or it puts us in a position to have a comparative advantage over the enemy. As soon as that combat mission needs statement comes in, we convene a group at SOCOM and we take a very quick look at this. We turn this within about 24 hours to determine whether or not we can meet the needs of the soldier downrange.

The only issue we have with the combat mission needs statement right now is it is procurement money. So we can go out and procure a system for him. We do not have any research, development, test, and evaluation (RDT&E) authority within the combat mission needs statement. So if there was something that really required some development and it may mean we couldn't get it to him on the battlefield in the shortest period of time, but we might be able

to get him a better product if we had a little bit of RDT&E money that we could apply towards that authority of the combat mission needs statement, do the RDT&E, figure out what the development is, and then get it downrange to him. So that is the only thing I would add there.

Senator HAGAN. But you are saying that still from a timeliness factor?

Admiral MCRAVEN. I am sorry, ma'am?

Senator HAGAN. It is still a timeliness factor?

Admiral MCRAVEN. Yes, ma'am, it is, absolutely.

Mr. LUMPKIN. Ma'am, if I may, we work with SOCOM within OSD. We have the Counterterrorism Technical Support Office, and what we do is we have the ability and we do have research and development dollars in order to support when we can, where we can. We also support the interagency as well on requirements, as well as State and local law enforcement, and there is also an international component to it as well where we work with our partners and allies to develop technologies.

We can help, but there are limitations still.

Senator HAGAN. Let me ask one quick question on Syria. Do you agree that, absent a change in the balance of power on the battlefield in Syria, that the Assad regime will not come to the negotiating table in a good faith manner? In your view, are there a sufficient number of moderate and vetted elements of the Syrian opposition to change the balance of power on the battlefield? Do you believe that we are in a position to conduct a large enough train-and-equip program for the vetted moderate elements of the Syrian opposition force to have a type of impact if we chose to do so?

Mr. LUMPKIN. A lot of questions there.

Senator HAGAN. I know. I can go back to them. The question is training the moderate and vetted elements of the opposition force.

Mr. LUMPKIN. I would prefer to talk about that in a closed session, to be honest with you.

Admiral MCRAVEN. Senator, I can tell you that I have the capacity to do that. If a decision is made to train moderate Syrians, we in the special operations arena have the capacity to do that.

Senator HAGAN. Okay. A final question, on attacking the financial network of the Haqqani network. A major support for the insurgency in Afghanistan is the Haqqani network, based out of the sanctuaries in Pakistan. They provide support both in terms of conducting cross-border attacks against the United States, against the coalition and Afghan forces, and terms of providing financial support and equipment to the insurgency.

The Haqqanis have a widespread financial network that supports their numerous licit and illicit activities in the region. To both of you: In your view, do we have an in-depth understanding of the banking and business relationships, both illicit and licit, that finance the Haqqani network?

Mr. LUMPKIN. I would submit it is a work in progress. So I would say we are working to get that, because it changes and it adapts. So we are working that.

Senator HAGAN. How are we doing to track this financial network and then go after their business interests that support the network? What are these businesses?

Mr. LUMPKIN. I think that is a closed session item, to be honest with you, ma'am, if possible.

Admiral MCRAVEN. Ma'am, I can tell you we do work with the Federal Bureau of Investigation and we work with Treasury and we have, a little bit like in the counterthreat finance piece, we do have folks that are looking at how the Haqqani network functions. I think we understand the basic structure of it. The hard part is I am not sure we understand the exact mechanisms that if we interdicted would really make a difference.

I think also a lot of people don't fully appreciate that it does not cost a whole lot to train-and-equip a Haqqani fighter to move from Pakistan into Afghanistan. So you would have to undercut a very large portion of their funding, I think, in order to have a significant impact on the fighters that we see in the P2K area in Afghanistan.

Senator HAGAN. Thank you.

No other questions?

Senator FISCHER. No.

Senator HAGAN. Senator Kaine, you said no, too. Then we are going to adjourn. Do you want to go to closed session?

Senator FISCHER. Yes, please.

Senator HAGAN. We will adjourn and we will very quickly proceed to SVC–217 in the Capitol. This session is adjourned. Thank you.

[Whereupon, at 3:27 p.m., the subcommittee adjourned.]

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR JACK REED

CYBER THREATS

1. Senator REED. Admiral McRaven, can you comment on any planning or consideration of offensive operations that will involve U.S. Special Operations Command (SOCOM) and cyber threats?

Admiral MCRAVEN. SOCOM's offensive cyberspace capabilities are wholly dependent on our partnership with the National Security Agency (NSA) and U.S. Cyberspace Command (CYBERCOM)—Cyber Mission Forces provided in support of the Department of Defense (DOD), which will be leveraged to support Special Operations Forces (SOF) operations. SOCOM will continue to partner closely with NSA and CYBERCOM to identify, request and coordinate offensive actions against cyber threats outside the DOD Information Networks (DODIN) to defend SOF operations and the SOF Information Environment (SIE), as well as, support global SOF military objectives. Additionally, as DOD and the U.S. Government continue to develop a common understanding of operations related to the cyberspace domain, SOCOM and future SOF operations may provide a level of access and placement to CYBERCOM forces that they may not otherwise operate in.

Per Joint Publication for Cyberspace Operations (JP 3–12), every Joint Force Commander must identify critical cyberspace infrastructure and key resources, respond to adversary actions, protect that infrastructure (communications circuits, data links, and electromagnetic spectrum) in order to sustain military readiness and warfighting capability. SOCOM owns its own critical IT networks, the SIE; detects, classifies, and identifies external threats to the SIE regardless of origination (other nation states, transnational actors, criminal organizations, or other groups and individuals) and takes internal defensive measures every day. As the CYBERCOM Cyber Mission Forces continue to develop, SOCOM fully anticipates additional SOF planning efforts that may leverage CYBERCOM Defensive Cyberspace Operation Response Actions capabilities (offensive effects outside of DODIN) when authorized to do so, in defense of the SIE and the Nation.

Regarding Overseas Contingency Operations (OCO) in support of SOCOM and SOF operations, CYBERCOM is also fielding offensive forces now that will conduct operational level planning, target development and integrated cyberspace attack in conjunction with SOF operations. These activities will create new options for geographic combatant command approved targets with cyber-fires where applicable and

desired by that geographic combatant command commander. CYBERCOM's non-lethal fires will be employed through Theater Special Operations Commands (TSOC) to create effects that deny, degrade, disrupt, destroy, or manipulate our adversaries in cyberspace. TSOC commanders will establish mission priorities that support SOF objectives within each geographic combatant command-supported campaign, and the cyberspace elements of each plan will be integrated no differently than any other warfare domain or weapons system.

DETAINEE POLICY

2. Senator REED. Admiral McRaven, if your forces detain an individual in Afghanistan, there's a pretty clear pathway to get that person through our system and ultimately into the Afghan system. Outside of that area of operations, can you comment on the policy and where the obstacles are to successfully detaining someone who is a threat?

Admiral MCRAVEN. As a general matter, DOD policy (DODD 2311.01E) requires that members of the DOD components comply with the law of war during all armed conflicts, however such conflicts are characterized, and in all other military operations. Therefore, regardless of the location, detention of individuals pursuant to a military operation must remain in compliance with the law of war (law of armed conflict). In terms of detention of civilians, considerations include compliance with domestic law and customary international law as well as treaty obligations (EX: Geneva Conventions of 1949).

SOF generally operate under the operational control of the geographic combatant commander and would thus follow the policy direction of the geographic combatant command for detention operations. The geographic combatant command policy would necessarily comply with DOD policy.

The current DOD policy on detainees (2310.01E) states that all detainees shall be treated humanely and in accordance with U.S. law, the law of war, and applicable U.S. policy.

Further, DOD personnel shall observe the requirements of the law of war, and shall apply, without regard to a detainee's legal status, at a minimum the standards articulated in Common Article 3 to the Geneva Conventions of 1949, as construed and applied by U.S. law in the treatment of all detainees, until their final release, transfer out of DOD control, or repatriation.

Whether detention of an individual is appropriate in a given operation would most likely be a top down case-by-case decision and would depend greatly on the context of the mission (Authorization for Use of Military Force, self-defense, U.N. Security Council Resolution, bilateral security operations, law enforcement support), the characterization of the conflict, the threat presented at the time, et cetera.

Potential obstacles to successfully detaining someone who is a threat include access to the area in question, physical location of planned detention, host nation support, length of detention, repatriation concerns, decisions on prosecutorial merit as determined by the interagency, et cetera.

QUESTIONS SUBMITTED BY SENATOR JEANNE SHAHEEN

CRAFT CHALLENGES AND SOLUTIONS

3. Senator SHAHEEN. Admiral McRaven, one of the persistent challenges for special operations craft is balancing high-speed, open-ocean capability with large shock and vibration experienced by operators under those conditions. Repeated exposure can lead to discomfort, injury, and performance degradation. Can you describe SOCOM efforts to develop or support commercially available platforms that could address this issue?

Admiral MCRAVEN. SOCOM is committed to understanding these impacts on the warfighter, and has undergone several initiatives to alleviate the effects of repetitive, high-impact shock on both Special Warfare Combatant-Craft Crewman and SEALS.

As SOCOM develops the technical specifications for our next generation combatant craft, we are including specific requirements which address reduced shock on the operator and incorporate lessons we have learned over the years. Our Special Operations Research, Development, and Acquisition Center recently awarded a contract for our Combatant Craft Medium (CCM) Mark (Mk) 1, which included specific requirements addressing reduced craft accelerations and shock exposure on the crew and passengers.

The first lot of CCM Mk1 production craft will incorporate commercially available state-of-the-art shock mitigating seats that will reduce the effect of repeated shock exposures. The currently fielded Combatant Craft Heavy—Sealion also incorporates commercially available shock mitigating seats to protect crew and passengers.

During our March 2014 Maritime Technical Experiment 14–1, several venders demonstrated technologies including active ride control (automated system which counteracts the wave-induced roll and pitch motions), hull form shaping (optimizing hull design for best performance and smoothest ride), and shock mitigating seats. SOCOM is continuing to evaluate these types of new technologies to mitigate the effects of repetitive shock and vibration on our warfighters.

4. Senator SHAHEEN. Admiral McRaven, is SOCOM working with the Office of Naval Research or other DOD research, testing, development, and evaluation (RDT&E) programs on a solution to that challenge?

Admiral MCRAVEN. SOCOM is working with NAVSEA Naval Surface Warfare Center (NSWC) Panama City and NSWC Carderock Combatant Craft Division to address shock mitigation. Program Executive Office—Maritime chartered a Shock Exposure Study working group to develop the measureable and testable shock specification. This working group resulted in the development of the SED8 metric.

SED8 is often referred to as the "Spine Exposure Dose (SED), over an 8-hour period." A daily equivalent static compression stress "SED" is then normalized to an 8-hour daily exposure duration, leading to the SED8 metric. The actual process of collecting and recording these observations are incorporated into an International Standards Organization (ISO) described in ISO 2631, Part 5. The metric is relatively new but has undergone the scrutiny of published research and peer reviews for 10 years now. All three of our newest combatant craft currently fielded or in production are required to meet SED8 requirements.

We are currently partnering with the United Kingdom, Canada, and Australia on shock mitigation technologies and common evaluation metrics. Existing memorandums of agreement with each country allow for the exchange of information and execution of joint projects aimed at research to better understand repetitive shock impact on the human body, health monitoring of the joint SOF combatant craft operator, and establishing a collective body of research for this unique and extreme operational environment.

QUESTIONS SUBMITTED BY SENATOR KIRSTEN E. GILLIBRAND

SOCOM COMBAT INTEGRATION

5. Senator GILLIBRAND. Admiral McRaven, in January 2013, former Secretary of Defense Leon E. Panetta and the Chairman of the Joint Chiefs of Staff General Martin E. Dempsey, USA, rescinded the ground combat exclusion policy of 1994. Panetta stated, "the Department's goal in rescinding the rule is to ensure that the mission is met with the best-qualified and most-capable people, regardless of gender." I understand that the Services are approaching this with phases of implementation. In what phase of implementation is SOCOM?

Admiral MCRAVEN. We are currently in the assessment phase of our implementation plan. As Major General Sacolick, SOCOM, testified before the House Armed Services Committee Military Personnel Subcommittee, the assessment phase consists of finishing third-party studies on standards, cohesion, and team effectiveness.

6. Senator GILLIBRAND. Admiral McRaven, according to the SOCOM Implementation Plan for Elimination of Direct Combat Assignment Rule from March 22, 2013, your stated the deadlines for completing the SOCOM-wide Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy analysis; the Special Operations Studies and Research in our Joint Special Operations University analysis; and the RAND study are July 2014. Are you on track to complete those studies?

Admiral MCRAVEN. We are on track to complete our Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy analysis and the research conducted by the Center for Special Operations Study and Research of Joint Special Operations University by July 2014. The conclusion of the RAND study on unit cohesion may be delayed by weeks pending analysis of the survey of SOF personnel.

7. Senator GILLIBRAND. Admiral McRaven, upon completion of these studies, SOCOM's Implementation Timeline indicates that the next steps are "unit training" and "develop cadre." Could you please explain what these follow-on steps include?

Admiral MCRAVEN. The Chairman provided guidance to the Services that included both unit training and developing cadre as mandatory steps in opening positions and specialties to women. SOCOM incorporated this guidance into its plan. Unit training includes preparing all SOF personnel for a successful implementation of the Secretary of Defense's final decision and consists of both education and information sharing to ensure that all SOF personnel understand the actions being taken and the expectations for their support. Unit training and assigning a cadre support the same goal of ensuring success within any position or specialty opened to women as part of the DOD process.

8. Senator GILLIBRAND. Admiral McRaven, what percentage of SOCOM Military Occupational Specialties (MOS) were closed to women under the combat exclusion policy?

Admiral MCRAVEN. Of the 19 SOCOM specialties MOS, 9 are closed to women (47 percent).

9. Senator GILLIBRAND. Admiral McRaven, how many positions exist within these closed MOS?

Admiral MCRAVEN. There are 18,604 billets within the 9 closed SOCOM MOS.

10. Senator GILLIBRAND. Admiral McRaven, the Army has notified Congress that it is opening some of its closed MOS to women. Insofar as some of these same MOS exist in SOCOM, what is preventing you from opening these MOS as well?

Admiral MCRAVEN. SOCOM is working closely with the Army to make recommendations regarding opening these positions.

11. Senator GILLIBRAND. Admiral McRaven, the Army has notified Congress that it is opening some of its previously closed positions in MOS already open to women, such as enablers. Insofar as some of these same positions exist in SOCOM, what is preventing you from opening these positions as well?

Admiral MCRAVEN. SOCOM is working closely with the Army to make recommendations regarding opening these positions.

12. Senator GILLIBRAND. Admiral McRaven, will SOCOM meet the deadline to open positions to women by January 2016?

Admiral MCRAVEN. SOCOM will adhere to all Secretary of Defense and Chairman of the Joint Chiefs of Staff (CJCS) guidelines and deadlines and is on pace to meet the deadline of January 1, 2016.

13. Senator GILLIBRAND. Admiral McRaven, are there things that you are waiting on from the Services before you begin opening Special Operations Forces (SOF) positions to women?

Admiral MCRAVEN. SOCOM is working closely with the Services because there are specific SOCOM MOS that are intertwined with those of the Services and that have implications across the force. It is imperative SOCOM maintain close lines of communication with the Services in order to synchronize efforts and ensure a smooth transition.

14. Senator GILLIBRAND. Admiral McRaven, how closely is SOCOM monitoring the Services' reviews of MOS available to women?

Admiral MCRAVEN. The working group at Headquarters, SOCOM is working closely with the Services and participating in monthly Office of Secretary of Defense Women in the Services working group meetings. This open line of communication allows us to share information freely with the Services. The SOCOM Service components (U.S. Army Special Operations Command, Naval Special Warfare Command, Air Force Special Operations Command, U.S. Marine Corps Forces Special Operations Command) coordinate with their respective Services on a regular, frequent basis.

15. Senator GILLIBRAND. Admiral McRaven, how closely is SOCOM monitoring the ways the Services are training for MOS available to women?

Admiral MCRAVEN. SOCOM is working closely with the Services. While training for Special Operations Forces MOS is typically different from Service training, we are in constant communication with the Services to discover best practices and lessons learned from integrating women into Service occupations.

16. Senator GILLIBRAND. Admiral McRaven, what actions will continue to take place after 2016 to ensure that women are being assessed, selected, and trained for these positions?

Admiral MCRAVEN. Women will be assessed, selected, and trained for all approved, opened positions via the same methods as their male counterparts. Consistent with the mandate to SOCOM to provide fully capable SOF, we will continue to monitor force health and readiness, promptly addressing specific needs that may arise to ensure successful integration.

17. Senator GILLIBRAND. Admiral McRaven, your plan is to implement gender neutral physical standards for all SOCOM specialties. Assuming these standards are determined objectively and implemented fairly, why would it be necessary to request an exception?

Admiral MCRAVEN. The Chairman of the Joint Chiefs of Staff January 9, 2013 memo states that if, "the assignment of women to a specific position or occupational specialty is in conflict with our stated principles, we will request an exception to policy." The driving principles as stated in the Chairman of the Joint Chiefs of Staff memo are: to preserve unit readiness, cohesion, and morale, ensure all service men and women are given the opportunity to succeed and are set up for success with viable career paths, retaining the trust and confidence of the American people by promoting policies that maintain the best quality and most qualified people, upholding valid occupational performance mental and physical standards, and ensuring a cadre is in place at the point of introduction. SOCOM is committed to upholding the guiding principles stated in the Secretary of Defense memo. If, and only if, SOCOM finds through thorough analysis that one or more of these principles cannot be upheld, then SOCOM will ask for an exception to policy.

18. Senator GILLIBRAND. Admiral McRaven, is your goal to open 100 percent of SOCOM positions to the most qualified candidate regardless of gender?

Admiral MCRAVEN. I fully support the decision to eliminate the Direct Ground Combat Definition and Assignment Rule and SOCOM's goal is to eliminate gender-based restrictions to the fullest extent possible in accordance with Secretary of Defense and Chairman of the Joint Chiefs of Staff guidelines and deadlines. SOF is and will continue to be committed to selecting the best and most qualified candidates to meet the SOF mission.

19. Senator GILLIBRAND. Admiral McRaven, women have been active in Air Force SOCOM since 1994. Have you consulted female operators already resident in SOCOM as you develop SOCOM's combat integration plan?

Admiral MCRAVEN. Yes, the women who currently work within SOF formations have valuable knowledge and experiences that we are leveraging to ensure we have all available information to successfully complete this task.

20. Senator GILLIBRAND. Admiral McRaven, what role will female operators already resident in SOCOM play in the ongoing implementation of SOCOM's combat integration process?

Admiral MCRAVEN. Women who currently serve within SOF formations are providing invaluable information at every level of the Women in the Services policy implementation. These women are playing key roles as members of working groups, in the implementation of surveys, analysis, and research and they will continue to be a great resource through the implementation of this policy change.

21. Senator GILLIBRAND. Admiral McRaven, will you develop mentorship programs linking senior women in Air Force SOCOM with women who will be entering previously closed positions across SOF?

Admiral MCRAVEN. The Secretary of Defense's January 9, 2013, memo outlines guiding principles for the Women in the Service Implementation Plan. One of these principles is to ensure "a sufficient cadre of midgrade/senior women enlisted and officers are assigned to commands at the point of introduction to ensure success in the long run." SOCOM is committed to adhering to each of the Secretary of Defense's guiding principles.

QUESTION SUBMITTED BY SENATOR TIM KAINE

END OF WAR TIMING

22. Senator KAINE. Assistant Secretary Lumpkin, in your written testimony you wrote, "We are ending the longest prolonged period of war in our Nation's history." Your verbal testimony affirmed your view that the United States is coming off of a war-footing, though existential threats to the country will remain. On May 17, 2013, Michael Sheehan, the previous Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict, testified the war on terrorism will last "at least 10 to 20 years." Is it now the official position of the administration that the war is ending in 2014 with a conclusion of combat operations in Afghanistan?

Mr. LUMPKIN. The combat mission in Afghanistan is concluding at the end of 2014 with International Security Assistance Forces, including U.S. forces, significantly drawing down. Although al Qaeda's leadership cadre has been depleted by U.S. counterterrorism operations in the Afghanistan-Pakistan border region, al Qaeda's global affiliates continue to present credible threats to U.S. personnel and interests overseas. DOD must remain postured and prepared to take lawful action against terrorists who pose a continuing and imminent threat to the American people, while continuing to engage with foreign partners to develop their counterterrorism capacity and capabilities to effectively address the threat.

DEPARTMENT OF DEFENSE AUTHORIZATION OF APPROPRIATIONS FOR FISCAL YEAR 2015 AND THE FUTURE YEARS DEFENSE PROGRAM

TUESDAY, APRIL 1, 2014

U.S. SENATE,
SUBCOMMITTEE ON EMERGING
THREATS AND CAPABILITIES,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

PROLIFERATION PREVENTION PROGRAMS AT THE DEPARTMENT OF ENERGY AND AT THE DEPARTMENT OF DEFENSE

The subcommittee met, pursuant to notice, at 2:15 p.m. in room SR–222, Russell Senate Office Building, Senator Kay R. Hagan (chairwoman of the subcommittee) presiding.

Committee members present: Senators Hagan, Fischer, and Graham.

OPENING STATEMENT OF SENATOR KAY R. HAGAN, CHAIRWOMAN

Senator HAGAN. We're going to go ahead and start because we do have several votes and we'll probably take turns with Senator Fischer chairing while I go vote, et cetera.

The Emerging Threats and Capabilities Subcommittee meets today to review the President's fiscal year 2015 request for proliferation prevention programs at the Department of Defense (DOD) and at the Department of Energy (DOE). We plan to end this open session at 3 p.m. so that we can adjourn to the Office of Senate Security in the Capitol Visitor Center for a closed session with today's witnesses, and that session will start at 3:15 p.m.

In the interest of time, I want to ask that each witness to please give a very brief, 1- to 2-minute opening statement. We're joined today by three expert witnesses to help us understand these programs. Anne M. Harrington is the Deputy Administrator for Defense Nuclear Nonproliferation at the National Nuclear Security Administration (NNSA) of DOE. Welcome back to the subcommittee, Ms. Harrington.

Rebecca K.C. Hersman is the Deputy Assistant Secretary of Defense for Countering Weapons of Mass Destruction (WMD) within the Office of the Under Secretary of Defense for Policy. I under-

stand this is your first time before the subcommittee, so let me issue you a warm welcome.

Kenneth A. Myers III is the Director of the Defense Threat Reduction Agency (DTRA) at DOD, which is focused on reducing the threats from WMD. DTRA is responsible for executing the Cooperative Threat Reduction (CTR) program. Mr. Myers is also the Director of the U.S. Strategic Command Center for Combating WMD at DOD. Welcome back, Mr. Myers.

Thanks for all of your service and thanks for joining us today.

For fiscal year 2015, DOD and DOE propose to spend roughly $1.9 billion for nonproliferation activities to help stem the flow of WMD. I would note that this is a 21 percent reduction from the $2.4 billion appropriated to both programs in fiscal year 2014. As I understand it, the lower funding levels are related to the termination of the CTR umbrella agreement with Russia, the planned completion of Syrian chemical weapons destruction, a proposed cold standby of the mixed oxide (MOX) fuel facility in South Carolina, and various other program milestone completions.

Although Congress has mandated tight budget constraints, the President recently completed his third international summit meeting on securing loose nuclear materials, and it is not clear that the lower budget request will fully support the aims of that meeting and other important nonproliferation goals. In my opinion, there is no shortage of work to be done in this area, since even the smallest quantities of WMD would pose a significant threat to the United States and our allies. We must not forget what just a few grams of anthrax released from two envelopes did to this Senate complex in 2001. We will review the budget request against these needs.

Among other missions, the CTR program is implementing DOD's role in helping to destroy Syria's chemical weapons program. The committee provided legislative authority last year to allow DOD to move quickly to address this rapidly developing requirement. We would be interested to know the status of this critical mission and its prospects for success.

I would also note that the program recently completed the successful destruction of Libya's chemical weapons, which was a remarkable accomplishment in that country.

Ms. Hersman, you are charged with developing DOD's policy for countering WMD, including the CTR program. The largest share of CTR funding is for the Cooperative Biological Engagement program, operating in numerous countries to reduce biological threats of concern to DOD. We are interested to know how this program responds to such biological threats and how it is coordinated with other U.S. international public health programs.

Ms. Harrington, your Defense Nuclear Nonproliferation program funding decreased by 20 percent in the fiscal year 2015 budget request. This subcommittee needs to understand the large decrease, and I understand 60 percent of that amount is tied to a proposal to put the MOX fuel program in cold standby. We obviously want to know what you mean by cold standby and whether you have an alternative disposal path to justify putting the program in cold standby.

Mr. Myers, DTRA implements the CTR program and led the remarkable effort to outfit the Merchant Marine vessel *Cape Ray* to

destroy the most dangerous Syrian chemical weapons agents and precursors. We will want you to explain to the subcommittee the interagency process involved in outfitting the ship, how the chemical weapons destruction process will work, and where the waste will go afterwards.

Again, let me thank all three of you for testifying today, and before asking our witnesses to summarize their testimony, briefly I want to turn to my colleague and ranking member, Senator Fischer, for any other comments.

Senator FISCHER. Thank you, Madam Chairwoman, and I thank the witnesses for appearing before us today to discuss proliferation prevention programs at DOE and DOD.

First, I would like to commend DOE for doing difficult but necessary prioritization in its budget submission. By bringing completed programs to a close and applying prior year balances to offset reductions, critical work is sustained while less is asked of the American taxpayers.

I join the chair today in emphasizing the importance of these programs. Proliferation prevention is intimately linked to many of the biggest challenges facing our Nation today. Media attention on events in Iran and Syria often focuses on the elegant diplomatic meetings and weighs the prospects for a deal against the odds of military action, but comparatively little attention is paid to the significant nonproliferation issues at stake.

Similarly, with respect to Russia, world leaders are quick to point out that its annexation of Crimea violates international law, but the harm done to the nonproliferation agenda receives only limited acknowledgment. I look forward to hearing more from the witnesses today on this subject, as well as the other issues they face and how this budget request supports their mission.

I thank the chair and the witnesses for their service.

Senator HAGAN. Thank you, Senator Fischer. I know we have votes during this hearing, so we will try to tag team on this.

At this point in the hearing, I would ask that the opening remarks of my friend and colleague, Senator Edward Markey, be included as part of the record.

[The prepared statement of Senator Markey follows:]

PREPARED STATEMENT BY HON. EDWARD J. MARKEY, SENATOR FROM THE STATE OF MASSACHUSETTS

Chairwoman Hagan, Ranking Member Fischer:

I thank you for calling today's hearing and for allowing me to submit testimony. I think we can all agree that preventing the spread of weapons of mass destruction (WMD)—especially nuclear weapons—is one of the highest priorities for our national security. Terrorist groups remain committed to acquiring nuclear weapons and the materials and expertise needed to make them.[1]

President Obama's 2009 speech in Prague set an ambitious agenda to secure the world's nuclear material that is at risk of falling into the wrong hands. This material includes the essential building blocks of nuclear weapons, highly enriched uraniuni, and separated plutonium. Securing these materials is the foundation of preventing nuclear terrorism.

The programs responsible for this important work include the Global Threat Reduction Initiative (GTRI), the International Materials Protection and Cooperation (IMPC), and the Cooperative Threat Reduction (CTR) program. GTRI is responsible

[1] Tobey, William H. and Zolotarev, Pavel, "The Nuclear Terrorism Threat" (Pattaya, Thailand: Presentation, Meeting of the 2014 Nuclear security summit Sherpas, Hosted by the Thai Ministry of Foreign Affairs, January 13, 2014).

for the securing, removal, or disposal of civil material that could be used for nuclear weapons, while IMPC works to upgrade security at military sites that house weapons or weapons-usable material, and CTR secures and dismantles WMD in former states of the Soviet Union.

Through programs like these, the administration has made significant progress in securing nuclear material since 2009. All of the locations in non-nuclear-weapon states where a single site contained enough highly enriched uranium to produce a simple nuclear bomb were either eliminated or experienced major security improvements. Thirteen countries, including Ukraine, have completely eliminated all of their highly enriched uranium and separated plutonium. The United States has added additional physical security to 32 buildings storing weapons-usable nuclear material.[2] Radiation detection systems have been installed in 260 sites and ports and 15 countries have deployed mobile radiation detection vans.

Despite this progress, there are still hundreds of sites spread across 30 countries that have weapons-usable nuclear material, some of which is not sufficiently secured to protect against all realistic threats.[3] This is why I was concerned to see the administration propose reductions to the budgets of these important nuclear security programs. The fiscal year 2015 budget proposal calls for a 27 percent cut to the budget of CTR relative to the previous year. In addition, the fiscal year 2015 budget calls for reductions to GTRI and IMPC by more than 20 percent from the previous year, which would be more than a 40 percent decrease in funding request from fiscal year 2011 levels.[4]

These funding levels would add years to GTRI's goal of converting or shutting down 200 research reactors fueled with highly enriched uranium. In addition, the fiscal year 2015 National Nuclear Security Administration (NNSA) budget request states that other work in the removal of nuclear material will be "deferred to future years." This budgetary reduction for nuclear and radiological protection is justified on the grounds that it "is consistent with broader budget austerity goals and prioritization within NNSA."

Meanwhile, nuclear weapons programs are prospering, largely escaping the effects of austerity. The fiscal year 2015 budget request for nuclear weapons sustainment and modernization programs received an increase of nearly 7 percent above the previous year, representing a 30 percent increase from the fiscal year 2010 enacted levels.[5] This includes a 20 percent increase to the already over budget B61 life extension program and a 26 percent increase to the NNSA's Naval Reactor program.

These increases in the nuclear weapons budget do not reflect the security requirements of the 21st century. We are no longer living in a world of nuclear arms races. As the President recently stated,[6] the security concern that keeps him up at night is the threat of loose nukes. As a result, we should prioritize funding for programs that secure nuclear material, while at the same time, ensure that our spending on nuclear weapons modernization reflects our stated commitments to reducing our weapons stockpile.

In order to right-size our nuclear weapons and delivery systems budget for the 21st century, I recently introduced the Smarter Approach to Nuclear Expenditures (SANE) Act (S. 2070). This bill will save approximately $100 billion over the next decade through targeted reductions to the U.S. nuclear weapons budget. Specifically, my legislation calls for:

- Reducing deployed strategic submarines from 14 to 8 and decreasing the purchase of replacement submarines from 12 to 8—saving $16 billion.
- Cutting warhead life extension programs and deferring the development of new intercontinental ballistic missiles (ICBM)—saving $15 billion.
- Removing the nuclear mission from F–35s and delaying the new long-range bomber—saving over $32 billion.

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[2] Bunn, Matthew, Malin, Martin B., Roth, Nickolas, and Tobey, William H. "Advancing Nuclear Security: Evaluating Progress and Setting New Goals," Cambridge, Mass.: Report for Project on Managing the Atom, Belfer Center for Science and International Affairs. Harvard Kennedy School. March 18, 2014, page 25.

[3] Bunn, Matthew, Malin, Martin B., Roth, Nickolas, and Tobey, William H. "Advancing Nuclear Security: Evaluating Progress and Setting New Goals," Cambridge, Mass.: Report for Project on Managing the Atom, Belfer Center for Science and International Affairs. Harvard Kennedy School. March 18, 2014, page 31.

[4] Roth, Nickolas, "U.S. Budget Request Shows Eroding Focus on Nuclear Security." Nuclear Security Matters, March 24, 2014.

[5] Reif, Kingston, "New Obama Budget Slashes Nonproliferation." The Center for Arms Control and Nonproliferation, March 6, 2014.

[6] Thys, Fred, "Obama Looks To Boston Fortunes To Boost Democrats." WBUR.org, March 6, 2014.

- Canceling nuclear bombmaking facilities and missile defense programs—saving $37 billion.

By focusing our resources on the real threats of this century, we can bolster both our economic and national security. America is long past due for modernizing our nuclear strategy to meet today's threats—not the threats we faced decades ago.

I thank the subcommittee once again for holding this important hearing and look forward to working with you to ensure our national security needs are met.

Senator HAGAN. Let's see. Ms. Harrington, your opening statement.

STATEMENT OF HON. ANNE M. HARRINGTON, DEPUTY ADMINISTRATOR FOR DEFENSE NUCLEAR NONPROLIFERATION, NATIONAL NUCLEAR SECURITY ADMINISTRATION, DEPARTMENT OF ENERGY

Ms. HARRINGTON. Thank you very much. Madam Chairwoman, Ranking Member Fischer, and Senator Graham: I am here to discuss the President's fiscal year 2015 budget request for the DOE's NNSA Office of Defense Nuclear Nonproliferation. I am very pleased to appear today with my colleagues from DOD. We share a strong commitment to the security of the Nation and to finding ways for our programs to work together to that end.

Last week, as you noted, I did attend the third Nuclear Security Summit in The Hague, where the President gathered with world leaders to reaffirm the high priority they placed on nuclear security. The Office of Defense Nuclear Nonproliferation plays the central role in implementing U.S. summit commitments and to advancing global nuclear and radiological security. I will not give the highlights in the interest of time, but would be happy to come back to those later.

The President's 2015 request of $1.55 billion provides the funding necessary to build on these successes. To meet the dynamic range of security challenges that we face, Defense Nuclear Nonproliferation draws on its core competencies, which are to remove, eliminate, and minimize the use of proliferation-sensitive materials, safeguard and secure materials, technologies, facilities, and expertise, detect and prevent the illicit trafficking of materials, technology, and expertise, provide research and development (R&D) technology solutions to nuclear security and nonproliferation efforts, and provide policy solutions to reduce nuclear and radiological dangers.

In the area of material elimination, the administration remains firmly committed to disposing of 34 metric tons of surplus weapons-grade plutonium and to the Plutonium Management and Disposition Agreement. While we further study more efficient options for plutonium disposition in an effort to decrease costs, the MOX fuel fabrication will be placed in cold standby. With your support, the Office of Defense Nuclear Nonproliferation will continue to pursue a multi-layered approach to protect and account for materials at their sources, remove, downblend, or eliminate materials when possible, detect, deter, and reduce the risk of additional states acquiring nuclear weapons, and support the development of new technologies to detect nuclear trafficking and proliferation, as well as verify compliance with arms control treaties.

Thank you for your attention and I would be happy to answer any questions.

[The prepared statement of Ms. Harrington follows:]

PREPARED STATEMENT BY MS. ANNE HARRINGTON

INTRODUCTION

Madam Chairwoman, Ranking Member Fischer, and distinguished members of the Subcommittee, thank you for allowing me to present the President's fiscal year 2015 budget request for the Department of Energy National Nuclear Security Administration's (NNSA) Office of Defense Nuclear Nonproliferation. The request of $1.6 billion provides the funding necessary to implement the President's nuclear security and nonproliferation priorities. I am particularly pleased to appear today with my colleagues from the Department of Defense. We share a strong commitment to the security of the nation and to finding ways for our programs to work together to that end. Ours is a global mission and more than 20 years after the collapse of the Soviet Union, many of our programs are now working on new security challenges across of the world. Recent actions, however, highlight that we must continue and complete important nuclear threat reduction work in Russia and the surrounding countries in Eurasia.

One of our most important missions has been to support the administration's commitment to secure the most vulnerable nuclear material across the globe, commonly referred to as the 4 year effort. I am pleased to report by the end of 2013 and in close coordination with interagency and international partners, we completed and exceeded our original targets. Examples of what NNSA has accomplished since 2009 include: removed or confirmed the disposition of 2,990 kilograms of highly-enriched uranium (HEU) and separated plutonium including removing all HEU from 11 countries and Taiwan; completed material protection, control, and accounting (MPC&A) upgrades at 32 buildings containing metric tons of weapons-usable material in Russia; installed 1,585 radiation portal monitors at border crossings, airports, and seaports, many of which have already transitioned to full sustainability by the partner country; deployed 54 mobile detection systems to partner countries; and supported the down blending of 4,900 kilograms of non-weapons HEU to low-enriched uranium (LEU) in Russia, among other activities. The work accomplished in the past 4 years has made it significantly more difficult to acquire and traffic the materials required to make an improvised nuclear device.

These U.S. achievements, as well as the announcement by the U.S and Japan to eliminate hundreds of kilograms of sensitive nuclear material by removing all HEU and plutonium from the Japan Atomic Energy Agency's Fast Critical Assembly, were highlighted last week by President Obama and Secretary Moniz at the third Nuclear Security Summit in The Hague. There world leaders reaffirmed the high priority that they give to nuclear security and demonstrated measurable progress in securing vulnerable nuclear and radiological material worldwide to prevent nuclear terrorism. However, I have to stress that much remains to be done. The President offered to host a fourth Summit in the United States in 2016 in order to maintain this positive momentum, and, as we have been since the Summit process began in 2010, NNSA's Defense Nuclear Nonproliferation programs will be key to executing U.S. commitments.

MEETING CURRENT AND FUTURE CHALLENGES

The President's request for funding the Defense Nuclear Nonproliferation account addresses current priorities, but also looks forward at the future threat environment. We have accordingly aligned our work to be prepared for those challenges. As we have seen recently, the global security environment is dynamic, characterized by the persistence and escalation of regional conflicts, continued diffusion of dual-use technology and information through the expansion of civil nuclear energy programs, remaining challenges associated with nuclear and radiological materials, increased sophistication of trafficking networks, and the growth of cyber threats to nuclear safeguards and security. State-level proliferation also continues to strain nonproliferation regimes, while vulnerable and excess nuclear and radiological materials are at risk of non-state actor acquisition, including the insider threat.

To meet this range of challenges, Defense Nuclear Nonproliferation draws on its core competencies to:

- Remove, eliminate, and minimize the use of proliferation-sensitive materials.
- Safeguard and secure materials, technologies, and facilities.
- Detect and prevent the illicit trafficking of nuclear/radiological materials, technology, information and expertise.

- Provide research and development (R&D) technology solutions for treaty monitoring, minimizing the use of proliferation-sensitive materials, and the application of safeguards and security.
- Provide unique technical/policy solutions and develop programs/strategies to reduce nuclear/radiological dangers.

Our programs are recognized within the interagency and the international community as leading the fight against nuclear proliferation and preventing nuclear terrorism through denying an adversary access to nuclear and radiological materials. In carrying out this role, we look for every opportunity to team with our colleagues in other U.S. Government Departments, as well as with countries and international organizations that share a commitment to nuclear nonproliferation. Since we were authorized in 2005 to receive international funds, 8 countries have partnered with us in project implementation, not only with financial resources, but with technical expertise, political support and other forms of participation. This is in addition to funding their own nuclear security and nonproliferation programs, as well as contributions to international organizations for nuclear security and nonproliferation efforts. Maintaining our programmatic capabilities and leadership is key to sustaining U.S. leadership in global nonproliferation efforts, and we look forward to building on these partnerships and expanding this important cooperation in fiscal year 2015 and beyond.

PROGRAM REQUESTS

The Global Threat Reduction Initiative (GTRI) has attracted much attention over the past years for its successful work securing and removing dangerous nuclear and radiological material from around the world and for its radiological security work domestically. The fiscal year 2015 budget requests $333 million to continue GTRI's important work. While this is a decrease in funding compared to prior years, this budget reflects the successful completion of aggressive removal goals under the 4 year effort, which allowed us to accelerate some of our most important work. The fiscal year 2015 budget request will allow us to continue to reduce threats to U.S. national security by funding the removal of an additional 125 kilograms of material; continuing to reduce the civilian use of HEU by converting four more HEU-fueled research reactors to LEU fuel, and completing domestic and international security upgrades for an additional 105 buildings that host high-priority radiological sources.

The fiscal year 2015 budget provides $305 million for another important element of the President's nuclear security agenda—the International Material Protection and Cooperation (IMPC) Program, which has two major components. In the material protection, control and accounting work, the fiscal year 2015 IMPC budget reflects the completion of a number of major initiatives including completing the consolidation of all Category I and II material into a new high security zone at a nuclear site in Russia. The fiscal year 2015 budget also funds perimeter upgrades at several sites that store and process weapons-usable nuclear material.

The Second Line of Defense (SLD) program element of the fiscal year 2015 IMPC request includes $118 million to provide fixed radiation detection deployments at 15 sites and ports, deploy 20 mobile radiation detection systems to 6 new partner countries, and connect sites to national communication systems in three countries to help counter the threat of illicit trafficking of special nuclear material. SLD will also provide sustainability support for over 150 sites, including training, maintenance support, workshops and exercises. These efforts reflect the thorough strategic review process the program undertook in 2012.

Another important element of the DNN suite of programs is the Nonproliferation and International Security (NIS) program, for which we are requesting $141. This will allow the program to focus on efforts to safeguard nuclear fuel cycle facilities, control illicit trafficking of nuclear-related technology and expertise, verify compliance with international arms control and nonproliferation treaties, as well as develop and implement policies to reduce nuclear dangers.

Another key element of our nuclear security and nonproliferation strategy is the development of technical capabilities to monitor nuclear treaties, weapons development activities, and nuclear detonations worldwide. The fiscal year 2015 request includes $361 million for the Defense Nuclear Nonproliferation Research and Development Program to address these core goals including producing nuclear detection satellite payloads. I want to point out that we have a very close working relationship with the Department of Defense, particularly the Defense Threat Reduction Agency in many of our R&D programs.

The fiscal year 2015 budget request of $311 million for the Fissile Materials Disposition Program reflects the decision to place the Mixed Oxide Fuel Fabrication Facility in cold standby while we further study more efficient options for plutonium

disposition due to cost increases. We owe it to the American people to continually reevaluate our work and make strategic decisions for the future and this is what we are doing.

We have been working closely with the MOX project contractor and others for a year to determine if there are opportunities to make the current MOX fuel approach for plutonium disposition more efficient. It has become clear during this time that this approach will be significantly more expensive than anticipated, even with potential contract restructuring and other improvements that have been made to the MOX project. In parallel, we have begun analyzing alternatives to accomplish the plutonium disposition mission. With a lifecycle cost of approximately $30 billion, the MOX project, as currently structured, is no longer a viable path for plutonium disposition. As a result, the MOX project will be placed in cold standby so that we can minimize costs to the greatest extent and preserve the taxpayer investment while we independently validate a more efficient path forward to dispose of excess weapons plutonium. I must underline, however, the administration remains firmly committed to disposing of 34 metric tons of surplus weapon-grade plutonium and the PMDA.

CONCLUSION

Our efforts on nonproliferation and nuclear security measures to reduce the risk of nuclear terrorism are vital, but in this current fiscal environment difficult decisions are inevitable. Although the fiscal year 2015 budget request is an overall decrease in funding, we will still be able to carry out a robust set of activities. The threat of nuclear terrorism remains and nuclear and radiological materials, weapons of mass destruction (WMD) technology and expertise continue to be at risk of falling into the wrong hands; the detonation of a nuclear device anywhere in the world could lead to significant loss of life, and extraordinary economic, political, and psychological consequences; and materials of concern, such as plutonium, are still being produced. In these challenging budget times, we must not lose sight of the critical role played by NNSA's nonproliferation programs and the protections they provide by reducing the risk of nuclear terrorism and WMD proliferation. One measure we are taking to ensure that we are prepared to meet these dynamic challenges is our participation in a Secretary of Energy Advisory Board review to assess our current capabilities and to better hone our ability to meet future threats.

With your support, the Office of Defense Nuclear Nonproliferation will continue to pursue a multi-layered approach to protect and account for material at its source; remove, down-blend or eliminate material when possible; detect, deter and reduce the risk of additional states acquiring nuclear weapons; and support the development of new technologies to detect nuclear trafficking and proliferation, as well as verify compliance with arms control treaties.

Thank you for your attention and I will be happy to respond to your questions.

Senator HAGAN. Thank you.

Ms. Hersman.

STATEMENT OF REBECCA K. C. HERSMAN, DEPUTY ASSISTANT SECRETARY OF DEFENSE FOR COUNTERING WEAPONS OF MASS DESTRUCTION, DEPARTMENT OF DEFENSE

Ms. HERSMAN. Chairwoman Hagan, Ranking Member Fischer, and Senator Graham: I'm pleased to testify today with my colleagues from DTRA and NNSA about our efforts to counter WMD.

Today, WMD threats can proliferate at the speed of an airliner, a missile, or even the Internet. Countering such complex and dynamic threats requires flexible, innovative, and agile responses, as well as whole of department, whole of government, and indeed even whole of international community solutions.

The international effort to deal with serious chemical weapons, unprecedented in scale, speed, and complexity, is a vivid example. Today, thanks to the efforts of many contributors and the support of Congress, Syria's chemical weapons program is on the path to elimination. The centerpiece of the U.S. contribution, the Motor Vessel *Cape Ray*, outfitted with DOD's recently developed Field Deployable Hydrolysis System and funded predominantly through

DOD's CTR program, is ready to neutralize the most dangerous chemicals in the Syrian arsenal, and to do so in a safe, secure, and environmentally sound fashion. This type of creative, collaborative approach to a WMD challenge can't be the exception; it must be the rule.

Another case in point is the January announcement of the complete destruction of the chemical weapons munitions that Libya declared in 2011 and 2012. This success was possible only through CTR's resources and expertise, coupled with cooperation from the Organization for the Prohibition of Chemical Weapons (OPCW) and the Libyan Government, and with contributions from the Government of Germany.

Looking ahead, we must address future challenges, not only chemical, but nuclear and biological as well, in similar fashion, bringing CTR and the rest of the countering WMD toolkit to bear.

I thank you for your support for our fiscal year 2015 budget request.

[The prepared statement of Ms. Hersman follows:]

PREPARED STATEMENT BY MS. REBECCA K.C. HERSMAN

INTRODUCTION

Chairwoman Hagan, Ranking Member Fischer, and members of the subcommittee, I am pleased to testify today about several of our ongoing efforts to counter the threats posed by weapons of mass destruction (WMD). The pursuit of WMD and potential use by actors of concern pose a grave threat to the security of the United States as well as our allies and partners around the world. Throughout the Department of Defense (DOD), and in concert with our interagency and international partners, we are continuously innovating to counter new and evolving threats with military and civilian solutions to ensure that we are neither attacked nor coerced by actors with WMD.

As the Deputy Assistant Secretary of Defense for Countering Weapons of Mass Destruction, I am responsible for establishing policies and guidance to protect U.S. and Allied Armed Forces against a chemical, biological, radiological, or nuclear (CBRN) attack from a State actor or terrorist. I also represent the Department's interests on counterproliferation and non-proliferation policy issues, including the Biological Weapons Convention (BWC), Chemical Weapons Convention (CWC), and Nuclear Nonproliferation Treaty (NPT), the Proliferation Security Initiative (PSI), as well as the DOD Cooperative Threat Reduction (CTR) program.

In this role, my office develops policy and guidance for DOD CTR programs and activities which are implemented by the Defense Threat Reduction Agency (DTRA), under the direction of Mr. Myers. We also work in close coordination with the National Nuclear Security Administration's (NNSA) Deputy Administrator for Defense Nuclear Nonproliferation, Ms. Anne Harrington, on a number of nuclear security and nonproliferation projects around the globe. I am pleased to be here today with these colleagues, both of whom are integral to countering the threats that I will be addressing.

COMBATING WEAPONS OF MASS DESTRUCTION CHALLENGES

A number of State and non-State actors continue to pursue WMD, posing a persistent threat to the security of the United States, as well as our allies and partners. In addition, the constant evolution of weapons, materials, tactics and technologies will continue to challenge our ability to dissuade, detect, deter, and defend against these threats. Finally, the interconnectedness of global communities means that WMD threats can proliferate at the speed of an airliner, a missile, or even the internet. Countering such complex and dynamic threats requires flexible, innovative, and agile responses. Twentieth century solutions are not sufficient to meet the WMD challenges of the 21st century.

Our warfighters play a large part in countering WMD, but we must consistently look beyond military solutions and take maximum advantage of diplomatic and nonkinetic tools available.

Countering the proliferation or use of WMD requires flexible and agile responses, capable partners, as well as "whole-of-department," "whole-of-government," and even "whole-of-international-community" solutions. In these times of fiscal austerity, we must make full use of partnerships, contributing where we can and avoiding unnecessary duplication. Cooperation is a force multiplier, enabling swift and comprehensive action to respond to existing and emerging WMD threats.

The extraordinary effort to deal with Syria's chemical weapons (CW) program in the face of instability, civil war, humanitarian disaster, and an influx of terrorist elements is a great example of how each of these communities has banded together to employ these principles and address an emergent threat rapidly.

As the crisis unfolded, we sought to reassure close partners and reduce the risk of cross-border proliferation of CW assets. We also started to work with several of Syria's neighbors to enhance their ability to mitigate the risk to their populations of possible CW use near their borders. More specifically, in addition to the prudent planning that is part of DOD's genetic coding, the authority granted by the Secretary of Defense, with concurrence of the Secretary of State, to expand our work into the Middle East, enabled growing work with Iraq, Jordan, Turkey, and even Lebanon and facilitated new partnerships and collaboration across DOD's communities to support both civilian and military requirements to reduce CW proliferation risks. Anticipating the potential need for eliminating Syria's CW program led to the rapid development and acquisition of key capabilities, particularly with respect to transportable neutralization of bulk chemical agents.

After the August 21, 2013, use of chemical weapons by the Syrian regime against its population led to the threat of military intervention, the United States and Russia forged the September 14, 2013, Geneva framework, which—together with United Nations Security Council Resolution 2118 and decisions by the Executive Council of the Organization for the Prohibition of Chemical Weapons (OPCW)—launched the international effort to eliminate Syria's CW program. This effort is unprecedented in scale, speed, and complexity. Although much remains to be done, it is extraordinary how much has already been accomplished through DOD, interagency and international partnerships.

Today, thanks to the tremendous efforts of so many contributors, Syria's CW program is on the path to elimination, albeit slower than desired. The international coalition to remove and destroy Syria's chemical weapons program is prepared and in place. The maritime task force spear-headed by our Danish and Norwegian colleagues and supported by the United Kingdom, Finland, Russia, and China has enabled the removal from Syria of almost half of the chemicals associated with the Syrian CW program. The centerpiece of the U.S. contribution, the motor vessel (M/V) *Cape Ray*, is ready to neutralize the most dangerous chemicals in the Syrian arsenal. This maritime Ready Reserve Force vessel is outfitted with DOD's recently-developed Field Deployable Hydrolysis Systems and manned by the finest experts from our operational and technical communities. This unprecedented international effort demonstrates the ability of DOD, other U.S. departments and agencies, and our international partners to develop innovative solutions to complex problems.

This type of creative, collaborative approach to a WMD challenge shouldn't be the exception—it must become the rule. As we look to two other high priority counter-WMD issues—countering biological threats and enhancing global nuclear security—we are seeing the payoffs from such national and international-level collaborations.

BIOLOGICAL THREATS

Biological threats pose a serious risk to the United States due to the emergence and spread of new pathogens; the globalization of travel and the food supply; the rise of drug-resistant pathogens; the advancement of biological science capabilities; and the risk of unsecured pathogens of concern. These developments could create dangerous opportunities for State and non-State actors that seek to do us harm—with the potential for truly catastrophic consequences and strategic impacts.

These concerns are reflected in our recently-released 2014 Quadrennial Defense Review (QDR), which specifically notes the confounding challenge of advancing biotechnology and the potential for use of agents that evade detection and countermeasures. This is a complex, global problem that can threaten our forces anytime, anywhere. The QDR acknowledges this challenge, directing us to pursue global prevention, detection, and response efforts.

DOD is executing a strategy to prevent and dissuade the malicious use of biological agents by working with partners to secure and consolidate collections of pathogens of security concern, establish biosafety measures to prevent accidental release, inculcate norms of responsible behavior to identify security breaches and potential internal threats, and institute force health protection measures such as vaccina-

tions. Should prevention fail, we understand that we must be prepared to respond and mitigate threats from the use of biological agents quickly. This requires proactive development and fielding of novel therapeutics; biosurveillance systems that integrate health, environmental, and intelligence data; and detection and diagnostic systems that leverage advancing technology to detect and identify not only traditional threats, but also novel, emerging, and potentially engineered agents.

To succeed against the biological threat, in which prevention, detection, and response rely heavily on public health infrastructure, we have had to forge new relationships with health partners, academia, and industry. Holistic approaches that leverage interagency partnerships and international collaborations are the most efficient and pragmatic way to address the biological threats we face today.

NUCLEAR THREATS

Nuclear threats also remain a prominent concern. Unless arrested and reversed, the nuclear ambitions of countries like North Korea and Iran can imperil interests of the United States and our allies and partners around the world, create instability, and increase the likelihood that other nations will seek to become nuclear-armed states. In addition, the significant number of nuclear-armed States increases the chances that terrorists may acquire nuclear materials, or even weapons.

Moreover, despite two dozen countries having completed the elimination of their weapons-useable nuclear material in the last couple of decades—half of them doing so since the President's 2009 speech in Prague—the remaining availability of such material provides additional opportunities for terrorists to obtain material to produce a nuclear weapon. Continued reports of nuclear material trafficking and insufficient security standards at nuclear sites demonstrate that threats are still present; this combination of vulnerable nuclear materials and non-state actors seeking to acquire WMD capabilities presents a grave threat to U.S. security and that of our allies and partners.

The ongoing spread of nuclear knowledge, fuel cycle technologies, and improved weaponization and delivery capabilities also could contribute to new types of challenges, especially when coupled with long-range ballistic missile capabilities. Unlike biological threats, however, preventing access to essential materials and technology significantly inhibits the ability of state and non-state actors to acquire nuclear capabilities. This underscores the importance of reducing the availability and accessibility of weapons-usable nuclear materials worldwide, along with the technologies required to produce them, promoting a culture of security, and sustaining robust interdiction efforts, to ensure that the nuclear weapon ambitions of state and non-state actors will remain difficult to realize.

DOD is taking action to reduce nuclear threats by working with partner countries, in close coordination with NNSA and the Department of State, to secure nuclear weapons and vulnerable nuclear materials and equipment, contributing to the Nuclear Security Summit process, and by promoting global best practices in nuclear security. DOD will continue to build on its partnerships with other U.S. Government agencies, support critical international organizations such as the International Atomic Energy Agency, and collaborate with countries that can contribute resources and expertise—all to help build a more robust, comprehensive global nuclear security system.

Finally, even as we focus on the highest priority nuclear threats, we must remain mindful of the potential for radiological dispersal and exposure devices that may become increasingly attractive to actors of concern. Although these devices do not generate the same destructive effects associated with nuclear weapons, they can produce significant health, psychological, and economic effects and increase the cost of addressing them due to the wide areas they may affect.

COOPERATIVE THREAT REDUCTION

Founded in 1992 to mitigate the WMD proliferation threats emanating from the breakup of the Soviet Union, the DOD CTR program has been at the forefront of our efforts to meet these challenges. Over the last year, the Program has continued to lead our response to the dramatic changes in the international security environment, proving its ability to be a flexible, adaptable tool for cooperating with a range of partners to implement solutions that mitigate WMD threats.

The DOD CTR program's contributions to the international effort to eliminate Syria's chemical weapons program is a case in point, as the DOD CTR program became the primary means through which the U.S. Government could provide funding, expertise, and resources to shape and implement the CW destruction plan spearheaded by the OPCW. Without question, much of our effort would not have been possible without the active support of Congress. DOD's CTR program has

worked hard in recent years to become more agile and able to respond rapidly to shifting requirements and threats worldwide. Syria represents the best example of these efforts, and congressional support has played a significant role in enabling its success.

The DOD CTR program's success is due largely to congressional authorization of 3-year funding and the ability to realign money internally when necessary. To date, the DOD CTR program has notified Congress that it has allocated approximately $160 million to support the Syria elimination effort, including by providing equipment to the United Nations/OPCW Joint Mission that is necessary to remove the chemicals from Syria, as well as to support the vast majority of the effort to prepare, use, and then decommission the M/V *Cape Ray* for the mission to neutralize Syria's most dangerous chemicals. I want to thank Congress for their support suspending the cap on funds for fiscal years 2014 and 2015 which will enable the DOD CTR program to spend the necessary funds to support this effort. Congressional support for the DOD CTR program's ability to accept contributions from foreign partners has enabled us to allow international partners to share the financial burden for these considerable efforts. In fact, in 2013 and 2014, the DOD CTR program has received more than $19 million in combined contributions from Germany, the United Kingdom, and Canada to assist in our threat reduction efforts in Syria, Libya, Jordan, Iraq, and Georgia, and we will seek additional contributions this year from our international partners for these efforts.

Beyond rolling back the Syrian chemical weapons program itself, we continue to advance our efforts to mitigate proliferation threats within the greater Middle East. The DOD CTR program's Proliferation Prevention Program (PPP) has led this effort, which has focused on enhancing detection and interdiction capacity in Jordan, Iraq, and Turkey, all of which share a border with Syria. This support has drawn on expertise from across the Department to provide both training and equipment. A cornerstone of these efforts is the Jordan Border Security Program (JBSP), which builds on a prior DOD effort along Jordan's north-western border with Syria, and will be an approximately $90 million effort to enhance Jordan's command and control over its borders with Syria and Iraq, and to prevent proliferation through enhanced awareness, coordination, and training.

Another successful effort spearheaded by the DOD CTR program is the destruction of the chemical weapons stockpile that Libya's new government discovered after the ouster of Moamar Qaddafi. Following nearly 2 years of close cooperation with the Libyan Ministry of Foreign Affairs, which was responsible for fulfilling Libya's commitments under the CWC, Libya announced in January of this year that it had completed destruction of the CW munitions it declared in 2011 and 2012. This success was due in large part to the DOD CTR program's provision of $52 million for training, security upgrades, advice, equipment, and destruction support in concert with the Government of Germany, which used our external contributions authority to assist with this effort.

These efforts are critical not just in responding to today's crisis, but to prepare to respond to future threats. Success in the destruction of the Libyan and Syrian CW stockpiles will not eliminate the WMD proliferation risks in the Middle East. We must continue to leverage the capabilities and partnerships we have both established and are now building to respond more effectively to the next challenges that emerge.

It is important to recognize that many of these requirements were not, and could not have been, predicted in advance, but rather were addressed rapidly as they emerged. Internally reprogramming money and support to the Syria effort would have been much more difficult in any previous year, and may not have been possible if the requirement had not coincided fortunately with a decreasing requirement in Russia.

Following the June 2013 expiration of the Umbrella Agreement with Russia, fiscal year 2013 activities in Russia such as intercontinental ballistic missile (ICBM), submarine-launched ballistic missile and ICBM launcher elimination came to a halt. Support to nuclear weapons transport and technical support for chemical weapons destruction also were stopped. Russia and the United States agreed to continue two already agreed upon projects: to dismantle a Delta III strategic submarine and to fund transport of highly enriched uranium (HEU) submarine spent fuel from less secure to much more secure locations in Russia. Even as the traditional DOD CTR program of assistance that has operated in Russia for the last 20 years draws to a natural conclusion, the United States and Russia agreed to continue a number of important efforts on a collaborative basis through the Framework Agreement and Protocol on a Multilateral Nuclear Environmental Programme in the Russian Federation, on which we partner with NNSA. Of course, given the unfolding events in Ukraine and the Crimea, we are carefully evaluating our activities in the region to

ensure consistency with Presidential guidance. We are mindful, however, that the DOD CTR program has a history of continued cooperation on vital threat reduction matters even through difficult periods in U.S./Russian relations. We hope that this will continue to be the case.

Meanwhile, the Middle East is not the only area in which the DOD CTR program is expanding. The PPP started by working to build land and maritime capacity in non-Russia former Soviet Union countries to detect, interdict, and report on the smuggling of WMD and related materials. In December 2011, the Secretary of Defense determined, with the concurrence of the Secretary of State, that PPP funds were authorized for use in Southeast Asia. This transition from the former Soviet Union to Southeast Asia was accompanied by a shift from its traditional emphasis on land borders to maritime surveillance. Our new focus in Southeast Asia is to enhance our partners' maritime domain awareness capabilities by providing to them the ability to detect illicit transfers of WMD materials and strategic delivery systems. In the coming months, we will be engaging with the Philippines to assist in the development of a fully operational National Coast Watch System and with Vietnam to improve logistics and maintenance as well as provide infrastructure and equipment and to develop a training center to enable the Vietnamese Coast Guard to thwart illegal smuggling of WMD and related equipment.

In addition to legacy partnerships with several countries of the former Soviet Union, the Cooperative Biological Engagement Program (CBEP) now includes active engagements in Africa, South and Southeast Asia, and the Middle East to address the diverse and rapidly changing global biological threat.

Although the potential for State-based biological threats remains, the DOD CTR program is now primarily concerned with terrorist organizations that are seeking to acquire pathogens of security concern for use in biological attacks. CBEP is, therefore, focused on enhancing partner countries' capability to identify, consolidate, and secure collections of pathogens of security concern as well as strengthening their capability to survey, detect, diagnose, and report rapidly and accurately biological terrorism and outbreaks of diseases caused by pathogens of security concern. As an example of the holistic, whole-of-government approaches that CBEP is utilizing, the Program will partner with the Malaysian Government, the Federal Bureau of Investigation (FBI), the Center s for Disease Control and Prevention (CDC), and U.S. academic partners this spring to conduct one of a series of intersectoral workshops on building a robust bio-risk management system for the country of Malaysia. Malaysia, as a leader in supporting the BWC, plans to invite participants from other countries in the region.

Consistent with other proactive steps we are taking to reduce WMD threats, we cannot wait for an act of nuclear terrorism before working together to improve our collective nuclear security culture, share our best practices, and raise our standards for nuclear security. Through its Global Nuclear Security (GNS) program, the DOD CTR program is the Department of Defense's primary mechanism to support all three approaches of our strategy to support and implement President Obama's objectives for nuclear security, at a: site-level, country-level, and global-level. The GNS program conducts projects and activities to increase the nuclear security of partner nations. The program also works to decrease the vulnerability of nuclear weapons-usable material based upon the latest threat assessments.

The DOD CTR program is partnering with NNSA to establish nuclear security Centers of Excellence in key locations around the globe to exchange nuclear security best practices and contribute to national and regional training programs. Our joint work with China is a case in point.

With Russia funding its own nuclear security and CW destruction, most of the Category 1 weaponized CW stockpile in Libya that caused a security concern destroyed, and funding in place to meet the current requirements to destroy Syria's CW, the DOD CTR program has requested a smaller but sufficient budget for fiscal year 2015. The DOD CTR program's fiscal year 2015 request for $365.1 million includes $256.8 million to secure biological pathogens of security concern and facilitate sustainable capabilities for countries to diagnose accurately and report rapidly disease outbreaks caused by pathogens of security concern. These efforts are for projects and activities in Southeast Asia, Africa, and the Middle East. The funds also continue efforts in Armenia, Azerbaijan, Georgia, Kazakhstan, and Uzbekistan. The fiscal year 2015 request also includes $40.7 million for PPP efforts that are focused on working with countries in key areas of the world to be able to detect and interdict WMD on the move. The Program is building sea-lane surveillance and interdiction capabilities in the South China Sea. These funds also complete border detection efforts in Armenia, Moldova, and countries bordering Syria. Finally, the fiscal year 2015 budget requests $20.7 million for GNS in order to continue to expand their nuclear security activities outside of Russia and the FSU by providing

support to the China Nuclear Security Center of Excellence, the Kazakhstan Nuclear Security Training Center, and Indian Global Centre for Nuclear Energy Partnership, while maintaining the flexibility to meet new challenges should they arise.

With the DOD CTR program, we have seen an enormous transformation at an unprecedented rate. We have established strategic guidance and a mechanism for assessing and establishing appropriate legal or political frameworks for conducting DOD CTR program activities based on the scope of the Program and dynamics of the partner, and are looking towards "right-sized" solutions to future threats. The DOD CTR program will remain one of DOD's most prominent efforts to achieve comprehensive, coordinated, collaborative, and rapid reduction of WMD threats, and we want to ensure that it continues to be able to flex to meet the needs.

As mentioned earlier, countering the proliferation and use of weapons of mass destruction is not just a DOD or even a U.S. Government responsibility. It is a global responsibility to be shared across the international community, especially as we live in a period of fiscal austerity. U.S. efforts to reduce and eliminate these threats must harness the power of international partnership and collaboration, and the President's approach does just that through the Nuclear Security Summit process, the Global Health Security Agenda and sustained support for PSI.

NUCLEAR SECURITY SUMMIT

World leaders have now gathered for three Nuclear Security Summits to collaborate on preventing nuclear terrorism by strengthening nuclear security. The broad goals of the Nuclear

Security Summit process are for participating countries and international organizations to come to a common understanding of the threat posed by nuclear terrorism, to agree to effective measures to secure nuclear material, and to prevent nuclear smuggling and terrorism. The Departments of State, Defense, and Energy work closely together to support the White House's objectives for U.S. Government engagement in the Nuclear Security Summit process. Although Department of Energy (DOE)/NNSA plays a significant role in the implementation of many of the Summit commitments, DOD also plays an important role. For example, at the 2012 Nuclear Security Summit in Seoul, Republic of Korea, President Obama announced that, through an unprecedented partnership with Russia and Kazakhstan and with support from DOE's Los Alamos National Laboratory, the DOD CTR program secured more than a dozen weapons worth of nuclear material at the former Soviet Semipalatinsk Test Site in Kazakhstan. The DOD CTR program has collaborated and continues to collaborate with partner governments on projects like this to account for, secure, and safeguard WMD and WMD-related material. DOD actively supported President Obama's participation at the March 24–25, 2014 Summit in The Hague, Netherlands, and will now work with our interagency partners to follow through on commitments made during last week's event.

Since the 2012 Nuclear Security Summit, DOD has participated in at least seven domestic exercises to increase nuclear preparedness, response, recovery, and resilience. We intend to continue to conduct safe and secure shipments of spent nuclear fuel containing highly enriched uranium for disposition and storage, as well as modify casks to use to transport the fuel from submarines with unique reactor designs.

GLOBAL HEALTH SECURITY

Harnessing the power of the international community to reduce biological risks can only be done by building bridges between the security and public health sectors. In June of last year, the interagency agreed upon and the administration released a Global Health Security (GHS) Agenda, outlining nine priority objectives for U.S. Government departments and agencies, with the goal of working with international partners to accelerate progress in improving capacity to prevent, detect, and respond to outbreaks of infectious disease threats, no matter the source. In addition, the Obama administration hosted an international launch event this February to bring together like-minded nations to discuss their commitments to achieving global health security.

As I noted earlier, DOD recognizes that addressing biological threats requires global prevention, detection, and response, which aligns directly with the administration's GHS Agenda. The Department of Health and Human Services is the U.S. interagency lead for this Agenda and DOD supports the GHS Agenda through existing missions and activities, such as force health protection, threat reduction, and biodefense. These activities, resourced and conducted to meet DOD's military objectives, provide benefit toward the achievement of GHS Agenda objectives while we continue to prioritize capabilities that counter operationally significant risks to our forces.

One example of a program that supports the GHS Agenda is DOD CBEP, which I described to you previously. The capability of this program to enhance biosecurity and detection not only directly supports our threat reduction mission, but also contributes to the achievement of Agenda objectives. Indeed, CBEP capabilities will be leveraged to support DTRA's fiscal year 2014 collaboration with the CDC in 12 countries. This collaboration is an innovative whole-of-government solution that leverages our relationships, access, and resources in areas where we have shared objectives.

On the force health protection side, the Armed Forces Health Surveillance Center/Global Emerging Infections Surveillance and Response System Division also benefits the GHS Agenda by conducting worldwide infectious disease surveillance and providing biosurveillance systems and laboratory training to partners. Our Defense Medical Research and Development Programs conduct infectious diseases research and development encompassing diagnostics and therapies for antimicrobial resistant infections and protection of forces from insect-borne diseases.

Finally, the Chemical and Biological Defense Program develops and fields diagnostic devices that benefit both U.S. forces and GHS partners in improving detection of and response to infectious disease outbreaks. Additionally, it is developing several medical countermeasures and improved electronic surveillance tools that will enable better protection against, detection of, and situational awareness of infectious disease outbreaks, which support key objectives of the GHS Agenda.

PROLIFERATION SECURITY INITIATIVE

The third national-level effort to highlight is the Proliferation Security Initiative, which continues to be an innovative way to build global, whole-of-government resolve and capacity in the face of vexing proliferation challenges. PSI is among our enduring efforts, just reaching its 10th anniversary last May, and remains a vital part of the international tapestry of countering WMD programs that enhance global security. Interdiction is a tool that can only have a strategic effect if states around the world cooperate, and that is why PSI's growth from 11 states upon its founding to 102 endorsing states today is so significant.

In 2003, when the Initiative was first established, revelations of a secret North Korean nuclear program had come to light, the A.Q. Khan network had enabled significant nuclear proliferation, and fears of "loose nukes" from the former Soviet Union continued to persist. Meanwhile, the attacks of September 11 had highlighted the massive disruptive power of a few individuals. With the combination of WMD-related technologies becoming increasingly available and increasing exploitation of global shipping, the circumstances for the relatively easy acquisition of WMD seemed at hand. Yet even in the face of an increasingly clear threat, most nations' resolve to act was unclear.

In the 11 years since PSI began, it has had a real, practical, and significant impact on interdiction. From the beginning, DOD has played an important role by serving as the U.S. Government lead to the Operational Experts Group (OEG); supporting PSI-related exercises and other engagements; and providing technical advice and assistance to endorsing nations as appropriate. Since its inception, PSI has convened 56 exercises and 34 experts and political-level consultations, demonstrating the enormous amount of energy and commitment resident within the Initiative. PSI exercises demonstrate the will of the PSI community to take action to prevent and, if necessary, to stop illicit shipments. The operational aspects of these exercises, with ships maneuvering at sea and aircraft above, are the most visible portions and have strong signaling and deterrence value.

In addition to operational-level collaboration, PSI has had a significant impact on international cooperation and norms in this area. PSI created the conditions for new international legal instruments, from U.N. Security Council Resolutions to Ship Boarding Agreements, and their operational implementation.

In his 2009 Prague speech, the President called for PSI to become a more "durable international" effort. DOD, working closely with the State Department and other interagency counterparts, has since worked to implement efforts to strengthen the Initiative, including through building consensus for and establishing a new annual PSI exercise hosting rotation among key PSI partners in the Asia Pacific. Since the beginning of PSI, our partners in this region have demonstrated their commitment to the Initiative and to regional cooperation by hosting many activities. The new annual exercise rotation among New Zealand, Australia, Singapore, Japan, South Korea, and the United States demonstrates PSI nations' long-term commitment to countering proliferation, makes planning and budgeting for exercises more efficient, and sends a consistent deterrence signal to proliferators. It is also an ideal burden-sharing construct. In August 2014, the United States will host the first exercise in

this rotation, Fortune Guard 14 at U.S. Pacific Command, which has made the new Asia Pacific Exercise Rotation its foremost tool for building counterproliferation capacity in the Asia Pacific.

Because the urgency of the proliferation threat not only remains but is evolving, cooperation through PSI is more relevant than ever. As States assess their own capacities to counter proliferators' increasingly sophisticated techniques, the OEG within PSI has created a more systematic means of increasing partners' ability to act. This is another way the United States is working with international partners to make PSI a more durable effort, and it was exactly what was needed as the predominant question transitions from being whether to take action to how to take action. The Critical Capabilities and Practices effort brings important, tangible tools to bear, and PSI partners' willingness to create, evaluate, and offer tools is yet another measure of the dynamism of the Initiative.

Agencies from across the U.S. Government work with partners every day to foster a PSI that continues to be innovative and adaptive in the context of evolving threats. Continued success in promoting broad U.S. nonproliferation objectives hinges on the U.S. Government's ability to support foreign partners in all phases of an interdiction case—not just the inspective and seizure phase, but also storage and ultimate disposal of the seized cargo. A persistent challenge in interdiction involves states' capacities to take post-interdiction actions, including disposition of controlled commodities. assistant Secretary of Defense for Global Strategic Affairs Madelyn Creedon announced at the PSI's 10th anniversary meetings in Warsaw last year that in order to help address some of the complexities associated with the disposition of interdicted WMD-related cargo, the DOD CTR program now has the authority to assist foreign partners by providing, where possible, technical advice in the safe handling and disposition of interdicted WMD-related materials. This announcement not only demonstrated DOD's ability to look holistically across its tools to develop solutions that meet the evolving nature of WMD-related threats, and challenges, but also illustrated yet another way in which the DOD CTR program has proven its agility as a countering WMD tool. The United States believes that it is vitally important to work through, and help resolve, these disposition challenges together with states acting in accordance with their PSI commitments. DOD is pleased that it now has a means to help do so.

FUTURE THREATS

Despite progress over the last year, much work remains to ensure our continued security. Syria and other recent events have given us great insight into how we may have to look at problems differently, enabling us to prepare for and tackle these and other threats more effectively as they emerge. But at the same time, we must recognize that the Syrian WMD program represents only a fraction of the risk directly posed by the Democratic People's Republic of Korea (DPRK) WMD program. The DPRK's pursuit of nuclear weapons and long-range ballistic missiles poses one of the most critical security challenges for the United States and our allies and partners. We will continue to manage the risks through close coordination and consultation with the international community and remain steadfast in our commitments to allies in the region, including the security provided by extended deterrence commitments through the nuclear umbrella and conventional forces.

Although an initial first step towards a comprehensive deal has been struck with Iran, the threat has not been eliminated and we must remain prepared for the possibility that a long-term, comprehensive agreement is not reached. Diplomacy remains the preferred means to resolve international concerns regarding Iran's nuclear program, but as the President has consistently reaffirmed, all options remain on the table in order to prevent Iran from acquiring a nuclear weapon.

In the increasingly interconnected global environment, the threat from WMD extends well beyond State actors and we cannot take our eye off the terrorism threat. Although the threat to the Homeland from core al Qaeda has been degraded in recent years, there has been an increase in threats by networks of like-minded extremists. The battlefield in Syria is generating new extremists who could eventually turn their glare elsewhere. As the diffusion of threats continues, the challenges we face will only increase, and terrorist networks continue to demonstrate interest in obtaining WMD. We must continue our vigilant efforts to prevent the proliferation of WMD, including by expanding adherence to international agreements and norms, dismantling State programs where possible, and interdicting transfers when necessary.

With our countering WMD efforts, it all comes back to preparing and posturing to address future challenges that may emerge and escalate quickly. We must bring these programs I have described and other solutions to bear as new challenges sur-

face, leveraging partnerships and lessons learned to respond quickly and decisively. I thank you for your support for our fiscal year 2015 budget request and look forward to our continued partnership.

Senator HAGAN. Thank you.

Mr. Myers.

STATEMENT OF KENNETH A. MYERS III, DIRECTOR OF THE DEFENSE THREAT REDUCTION AGENCY, DEPARTMENT OF DEFENSE, AND DIRECTOR OF THE U.S. STRATEGIC COMMAND CENTER FOR COMBATING WEAPONS OF MASS DESTRUCTION, DEPARTMENT OF DEFENSE

Mr. MYERS. Madam Chairwoman, Ranking Member Fischer, Senator Graham, it is an honor to be here today to discuss the work being done to counter the threats posed by the proliferation and use of WMD. I would like to use my testimony today to highlight three of our recent activities.

One of the best examples of the capabilities that Defense Threat Reduction Agency-Strategic Command Center (DTRA–SCC) can provide and the missions we take on is related to our work in Syria. We had the expertise to evaluate a serious WMD threat, we developed the needed technologies, and we provided planning support to all aspects of the operation. Now, the *Cape Ray*, the ship that houses the two Field-Deployable Hydrolysis Systems, stands ready to begin destruction once all the chemical materials are out of Syria.

Another mission-critical area for us is the intersection of terrorism and the acquisition of WMD materials, particularly biological threats. This is an emerging and evolving threat and we are expanding our areas of cooperation to stay one step ahead. We work closely with the Centers for Disease Control (CDC) and we often pursue global health security projects together internationally. The CDC handles public health issues, but they are not equipped to address the security threats posed by deadly pathogens. We are.

I am proud to announce that earlier this year we signed a Memorandum of Understanding and a strategy for joint work with the CDC. These documents will maximize our effectiveness related to biological threats around the world and ensure that there is no duplication of efforts.

Finally, DTRA–SCC recently completed the destruction of weaponized mustard agent in Libya. We destroyed 517 mustard-filled artillery rounds, 8 500-pound aerial bombs, and 45 insert tubes.

I am proud of what our team has achieved and believe that we have served as good stewards of the taxpayers' dollar. As we look to fiscal year 2015, I am confident that we are prepared to address future WMD threats around the world.

Thank you again for the opportunity to be here today and I would be pleased to respond to your questions.

[The prepared statement of Mr. Myers follows:]

PREPARED STATEMENT BY MR. KENNETH A. MYERS III

Madam Chairwoman, Ranking Member Fischer, and members of the subcommittee, it is an honor to be here today to share with you the work being done to counter the threats posed by the proliferation and use of weapons of mass destruction (WMD). There are three entities co-located at our facilities at Fort Belvoir:

the Defense Threat Reduction Agency (DTRA), the U.S. Strategic Command Center for Combating Weapons of Mass Destruction (SCC–WMD) and the U.S. Strategic Command Standing Joint Force Headquarters for Elimination. Each one of these entities has different mission areas, authorities, requirements, and funding, but they are all located together and intertwined in order to leverage expertise from each other and coordinate efforts. These three entities, as one Team, are engaged in nonproliferation, counterproliferation and consequence management missions throughout the world—addressing the full spectrum of WMD threats.

WHY WE EXIST—THE THREAT

Our combating weapons of mass destruction (CWMD) efforts are driven by the threats we face today. A terrorist attack utilizing WMD can result in enormous loss of life, negatively impact economies, constrain national budgets, create political unbalance in geographic regions, and most certainly promote additional proliferation and terrorist activity around the world.

Our mission is further complicated given the complex nature of countering weapons of mass destruction. During the Cold War, most of our focus was on nation states. We were worried about huge stockpiles of nuclear, chemical, and biological materials. While there is no question that these stockpiles are still a threat today—and some of my testimony will describe our efforts in these areas—the more difficult area for us to track and address is terrorist acquisition of WMD materials that can be modified, grown, or enhanced for use as a weapon. The footprint is smaller in these cases, harder to track and thus harder to find and disrupt. We are not talking about huge factories or facilities in most of these cases; sometimes it is a small laboratory that could fit inside a bathroom. Given this reality, no region of the world is impervious to potential chemical, biological, radiological or nuclear threats.

Our focus is to keep WMD out of the hands of terrorists and other enemies by locking down, monitoring, and destroying weapons and weapons related materials. We also assist combatant commanders with their plans and responses to WMD events and develop and deliver cutting-edge technologies to assist with all of these endeavors.

WHO WE ARE

There is no other country or government that is focused on CWMD 24-hours-a-day, 7-days-a-week. Every day, 2,000 people from our organization come to work in locations around the United States and around the world focused on one thing, and that's safeguarding the American people against these threats. Our success is determined by what didn't happen—what we prevented, what we helped to interdict, what we eliminated, what we mitigated, and how prepared we are to respond. That is the basis of the shield that we can provide across the full threat spectrum—chemical, biological, radiological, nuclear and high yield explosives (CBRNE).

Regardless of the time or day, our building is buzzing with activity and with a diverse and remarkable collection of talented workers. As you enter our building and walk through the hallways, you encounter personnel with highly advanced technical degrees and skills related to physics, chemistry, microbiology, and nuclear engineering. They are working right alongside those with expansive experience with program management, logistics, planning, special operations, targeting and military operations. Our operation is often described as unique in this way, and it is true.

The reason why is simple. Subject Matter Experts in the WMD field are highly specialized and hard to find. There simply are not enough experts to adequately staff the Services and Commands. Even if you did, you would not have the right type of coordination and synchronization which is critical for WMD planning. The most effective way to utilize this expertise is to locate it in one place and provide efficient communication channels for collaboration.

One of the reasons we are successful is because of the breadth of services that we can provide. We combine our operational side of the house with our research and development side focusing all our assets on the issue at hand. Let me give you an example, when a Command or other customer calls into our Operations Center a watch officer takes the call. This officer represents the whole team, the operations side, planning, and the research and development side of the house. The watch officer's job is to stay abreast of what is taking place throughout the Agency/Center and be able to quickly leverage the diverse expertise on our staff. If the watch officer recognizes that there's some technical complexity to the question, they will go straight to our Technical Reachback personnel. The whole process literally takes seconds. Throughout the response process, operational and technical subject matter experts are engaged. This set-up allows us to fully answer questions from all aspects of a WMD problem, anticipate the needs of the various commands and special cus-

tomers, and properly prepare in case there is any follow-up. Timing is critical when dealing with WMD and our Operations Center is organized for collaboration and time sensitive requests. Last year we responded to 947 Technical Reachback requests from our customers.

HOW WE ARE STRUCTURED

As a Combat Support Agency, we are available 24-hours-a-day, 7-days-a-week, to support the combatant commanders and Services in responding to any WMD threat. This requires us to not only address current needs but also to anticipate future threats to our warfighters. In our Defense Agency role, we manage a research and development portfolio to develop tools and capabilities. In fact, DTRA provides the Special Operations Command with all of their counter proliferation science and technology (S&T). As a STRATCOM Center, we support STRATCOM's synchronization of Department of Defense (DOD) planning efforts to counter weapons of mass destruction. The complementary Standing Joint Force Headquarters for Elimination provides both steady state CWMD planning support and can be deployed to provide direct operational support for U.S. Military task forces in hostile environments.

While I am pleased to walk through individual programs with the committee members and their staff, I would like to use my testimony today to highlight four real-world examples of our activities and the roles that different parts of our Team played in these challenges.

SYRIA

Beginning in 2011, we began looking at ways to address the CWMD challenges in Syria. The U.S. Government and international community were alarmed by the continuing civil war in Syria and particularly concerned about the threats of chemical weapon use and proliferation. DTRA's CWMD planners and intelligence officers worked closely with U.S. Central Command (CENTCOM) to evaluate the WMD threats and options for the destruction of these weapons and materials. This analysis was coordinated with DTRA's research and development directorate who began the process of evaluating technologies to destroy these materials. Our Technical Reachback personnel provided modeling and analysis of the potential threats we faced. We were even able to utilize our expertise and knowledge of treaty implications to help shape and steer the Department's actions to respond. Our team led the synchronization effort within DOD and across the interagency to bring the right expertise to the technology review. This was truly a Team effort that allowed us to utilize our capabilities and expertise.

The conclusion that we came to was that we simply did not have a good way to get rid of bulk chemical agents in a foreign land, in particular hostile environments where we did not have a cooperative relationship. After reviewing a number of options, we were the first organization to invest in a prototype Field Deployable Hydrolysis System (FDHS), a capability that is suitable for the destruction of industrial quantities of bulk chemical agent. The FDHS was developed in fewer than 6 months and was designed to be transportable for rapid deployment in a variety of environments.

The Syrian chemical attacks on 21 August 2013 were a turning point for the international community. DTRA planners provided technical expertise to Department of State and White House-led diplomatic efforts at every step, including the seminal meetings between Secretary Kerry and Russian Foreign Minister Lavrov in Geneva. After the U.S.-Russia Framework and Syria's accession to the Chemical Weapons Convention, DTRA's Nunn-Lugar program was prepared to support the extremely rapid effort to destroy Syria's declared chemical materials. The Nunn-Lugar program provided the Joint (UN/OPCW) Mission with the majority of the logistics equipment to move chemicals out of Syria.

When the international community failed to identify a nation willing to host destruction operations for the most dangerous chemicals, a full court press was employed to develop a ship-based destruction option with only 60 days from the word "go". With full cooperation across the interagency and Commands, we were able to deliver a sea-based destruction capability. I am proud to say that the Motor Vessel *Cape Ray*, the ship that houses the two field-deployable hydrolysis systems, stands ready to begin destruction of a large portion of these chemicals once the materials are taken out of Syria.

BUILDING PARTNER CAPACITY

I would also like to share with the committee our efforts to build partnership capacity in the countries surrounding Syria. It was clear in 2012 that the countries neighboring Syria both wanted and needed improvements to their military and civil-

ian response sectors to counter the possible illicit WMD-related trafficking coming from Syria. Beginning in 2012, DTRA started working with CENTCOM and the whole of the U.S. Government to build the CWMD capacity of the Governments of Jordan, Turkey, Iraq, and Lebanon. In these countries, to varying degrees we train, equip, and exercise with the military and civilian sectors so they can address nonproliferation, counter-proliferation and consequence management issues.

One of our biggest projects is in Jordan which has hundreds of thousands of refugees from Syria. The Jordanians are concerned about Syrian WMD coming across its borders along with the refugees. Working with CENTCOM and our interagency partners, DTRA's Nunn-Lugar program is building a 247 mile long security system that runs along the northern and eastern border. To put this in perspective, 247 miles is the distance from Washington, DC to Raleigh, NC. We are building the system in 29 months and should be at full operation by August 2015. The system is designed to detect a person from 5 miles away and provides the Jordanians with a capability to safely detect, inspect, and apprehend someone suspected of smuggling WMD.

We also trained and equipped the Jordanian military and civilian first responders, approximately 1,000 key personnel, to operate in a CBRNE environment. We have helped the Jordanians develop a National Response Plan for potential chemical attacks. We have conducted exercises to synchronize their efforts, reinforce and improve the operational implementation of their newly acquired capabilities.

DTRA's Nunn-Lugar program was the only DOD solution that had the right expertise, authorities, and funding to respond to this emerging requirement in a timely manner. Our subject matter experts have decades of experience training international partners in border security and nonproliferation techniques. Through the Middle East Determination in October 2012, the Secretary of Defense and the Secretary of State were able to quickly approve and re-notify funding toward this urgent end.

The Nunn-Lugar effort was enhanced by DTRA's CBRN Preparedness Program (CP2) and their ongoing engagements with CENTCOM in the region. However, the CP2 work was limited in authorities under Title 10. Fortunately, last year Congress granted relief by authorizing the Secretary of Defense, with the concurrence of the Secretary of State, to provide assistance to the military and civilian first responder organizations of countries that share a border with Syria. This was a significant step because not all nations have their response capabilities resident within their military organizations. With Congress' continued support, we plan to immediately use this authority and work within the Department to expand the authority to provide such assistance to other countries. This year, using both this new authority and our existing Title 10 authority, we will build CBRN preparedness and response capacity in approximately 34 countries—thus creating stronger partners for a safer world.

CENTERS FOR DISEASE CONTROL AND PREVENTION

Building partnership capacity is a good transition into discussing our cooperative relationship with the Centers for Disease Control and Prevention (CDC). The missions of DTRA/SCC–WMD and CDC touch in many places, and we often pursue global health security projects together internationally.

DTRA is well known for its successful projects in the former Soviet Union. But what may not be well known is that these types of projects are now being tracked alongside smaller, yet equally critical biological material projects in sub-Saharan Africa, the Middle East, and Southeast Asia. Why? The threat has changed. Because of our success in eliminating access to materials in the former Soviet Union, groups and states seeking WMD have shifted their attention to other geographic areas and potential WMD sources. We are evolving to address these threats and expanding our areas of cooperation to stay one step ahead.

In most cases, our new partners have no WMD aspirations. But, pathogens for endemic diseases can be weaponized and are not constrained by geographic or political boundaries. Pathogens for deadly diseases like Ebola, Marburg, and Anthrax that have been used to make biological weapons are being safely secured as part of the Cooperative Biological Engagement Program, now the largest activity within the Nunn-Lugar Program. For a relatively small investment, the program is reducing access to biological materials and expanding international partnerships to better counter natural and man-made biological events.

We are working closely with these countries to improve awareness, improve security, to train them in biological safety, consolidate dangerous pathogen collections into fewer facilities with better security, better safety standards, and better diagnostic equipment so we can get early warning of disease outbreaks—regardless if

it is a result of a naturally occurring or a deliberate attack. Not only is this important for nonproliferation efforts but also for force protection and public health.

This is where our partnership with the CDC comes in. The CDC handles public health issues, but they are not tasked to address the security threats posed by deadly pathogens. This is a different mission altogether. The CDC has great experience and networks operating in Africa and Southeast Asia where many of these biological agents can be found. We can leverage their expertise by bringing the DOD security culture together with CDC's public health work. This allows us to see a pandemic problem from both sides.

As a result, we have worked very closely with the CDC over the last several years. However, we also realized that there was still a good amount of duplicative work being done by our two agencies. I am proud to announce that earlier this year, DTRA and the CDC's Center for Global Health signed two documents: (1) a memorandum of understanding; and (2) a strategy for joint work. The memorandum of understanding formalizes DTRA/SCC–WMD's relationship with the CDC and establishes a joint steering committee that will review and advise on future work the agencies pursue together. The Strategy document outlines the types of work that DTRA/SCC–WMD and the CDC will pursue together. The two agencies will work together on three broad biosecurity/global health goals: (1) Prevent, (2) Detect, and (3) Respond. Working on these three goals together, DTRA and CDC hope to (A) improve and expand a global network of international partners that can provide accurate and timely awareness of biological threats; and (B) build a reliable and sustainable capacity to detect, prevent, attribute, report, respond, and recover from CBRNE threats, as early as possible, for the United States and international partners.

This joint effort matters because timing is everything with biodefense. We have American military personnel, foreign service personnel, and other government personnel operating in every corner of the world right now. Improved biosecurity, safety, and surveillance is essential for their safety and the performance of their missions. The better we can address a problem away from our shores, the safer our country will be. Our continued strong relationship with the CDC improves our odds of success, and sits at the center of the United States's contribution to the Global Health Security agenda, launched in February with 28 international partners.

LIBYA

Finally, I would like to share with the committee that we are on the verge of another milestone in Libya.

In response to Operation Odyssey Dawn, DTRA/SCC–WMD deployed experts to Stuttgart, Germany to support U.S. Africa Command. The deployed personnel provided key planning and liaison support to U.S. and NATO operations in Libya. We made sure that any plans for action considered the consequences associated with chemical weapons. We also worked to make sure that the chemical weapons stored in the desert remained secure.

Subsequently, we played an integral role in the interagency effort to develop courses of action for security and destruction of the chemical weapons (CW) stockpile. Beginning in January 2012, the Nunn-Lugar team joined the interagency dialogue on action in Libya, and began discussions with the Government of Libya regarding security improvements at the storage site and technical options for CW destruction. Fast forward to today, weaponized mustard agent destruction is complete. Working with the Libyans, wedestroyed 517 mustard-filled 130mm artillery rounds; 8 500 lb. mustard-filled aerial bombs; and 45 mustard-filled tubes we believe were to be used in other bomb types as mustard filled inserts into the bomb casings. To put this into context, just one of the 500 lb. mustard-filled aerial bombs, detonated in an urban setting, could cause significant damage. The mustard agent would likely be dispersed as an aerosol, which could have a devastating impact depending on the environment and location. Now all of the declared Libyan chemical weapons have been destroyed and the team is helping Libya to rapidly eliminate the residual mustard agent.

Fiscal Year 2015 Defense Threat Reduction Agency Budget Request Overview

Our budget request for fiscal year 2015 is $1.27 billion and comprises Defense-wide Research, Development, Test and Evaluation; Operations and Maintenance; Procurement; and Nunn-Lugar Cooperative Threat Reduction (CTR) appropriation accounts. In addition, DTRA executes the $407.3 million S&T portion of the DOD Chemical and Biological Defense Program (CBDP) and serves as the funds manager for the remainder of that program's funding, $980 million. Therefore, the total DTRA resource portfolio is approximately $2.66 billion. Details and highlights for these requests follow.

Operations and Maintenance Funding

O&M funding directly supports the warfighters and national missions as it pays for planning, training, exercises, and other means for collaboration across DOD and the U.S. Government, and with international partners. O&M funding is the fuel that enables us to reach out to our components and personnel, the warfighters, and international partners across the globe.

The requested O&M funding would be applied as follows:

- Nonproliferation Activities ($58.8 million) for arms control activities including the conduct of U.S. Government inspections of foreign facilities, territories, or events; coordination and conduct of the escort of inspection teams for inspections or continuous monitoring activities in the United States and at U.S. facilities overseas; and the acquisition and fielding of technology capabilities required to implement, comply with, and allow full exercise of U.S. rights and prerogatives under existing and projected arms control treaties and agreements.
- WMD Combat Support and Operations ($176.4 million) for a wide range of combat and warfighter support to the Joint Chiefs of Staff, the Combatant Commanders, and military forces as they engage the WMD threat and challenges posed to the United States, its forces and allies. DTRA supports the essential WMD response capabilities, functions, activities, and tasks necessary to sustain all elements of operating forces within their area of responsibility at all levels of war.
- U.S. Strategic Command Center for Combating WMD ($11.3 million) for DTRA direct support to the SCC–WMD including providing strategic and contingency planning, policy, and analytical support; developing interagency relationships; and working closely with STRATCOM partners to establish the means for assessing and exercising capabilities to combat WMD.
- Core Mission Sustainment ($167.9 million) for a wide range of enabling capabilities which include information management; resource management; security and asset protection; acquisition and logistics management; strategic planning; leadership and professional development; and provide the safety, security, and efficiency necessary for mission success.

Nunn-Lugar Cooperative Threat Reduction

The request of $365.1 million for this important program would be used as follows:

- Strategic Offensive Arms Elimination ($1.0 million) for elimination activities of ICBMs, SLBMs, and land-based launchers to the Russian Federation in 2014. Elimination of ballistic missile submarines will continue under the recently signed bilateral protocol to the Multilateral Nuclear Environmental Programme in the Russian Federation. DOD will fully transition remaining responsibility for elimination activities to the Russian Federation in 2014.
- Chemical Weapons Destruction ($15.7 million) for technical expertise and resources to support the U.N. OPCW joint mission to remove CW from Syria. It is also providing support for CW destruction of materials removed from Syria and providing technical advice and assistance in other Regions.
- Global Nuclear Security ($20.7 million) for improving nuclear material security, including security for nuclear warheads and weapons-usable nuclear material. This program also assists in the secure transport of nuclear warheads and other qualifying nuclear material to dismantlement facilities, secure storage areas, or processing facilities for disposition.
- Cooperative Biological Engagement ($256.8 million) for combating the threat of state and non-state actors acquiring biological materials and expertise that could be used to develop or deploy biological materials and weapons. This program destroys or secures biological agents of security concern at their source, and works in partnerships to ensure a secure disease surveillance system. This program works closely with other U.S. Government departments and agencies, international partners and the private sector.
- Proliferation Prevention ($40.7 million) to enhance the capability of non-Russian, Former Soviet Union (FSU) states and other partner countries to deter, detects, report, and interdict illicit WMD trafficking across international borders. Beginning in fiscal year 2013, the Proliferation Prevention Program began expansion outside of the FSU to Southeast Asia and the Middle East.
- Threat Reduction Engagement ($2.4 million) to develop active and positive relationships between the defense, military, and security establish-

ments of the United States and the states of Eurasia and Central Asia. This program engages military and defense officials in activities that promote regional stability, counter-proliferation, and defense reform; build security cooperation with the partner states; and promote exchanges that enhance interoperability with U.S. and North Atlantic Treaty Organization (NATO) forces for multinational operations.

• Other Assessments/Administrative Support ($27.8 million) to ensure that DOD-provided equipment, services, and related training are fully accounted for and used effectively and efficiently for their intended purposes. This account also funds Nunn-Lugar program travel, logistics, translator/interpreter support, and other agency support.

Research, Development, Test, and Evaluation

DTRA Research, Development, Test, and Evaluation (RDT&E) programs respond to the most pressing CWMD challenges including stand-off detection, tracking, and interdiction of WMD; modeling and simulation to support weapons effects and hazard predictions; classified support to Special Operations Forces; defeat of WMD agents and underground facilities; and protection of people, systems, and infrastructure against WMD effects.

DTRA RDT&E is unique in being focused solely on CBRNE; tied closely with the agency's Combat Support responsibilities; has a top-notch in-house field test capability; relies upon competitive bids, the national labs, industry, and academia rather than an in-house laboratory infrastructure, allowing for a "best-of-breed" approach to performer selection; and is nimble and responsive to urgent needs.

The agency has a comprehensive, balanced CBRNE S&T portfolio that supports DOD goals and is well connected with DOD customers, as well as interagency and international partners. Our RDT&E approach balances the need for near-term payoff with the need for long-term technology and capability development, knowledge and expertise, and is centered upon the following programs: Basic Research (6.1), Applied Research (6.2), Advanced Research (6.3), and System Development and Demonstration (6.5). The requested RDT&E funding includes $37.8 million in Basic Research to provide for the discovery and development of fundamental knowledge and understanding by researchers primarily in academia and world-class research institutes in government and industry. The DTRA fiscal year 2015 request also includes $151.7 million for WMD Defeat Technologies Applied Research, which is used to translate fundamental knowledge into useful materials, technologies, and concepts that address recognized CWMD needs. Our $283.7 million budget request for Proliferation Prevention and Defeat Advanced Research funds development of systems, subsystems, and component integration to build, field and test prototypes to assess utility and feasibility of technology solutions to well-defined CWMD requirements. Finally, $6.9 for WMD Defeat Capabilities System Development and Demonstration funds development, operational testing, and initial deployment of mature technologies and systems.

Chemical and Biological Defense Program S&T

The Department's CBDP S&T programs support DOD-wide efforts to research, develop, and acquire capabilities for a layered, integrated defense against CBRNE agents; better understand potential threats; secure and reduce dangerous materials whenever possible; and prevent potential attacks. Although funding for the CBDP is not part of the DTRA budget request, the agency executes the S&T portion of this program, for which the Department has requested approximately $407.3 million in fiscal year 2015. The agency also manages funding execution in support of CBDP advanced development and procurement.

CONCLUSION

I would like to thank the committee for this opportunity to share some of our recent efforts and accomplishments. What I hope has become clear is that how we are structured, the breadth of services we provide, the mix of authorities which we can utilize, and the depth of our subject matter expertise is just as important as the strong funding allocated by Congress. We are not just a set of programs, agreements, or funding streams—we are much more than that. We are a problem-solving tool, a unique capability. Former Senator Richard Lugar describes us as a national security engine that can be utilized around the world.

We hope that we will continue to earn the committee's trust and support in meeting these threats and ensuring our security. Thank you, again, for the opportunity to be here today. I would be pleased to respond to your questions.

Senator HAGAN. Thank you, Mr. Myers. As I said earlier, it is a job well done in Libya.

We will have 7-minute questions and I will start. Ms. Hersman and Ms. Harrington, our understanding is that the CTR umbrella agreement has terminated with Russia, but continues in some form through DOE. Ms. Hersman, can you explain the status of the activities that were ongoing with Russia and whether or not they have been terminated or are on hold? Ms. Harrington, can you please explain with what framework the DOE is continuing this relationship with Russia and the status of the project?

Ms HERSMAN. Thank you. Even as the traditional DOD CTR program of assistance that had operated in Russia for the last 20 years draws to a natural conclusion, the United States and Russia have agreed to continue in a number of important efforts on a collaborative basis through the Framework Agreement and Protocol on Multilateral Nuclear Environmental Program in the Russian Federation (MNEPR) on which we partner with the NNSA.

Russia and the United States plan to proceed through the DOD CTR program with two already-agreed projects: to dismantle a Delta 3 strategic submarine and to fund transportation of highly enriched uranium submarine spent fuel from a less secure to a much more secure location in Russia. We believe these continue to be priority threat reduction activities and important to the U.S. national security interest.

Of course, given the unfolding situation in Ukraine and Crimea, we are carefully evaluating our activities in the region to ensure full consistency with the President's guidance. We're mindful, however, that the DOD CTR program has a history of continued cooperation on vital threat reduction matters even through difficult periods of the U.S.-Russia relationship and we hope this will continue to be the case.

Ms. HARRINGTON. I'm glad that Ms. Hersman went first because a lot of her answer applies to ours. We also have had a history with Russia where even during times of high politician tension both sides have recognized the importance of the work, certainly from our perspective, the work we do there to secure nuclear warheads, weapons-capable material, and other activities are vital to U.S. national interests.

We do work under the same MNEPR protocol and under that our teams continue to work with Russian counterparts to improve the security of Russian nuclear and radiological material at fixed sites and in transit and to develop strong and sustainable national-level nuclear security infrastructure, including strengthening regulatory requirements related to the security of nuclear and radiological material in Russia.

The cooperation remains an essential element to the global effort to address the threat posed by nuclear terrorism and therefore supports key interests of both the United States and the international community.

Senator HAGAN. Thank you.

Ms. Hersman, if you can frame where the CTR program is with respect to Syria and removal of the chemical weapons, in addition to destroying them outside of Syria.

Ms HERSMAN. Thank you. The CTR program has taken on two major elements of support to the Syrian elimination program. On the one hand, we've provided more than $15 million worth of support for the removal activities, to include equipment and logistics support to the joint mission and to the OPCW to facilitate inspections and consolidation and removal and transit, so that those items can be removed for destruction externally.

In addition, the CTR program has provided and is providing the bulk of the funding to support the outfitting and operations, as well as the follow-on activities associated with the *Cape Ray*, which will then through neutralization destroy the rest of those chemicals.

Senator HAGAN. Can you explain the approach that the CTR program is taking with respect to the rest of the Middle East and North Africa?

Ms HERSMAN. In the rest of the Middle East, we continue to focus on our proliferation prevention efforts. We ramped those up substantially in fiscal year 2013 and fiscal year 2014, with the most significant efforts being in Jordan, where we embarked on the Jordan border security project to help shore up border security between Syria and Jordan, but also began efforts in Iraq, Turkey, and some nascent efforts in Lebanon as well.

We don't have the same level of funding into fiscal year 2015. The environment's still a little uncertain about what will be necessary, but we recognize that there will certainly be residual proliferation risks in the aftermath even of the removal of the bulk of Syria's chemicals, and this will remain a big priority for us.

Senator HAGAN. Speaking of that, 70 percent of the CTR program is devoted to the cooperative biological engagement program. Can you explain what threat you are addressing and how it differs from the efforts of the other agencies, such as the CDC, and how do you work together?

Ms HERSMAN. The Cooperative Biological Engagement Program (CBEP) starts with a fundamental premise, and that is where dangerous pathogens, hostile actors, endemic disease, and weak government controls and capacities exist, a lot of bad things could happen, especially when we have hostile actors in proximity, whether those are lone wolf actors, terrorists, non-state actors, or insider threats.

The CBEP looks to try to reduce those risks by focusing on security, enhanced security measures, securing pathogens, as well as improving our ability to surveil disease threats, to detect them better, and to provide better strategic warning. We see this as really the unique niche of the CBEP, something not done with the same focus elsewhere across our interagency partners. But we do collaborate very closely both with the Department of State (DOS) and their diplomatic outreach and all of the expertise resident in the CDC, where they also have in some areas access and opportunity that we can build on.

Senator HAGAN. Thank you.

My next question is on the MOX fuel. I know Senator Graham also will be asking about that. But, Ms. Harrington, I really want to know is what is the definition of cold standby?

Ms. HARRINGTON. All right. The definition of cold standby means that we will cease construction activities in order to control and

minimize costs, while working with the contractor to develop a cold standby execution plan. Currently, we go through about $1.1 million per day at the construction site, and looking forward into the future that amount of money accumulates very rapidly.

Any construction work that is performed would only be in support of placing the MOX fuel facility and equipment in a safe and secure state, and most importantly, going to Senator Fischer's point, a recoverable state. We have very much the interest of U.S. taxpayers in mind here, and the option of moving forward with this project is not off the table. That is part of what is under consideration right now.

Senator HAGAN. I'm sure we will go over that a little bit more, too.

Senator FISCHER. Thank you, Madam Chairwoman.

I know that Senator Graham has another commitment and so I would suggest that you recognize him Madam Chairwoman.

Senator HAGAN. Certainly. Senator Graham.

Senator GRAHAM. Thank you, Senator Fischer. Thank you both, Madam Chairwoman.

Let's just get right to it. Last year in the budget we appropriated $430 million, Congress did, for construction of the MOX facility; is that correct?

Ms. HARRINGTON. I would have to recheck that, but I believe it is, yes, sir.

Senator GRAHAM. Are you doing with the money what Congress told you to do?

Ms. HARRINGTON. We have proceeded with a plan according to the scope of work that we had established initially.

Senator GRAHAM. We gave you $430 million to complete construction on a facility that's 60 percent complete. From what you just told Senator Hagan, it's my understanding you've stopped construction; is that correct?

Ms. HARRINGTON. The order to stop construction has not yet been given.

Senator GRAHAM. That's the plan.

Ms. HARRINGTON. We expect it to be.

Senator GRAHAM. How can you do that?

Ms. HARRINGTON. The issue of appropriate use of 2014 appropriations is currently an issue of a lawsuit and therefore it would be inappropriate for me to comment further on that matter, as it currently is before the courts.

Senator GRAHAM. There is an agreement between us and the Russians and that's what the MOX program is all about. It's 34 metric tons of weapons-grade plutonium determined to be in excess of both nations' defense needs, that could be used to create thousands of nuclear warheads. The MOX program in 2011 was designated by the United States as the disposition path that we would pursue; is that correct?

Ms. HARRINGTON. That is correct.

Senator GRAHAM. Have you talked with the Russians about this idea of changing course?

Ms. HARRINGTON. We have had some consultations with the Russians, yes.

Senator GRAHAM. What did they say? Who did you talk to and when?

Ms. HARRINGTON. I would have to look at that in detail. The Secretary has had a brief conversation with the Russian Ambassador.

Senator GRAHAM. Okay. Please tell me when and who had the conversation and provide me information about what they said, please?

Ms. HARRINGTON. We will take that back.

[The information referred to follows:]

On April 5, 2013, officials from the Department of Energy/National Nuclear Security Administration (DOE/NNSA) and the Department of State (DOS) briefly discussed with the Russians the fiscal year 2014 budget request and the beginning of the U.S. analysis of plutonium disposition options. (Note: In these and all subsequent exchanges, the U.S. commitment to its obligations under the Plutonium Management and Disposition Agreement (PMDA) has been underlined and not been questioned.)

On April 25, 2014, officials from DOE/NNSA and DOS discussed with Russian officials the nature of the U.S. analysis of its plutonium disposition options in light of the fiscal year 2014 budget request, the implications for the U.S. mixed oxide project, and the implications of possible options with respect to the PMDA.

On December 18, 2013, officials from DOE/NNSA and DOS updated Russian officials on the status of the U.S. analysis and the plutonium disposition options under consideration, along with their implications with respect to the PMDA noted above.

On March 11, 2014, officials from DOE/NNSA and DOS briefly discussed with Russian officials the implications of the fiscal year 2015 budget request for plutonium disposition and updated status of the DOE analysis of disposition options.

Senator GRAHAM. Okay. Now, how much plutonium is in South Carolina as a result of the agreement by the State of South Carolina years ago to take this material as a result of the MOX program? How much is in South Carolina?

Ms. HARRINGTON. About 13 metric tons.

Senator GRAHAM. How much of that is MOX-able?

Ms. HARRINGTON. About 8.

Senator GRAHAM. Where's the rest of the plutonium?

Ms. HARRINGTON. The rest of the 34 metric tons?

Senator GRAHAM. Yes.

Ms. HARRINGTON. It's still in pit form.

Senator GRAHAM. When is it supposed to be sent to South Carolina?

Ms. HARRINGTON. At this point, we are not sending further shipments of plutonium to South Carolina.

Senator GRAHAM. How much does it cost to guard or manage that stockpile per year?

Ms. HARRINGTON. That is a stockpile at the Pantex facility that is incorporated into annual costs there.

Senator GRAHAM. There is a cost to be borne by watching this material, I would hope?

Ms. HARRINGTON. Yes, yes.

Senator GRAHAM. In the President's budget does he lay out a disposition alternative other than MOX?

Ms. HARRINGTON. No, the disposition alternative is not yet identified.

Senator GRAHAM. Even though Congress told you to keep constructing the facility, you decided not to. You're going to put it in cold standby and you don't have an alternative to move forward. Also, you have an agreement with the Russians where we signed

in 2011 saying this would be our exclusive path of disposition. Is all that correct?

Ms. HARRINGTON. That is correct.

Senator GRAHAM. When it comes to 50 U.S.C. 2566—are you familiar with that statute?

It's the requirement to meet disposition goals or pay $100 million a year fine for 5 years.

Ms. HARRINGTON. Yes, I am very familiar with it.

Senator GRAHAM. The statute was written by myself and Senator Thurmond to protect South Carolina in case something happened with us receiving this plutonium. Is there any way you're going to meet, if you put this in cold storage, the obligations under the statute to have one metric ton processed by 2016?

Ms. HARRINGTON. We believe that there are options, but again, that is going to be an element of what we study.

Senator GRAHAM. I don't want to get this thing overly nasty, but I have been dealing with this forever. There is no option. There is no viable option to MOX that would be cheaper and meet the target dates of disposition. That's just a complete, absolute absurd concept, and I know that to be the fact.

This program has had cost overruns. I want to work with you to deal with that. But you're taking an agreement with the Russians, the State of South Carolina, you're breaking the direction given to you by Congress, without any viable alternative. This is incredibly irresponsible. It's going to cost us more money. It's going to create problems with weapons-grade plutonium in the hands of the Russians at a time we need no more problems with the Russians.

I just promise you this will not go away and it will not be allowed to stand, because it is so, so irresponsible.

How much will it cost to terminate the MOX program?

Ms. HARRINGTON. We do not yet have a projection for what it would cost to terminate, because that's not part of the plan.

Senator GRAHAM. I've been told at least $1 billion. Is that correct? Would that be true? The taxpayers would be on the hook for $1 billion in costs if we terminated the program?

Ms. HARRINGTON. I do not believe that there is a detailed cost estimate.

Senator GRAHAM. I'm going to give you a series of questions for the record, as I don't have time right now. I would appreciate a prompt response. Particularly, I will be talking to the Russians myself. I have talked to DOE. They very much hope we don't lay off the workforce until we can find a way forward.

Ms. Harrington, I will work with you and others to try to make this program more cost efficient. I don't think that's an unreasonable request. What you have decided to do, this administration has decided to do, in the budget is irresponsible financially. I think it's reckless in terms of trying to take material that would present a proliferation threat. I think it makes no business sense, and we will continue to have this discussion.

So, thank you very much.

Ms. HARRINGTON. Thank you, Senator, and thank you for all of the efforts you've put into this, and we would look forward to working with you.

Senator GRAHAM [presiding]. Yes, ma'am, we will.

We'll be in recess until after the vote. Thank you.

[Recess.]

Senator HAGAN [presiding]. We're going to bring the meeting back to order.

Ms. Harrington, I'm sorry I missed all the other discussion on this issue. In the fiscal year 2015 budget submission, it has a $114 million reduction for the Second Line of Defense (SLD) program, reducing it to $305 million. Overall, this is the second year of a decrease, from a fiscal year 2013 amount of $527 million. This is an important program to help stem the flow of illicit nuclear material across the borders.

Will you please explain why these reductions continue?

Ms. HARRINGTON. Yes, thank you, Senator. First of all, the fiscal year 2013 $527 million number is a bit of an accounting anomaly because the 2013 CR [Continuing Resolution] was based on 2012, where we had a quite high level for that particular program, so it bumped that number up a little bit.

Senator HAGAN. The high level was based on what?

Ms. HARRINGTON. A scope of work that we had underway at the time.

The $527 million was actually the target of some of our reprogramming, which we thank you and our other oversight committees for allowing to move forward at the end of 2013, early 2014. The reduction that's being referenced is actually the reduction for the entire international material protection cooperation budget. The SLD budget itself in 2014 was $190 million and in 2015 is $117 million. Of the $190 million in fiscal year 2014, a piece of that is from the reprogramming. That allows us to front load some of the activities in fiscal year 2014 and absorb a reduction in the fiscal year 2015 budget.

We only just received at the end of February of this year that reprogrammed money. That is now being carried into the remainder of 2014. We feel that in calendar year 2014 SLD will be able to accelerate important work that's laid out in its strategic plan and forward fund a number of activities to prepare for a slight reduction next year.

Senator HAGAN. Thank you.

In your opening remarks, I think you wanted to talk a little bit about the summit that was just completed. I'd like to ask you about the summit in the Netherlands last week. Can you explain the principal actions of the summit and how they're reflected in the fiscal year 2015 budget?

Then, I'm also concerned why Russia, China, India, and Pakistan did not sign up to these actions along with the other 35 nations.

Ms. HARRINGTON. Let me clarify that last point first. That was on a particular group action to strengthen nuclear security. It's what we call in summit parlance a gift basket, when a group of countries band together and basically make a common commitment. China, India, other countries, all countries participating, fully supported the communique. This was a separate action and there were a number, probably about a dozen, of these so-called gift baskets offered up by different states. It just was some countries like this particular format, a voluntary format of banding together and offering to do something. Other countries simply do not.

I would not gauge their interest or commitment to nuclear security on whether or not they signed up to this particular gift basket.

Senator HAGAN. I'm not sure I understand what the gift basket was that these countries didn't agree with.

Ms. HARRINGTON. It was a commitment to essentially try to go above and beyond what is expected of our nuclear security behavior, to explore ways of being transparent with each other, of offering assurances that our security is adequate, and so forth, things that are not currently required under international guidelines.

As for the accomplishments at the summit, I think the highlight of the summit certainly was the joint U.S.-Japan announcement to eliminate hundreds of kilograms of highly enriched uranium and plutonium from the Japanese Atomic Energy Agency's Fast Critical Assembly. We had been working with Japan for some time on this. It's a very important accomplishment for both countries and something that we will now energize.

We also announced the successful removal of quantities of highly enriched uranium from both Italy and Belgium. We announced the completion of the President's 4-year effort to secure the most vulnerable material across the globe, and that included removing or confirming the disposition of almost 3,000 kilos of highly enriched uranium and separated plutonium, including removing all highly enriched uranium from 11 countries and Taiwan, enhancing the security of 32 buildings containing metric tons of weapons-useable material, and installing almost 1,600 radiation portal monitors at border crossings, airports, seaports, among other activities.

Those were some of the U.S. highlights, but many other countries came bringing their accomplishments as well. If you're interested in a more detailed accounting of all of the things that were announced at the summit, we certainly can get that for you.

Senator HAGAN. Thank you.

Mr. Myers, thank you for your patience. On the Syrian chemical weapons, DTRA is implementing the CTR program, including the Syrian chemical weapons destruction effort. Please explain the interagency effort to outfit the *Cape Ray* and the technologies you're employing to destroy the chemicals and their precursors?

Mr. MYERS. Yes, Senator, thank you. First and foremost, the efforts with regard to eliminating the Syrian chemical weapons stockpile is truly an interagency effort. From the very beginning, strong cooperation between DOS and DOD in terms of the activities, discussion, negotiations with Russia, with Syria, through the OPCW, and a number of other international forums. That carried through through a number of different efforts and layers that brought us to the *Cape Ray*, to outfitting the *Cape Ray*.

It is a very complicated, very difficult process, but it could not have been possible without the Department of Transportation, who oversee the Maritime Administration, which in turn maintains the National Defense Reserve Fleet, which is where the *Cape Ray* came from, a fleet of ships on standby, ready to respond in short order. The cooperation between the Department of Transportation and the Maritime Administration to get the *Cape Ray* to the right spot for us to do our work was absolutely critical.

In addition to that, the cooperation of the Coast Guard, again just a Herculean effort to make sure that everything that we were

doing on the *Cape Ray* in terms of installing the field-deployable hydrolysis systems, storing all the different chemicals and reagents that we would need, locking down various generators and berthing modules for the crew to stay in during the destruction effort, all required—all had to meet international shipping standards, and the Coast Guard was absolutely critical in that, as were a number of other entities both in the public and private sector, for which we are very thankful for their cooperation.

This truly was an interagency effort and, quite frankly, even within DOD, the number of different entities that were involved—obviously, Ms. Hersman's office, OSD Policy, DTRA, multiple elements in the chemical and biological defense program; my boss, Frank Kendall, Under Secretary of Defense for Acquisition, Technology, and Logistics, was critical in leading senior groups together to come behind and gain consensus behind paths forward. This truly was a tremendous effort.

In addition to that, you asked about the technology that we're using. We're using the field-deployable hydrolysis system. From the very beginning, we've had a close relationship with the chem-bio defense program, our R&D arm at DTRA. We have had seed money, if you will, with the chem-bio defense program to begin building this capability. Within a 20-week turnaround, design and development were completed. This was because a lot of early work and a quite Herculean effort by our friends up at Aberdeen, MD, at the Edgewood Chemical and Biological Command, so hats off to them. They did a phenomenal job.

The neutralization really comes through chemical reaction involving a number of reagents, which are mixed with the chemical material and then heated. In effect, we basically turn it into sludge. The sludge in turn will be incinerated at commercial incinerators in Europe and elsewhere.

Obviously, this is a big undertaking, something that we've done on land on a number of occasions here in the United States and around the world. This will be the first time we've done it on a ship. All of this time since the launch of the *Cape Ray* back in January until today, they are exercising. They are preparing for the day when the materials are delivered to the *Cape Ray* and they are able to start work.

They're learning a lot of important lessons and we're learning from those lessons, providing them with additional materials, additional tools, they may need on board to ensure that we do it in the most safe and secure way possible and we do it in a way that completely eliminates the Syrian chemical weapons stockpile.

Senator HAGAN. They are waiting right now for the delivery; is that correct?

Mr. MYERS. That's correct.

Senator HAGAN. All right.

I'm going to go ahead and ask one more question and then see if somebody else comes. Then we might actually convene to the closed briefing.

I wanted to ask, Mr. Myers, on the nuclear inspections. One high profile activity that's made the news lately is the nuclear surety inspections at the intercontinental ballistic missile bases. My understanding is the Navy conducts separate inspections for their fleet

of our nuclear-armed ballistic missile submarines. Do you think it would make sense to develop common inspection procedures where possible between the two Services, and can you elaborate on that?

Mr. MYERS. Yes, thank you. We do, in fact, have a common inspection procedure that DTRA implements, and the two Services. This was put forward by an instruction from the Chairman of the Joint Chiefs of Staff back in 2013, and the instruction identifies common guidance for both the Services and DTRA to conduct nuclear weapon technical inspections.

In addition to that, the Services have also identified additional items that they want to inspect. In other words, they broadened the scope of the inspection beyond the Chairman's instruction. They've each added some individual or independent elements that are applicable to their Service. Those are in addition to the aspects of the nuclear weapons inspections DTRA carries out under the mandate from the Chairman of the Joint Chiefs of Staff.

Senator HAGAN. Do you have any comments on some of the actions that were taken that were in violation of security measures?

Mr. MYERS. No, ma'am. We have had a long history of carrying out those inspections. We try to do it in the most deliberate, transparent way possible. I think we do a very good job at it and I think it's done in a manner that provides the highest amount of confidence that the results are accurate and carried forth in a very straightforward manner. [Pause.]

Senator HAGAN. These votes really do complicate having a hearing. I'm going to recess. Senator Fischer is on her way back. She will pick up with her questions for maybe 5 to 7 minutes, and then we'll recess this. Then I will meet you over at the closed briefing.

Thank you.

[Recess.]

Senator FISCHER [presiding]. I'll catch my breath, because we're running back and forth here. What I'd like to do is just take 5 minutes to ask a few questions, and then we'll head over to the Capitol to have a further discussion in a closed session, if that's okay.

Ms. Hersman, what effect does Russia's violation of the 1994 Budapest Memorandum have on proliferation? Do you think some of these nations and some that are aspiring to become nuclear powers will see this as diminishing the value of security guarantees and increasing the value of nuclear weapons?

Ms HERSMAN. I think the value of pursuing a policy of nonproliferation and the rejection of nuclear weapons by countries like Ukraine will continue to be the best path forward for them.

Senator FISCHER. Do you believe that's the best path forward?

Ms HERSMAN. I do. I think that it won't really change their policy or the approach, despite some of these concerns from Russia.

Senator FISCHER. Mr. Myers, do you agree with that?

Mr. MYERS. Senator, we play a number of different roles at DTRA–SCC and one of them is in support of U.S. Strategic Command. We play a lot of roles in terms of eliminating threats of nuclear weapons as well as supporting the U.S. nuclear stockpile. I will defer on the specific matter on the arms control issue you raised to Deputy Assistant Secretary of Defense Hersman on the policy side.

Senator FISCHER. Thank you.

I'd have to say, Ms. Hersman, I disagree with you. Ukraine was the third power with regards to nuclear weapons. They signed an agreement with Russia and the United States that I understand basically says give up your nukes and we'll take care of you forever. Is forever now 20 years? Is that the mark that we're going to go by? Do you think other nations are going to look at that and think we can give up our weapons as well and be protected?

We see Russia move into Crimea. I guess how would you respond to my concerns and what I believe would be concerns with any other nation sitting back and watching our lack of action in honoring that agreement?

Ms HERSMAN. What I'd like to do is perhaps take that question back. I think that, again, they remain very committed, but I'd like to pursue the more specific question about that agreement perhaps in a written answer for you.

[The information referred to follows:]

Senator Fischer, we understand and share some of your concerns. We continue to condemn Russia's annexation of Crimea and military intimidation of Ukraine. Ukraine's courageous decision to reject nuclear weapons and join the Nuclear Nonproliferation Treaty (NPT) was the right choice in 1994, and it remains so today. By joining the NPT, Ukraine also joined the global community that respects international norms, composed of states that are now coming to Ukraine's defense. Ukraine's decision established Ukraine as an international leader on nonproliferation, facilitated the peaceful transition from the Soviet Union, and supported economic and political integration from which Ukraine benefited greatly.

The U.S. Government continues to fulfill its obligations under the 1994 Budapest Memorandum, and our resolve to support and defend our partners remains strong. The NPT regime continues to help deter proliferation and to create a strategic environment in which we have seen that progress can be made toward nuclear disarmament. Commitments to renounce nuclear weapons and join the NPT will continue to be the right choice, not just for Ukraine, but also for the security of our nation and for the peace of the world.

Senator FISCHER. We will follow up then. Thank you.

When we talk, Ms. Harrington, about the recent nuclear security summit in The Hague, can you tell me if there were any new commitments that were made at that summit?

Ms. HARRINGTON. In fact, there were a number of new commitments made at that summit. I don't have the entire list with me, but the highlight was our joint announcement with Japan that we are going to remove hundreds of kilos of highly enriched uranium and plutonium from their Fast Critical Assembly that belongs to the Japan Atomic Energy Agency. This is a huge step forward in a number of regards and reflects the close working relationship we have with Japan.

There are a number of new commitments that came out of the summit and we'd be happy to get a complete list of those back to the subcommittee if that would be of interest.

[The information referred to follows:]

The 2014 Nuclear Security Summit, which took place on March 24–25 in The Hague, the Netherlands, saw 53 countries and 4 observers (the International Atomic Energy Agency (IAEA), the United Nations, INTERPOL, and the European Union as represented by the European Council and the European Commission) reaffirm their political commitments to take tangible actions to reduce the threat of nuclear terrorism and to make progress towards strengthened international norms and standards for nuclear security. The Hague Summit saw several notable achievements and major announcements for further actions, including:

- A joint U.S.-Japan agreement to remove to the United States hundreds of kilograms of weapons-usable nuclear material from Japan's Fast Critical Assembly facility;
- The shipment to the United States of surplus highly enriched uranium and separated plutonium from Belgium and Italy, continuing progress in minimizing such materials;
- A statement by 35 countries expressing their intent to further strengthen nuclear security by meeting or exceeding the objectives recommended in specific IAEA nuclear security documents and to consider additional actions that would further ensure continuous improvement in nuclear security, including initiatives to work together to share experiences, lessons learned, and assist other countries in raising their nuclear security capabilities;
- A statement by 23 Summit countries expressing their intent to securing their highest-risk radioactive sources, consistent with guidance in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and with consideration of other IAEA nuclear security documents by 2016;
- A statement by 13 Summit countries expressing their intent to combat illicit nuclear material trafficking by seeking enhanced measures to remove nuclear and radiological materials not under regulatory control from the global maritime supply chain and worldwide; and
- The recognition that other international and multilateral mechanisms, such as the IAEA, should be prepared (and strengthened) to assume the many positive aspects of the Nuclear Security Summit process after the 2016 Summit to be hosted in the United States.

As was the case in the 2010 and 2012 Summits, Department of Energy (DOE)/National Nuclear Security Administration (NNSA) programs will have a leading role both in assisting other Summit countries in achieving their 2014 Summit objectives, as well as in contributing to the U.S. efforts to meet these objectives. For example:

- DOE/NNSA will be responsible for removing the nuclear materials identified in the U.S.-Japan Fast Critical Assembly Agreement;
- DOE/NNSA will also assist Summit countries, as well as facilities in the United States, to secure their remaining highest-risk radioactive sources, in order to support efforts to secure all such sources by 2016;
- DOE/NNSA will assist other Summit countries in supporting the goals of the Summit's joint statements on combatting illicit nuclear material trafficking and in removing materials not under regulatory control from the global maritime supply chain; and
- Several DOE/NNSA offices, particularly the Defense Nuclear Nonproliferation's Office of Nonproliferation and International Security, as well as DOE/NNSA programs in counterproliferation/counterterrorism, emergency incident response, and U.S. domestic nuclear security, will fulfill the U.S. leadership role in the 2014 Summit's statement regarding meeting or exceeding the intent of internationally-accepted levels of nuclear security.

Senator FISCHER. That would be great.

Can you tell me if Russia, China, India, and Pakistan joined in on that statement?

Ms. HARRINGTON. They did certainly join in on the summit communique. I was trying to explain to Senator Hagan the complicated system of different documents that come out of the summit process. When a group of countries join together around a certain principle, whether it's radiological security, whether it's maritime security, it's called a gift basket in summit language.

Senator FISCHER. Did we get a good gift basket from Russia and China and India and Pakistan? It seems to me those are the countries that I would have the most concern with, rather than Japan.

Ms. HARRINGTON. Right. They are not very fond of the concept, but Russia certainly did sign up on the statement on combating nuclear terrorism under the global initiative, and Pakistan and China have made a number of other of their own unilateral commitments to do other things.

Senator FISCHER. These are voluntary standards, is my understanding. These four countries that I mentioned, wouldn't even sign onto voluntary standards?

Ms. HARRINGTON. I would say neither did perhaps another 20 participants in the summit.

Senator FISCHER. Was it a success?

Ms. HARRINGTON. The summit? Absolutely. We may have our issues with Russia right now, but one of the reasons that we were successful going into this summit was the removal of all highly enriched uranium in partnership with Russia from a number of countries, for example like the Czech Republic, Hungary, where the material was of Russian origin. We continue to be able to execute under that kind of partnership.

Different countries express their commitment to nuclear security in different ways.

Senator FISCHER. Thank you.

My time is up. With that, I will end this hearing. We'll move to the Capitol Visitor Center for a closed hearing. Thank you all for your participation here today. This subcommittee open hearing is now adjourned.

[Whereupon, at 3:10 p.m., the subcommittee adjourned.]

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR KAY R. HAGAN

GLOBAL THREAT REDUCTION INITIATIVE

1. Senator HAGAN. Ms. Harrington, the fiscal year 2015 request reduces funding for the Global Threat Reduction Initiative (GTRI) by roughly 25 percent relative to last year's appropriation. Within GTRI, the request delays the goal to convert or shut down 200 research reactors that still use highly enriched uranium (HEU) by an additional 5 years to 2035. Other planned HEU reactor conversion and related work for fiscal year 2015 is apparently deferred to future years, though there are no specific details about what exactly is being deferred. The request for nuclear and radiological material removal also states that some planned follow-on work is deferred to future years, but again what exactly is being deferred is opaque. Finally, the reduction in the request for nuclear and radiological protection is justified on the grounds that it is consistent with broader budget austerity goals and prioritization within the National Nuclear Security Administration (NNSA). The previous end date to secure 8,500 buildings with radioactive material by 2044, which itself is a delay of nearly 2 decades relative to the goal in 2012, is now to be determined pending a review of GTRI's protect program examining current inventory, scoping, budgeting, and project planning processes that will maximize resources and decrease the program's completion timeline. Would you provide specific examples of critical security work that is being deferred due to budget cuts?

Ms. HARRINGTON. The administration and the Department of Energy (DOE)/NNSA remain committed to our nuclear nonproliferation and security objectives, consistent with the President's vision of reducing nuclear dangers and our reliance on nuclear weapons. In the current budget environment, difficult choices are inevitable and this budget balances the activities on a priority basis within the available budgetary resources. With the budget proposed and by working together with our international partners, NNSA expects to be able to continue its strong support for priority programs.

For the GTRI, the impact of the reduction in funding from fiscal year 2014 to fiscal year 2015 will result in delay in the completion of security upgrades at 15 domestic and international buildings that contain high-priority radiological material and in the completion of Russian research reactor conversions. The reduction also results in the deferral of funding for nuclear material removals from South Africa. Though existing political obstacles to that work limit the impact of this reduction, it eliminates the possibility of accelerating other key shipments planned for later years, such as from Kazakhstan.

2. Senator HAGAN. Ms. Harrington, what additional work could be done in fiscal year 2015 with additional funding?

Ms. HARRINGTON. With additional funding, the GTRI could secure an additional 50 buildings containing high-priority radiological material (~$20 million), and accelerate the removal of HEU from Kazakhstan and/or other high-priority countries (~$15 million).

No reactors scheduled for conversion in fiscal year 2016 or beyond could be accelerated into fiscal year 2015, as conversions are multi-year projects, and fuel fabrication timelines and technology development cannot typically be accelerated at the final stage of the conversion project.

3. Senator HAGAN. Ms. Harrington, what percentage of the GTRI budget funds activities in Russia?

Ms. HARRINGTON. The total request for the GTRI in fiscal year 2015 is $333.5 million. Of that, $25.6 million (7.7 percent) supports GTRI activities in Russia. In addition to GTRI's activities in Russia, GTRI partners with Russia to support nuclear material removal in third party countries. In fiscal year 2015, for GTRI's Russian-origin nuclear material removal efforts, including key removals in Kazakhstan and Uzbekistan, will require $46.2 million in funding (13.9 percent). These efforts do not include providing equipment or other forms of assistance to Russia, but do include funds for Russian services, including transportation and packaging, material handling and storage, and other requirements that facilitate GTRI's material removal efforts. The majority of the value of the funding remains in third-party country in the form of facility upgrades, reactor modifications, and the provision of replacement low-enriched uranium (LEU) fuel.

4. Senator HAGAN. Ms. Harrington, the fiscal year 2015 request reduces funding for the Cooperative Threat Reduction (CTR) program by roughly 27 percent relative to last year's appropriation. Can you please explain the rationale for such a drastic budget cut?

Ms. HARRINGTON. The fiscal year 2015 budget for the Office of International Material Protection and Cooperation (IMPC) will decrease by approximately 27 percent from 2014 due to reduction of the work scope in Russia. For example, Material Protection, Control, and Accounting (MPC&A) cooperative work will not continue at sites under the jurisdiction of the Russian Ministry of Defense, and MPC&A work at two Rosatom nuclear sites will be completed in 2014.

5. Senator HAGAN. Ms. Harrington, are there priorities and/or goals that are being deferred or scrapped because of the budget cuts?

Ms. HARRINGTON. In the current budget environment difficult choices are inevitable, but we believe that at this funding level, we will still be able to fully support the President's nonproliferation priorities as well as have the flexibility to take advantage of new priorities and opportunities. The administration and DOE/NNSA remain committed to our nuclear nonproliferation and nuclear modernization objectives, consistent with the President's vision of reducing nuclear dangers and our reliance on nuclear weapons. As a demonstration of our continued commitment to nuclear security as a priority, the fiscal year 2015 budget request provides funding to continue remaining high-priority nuclear and radiological threat reduction efforts, following the accelerated 4-year effort activities. With the budget proposed and by working together with our international partners, NNSA expects to be able to continue its strong support for priority programs.

QUESTIONS SUBMITTED BY SENATOR DEB FISCHER

IMPACT OF RUSSIA'S ACTION ON NONPROLIFERATION NORMS

6. Senator FISCHER. Ms. Hersman and Ms. Harrington, last month, U.N. Secretary General Ban Ki-moon stated that Russia's action in Ukraine has "profound implications for the integrity of the nuclear non-proliferation regime," apparently based on concern that potential aspiring nuclear powers would interpret recent events as confirming the need for nuclear weapons. Do you agree with his statement?

Ms. HERSMAN. Despite the gloomy predictions regarding the damage to the Nuclear Nonproliferation Treaty (NPT) from the current crisis in Ukraine, Ukraine leaders such as Minister of Foreign Affairs Deshchitsa have recently reaffirmed Ukraine's commitment to the NPT. I believe that we should take heart in Ukraine's reaffirmation of its nonproliferation obligations, even in the face of the current cri-

sis. Non-nuclear-weapon states have far more to lose than they have to gain by developing or acquiring nuclear weapons. The process of developing or otherwise obtaining nuclear weapons is tremendously expensive and destabilizing, and undoubtedly such actions would undermine the very security that the states were seeking to achieve. By remaining united against Russia's aggressive actions, the international community will continue to send a strong message to non-nuclear-weapons states that obtaining nuclear weapons is not necessary for their security.

Ms. HARRINGTON. I agree that Russia's recent actions have impacted the international security environment. However, recent events do not diminish the many political and security benefits that states enjoy as states parties to the treaty on the NPT. Ukraine has reaffirmed its commitment to uphold its nuclear non-proliferation commitments, including its obligations under the NPT as a non-nuclear-weapon state. Non-nuclear-weapon states parties to the NPT have an obligation under the Treaty not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices. States value the NPT for its contribution to international peace, stability, and security throughout the world for over four decades. I do not believe that Russia's actions will lead non-nuclear-weapon states parties to the NPT to reconsider the merits of nuclear disarmament, nonproliferation, and security. The acquisition of nuclear weapons by NPT non-nuclear weapon states would not increase their security; rather, it would detract from their security and lead to international condemnation and isolation.

7. Senator FISCHER. Ms. Hersman and Ms. Harrington, are you concerned that potential aspiring nuclear powers will conclude that Russia's actions demonstrate the security value of nuclear weapons and diminish the importance of security guarantees?

Ms. HERSMAN. Russia's actions do not demonstrate the security value of nuclear weapons, and we continue to condemn Russia's annexation of Crimea and military intimidation of Ukraine. The U.S. Government stands with the Government of Ukraine in this crisis; Ukraine's courageous decision to reject nuclear weapons and join the NPT was the right choice in 1994, and it remains so today. By joining the NPT, Ukraine also joined the global community that respects international norms, composed of states that are now coming to Ukraine's defense. Ukraine's decision established Ukraine as an international leader on nonproliferation, facilitated the peaceful transition from the Soviet Union, and supported economic and political integration from which Ukraine benefited greatly. The U.S. Government is fulfilling its obligations under the 1994 Budapest Memorandum, and our resolve to support and defend our partners remains strong.

Ms. HARRINGTON. We condemn Russia's failure to abide by its international obligations and commitments, including the commitments made under the 1994 Budapest Memorandum. However, recent events do not diminish the many political and security benefits that states enjoy as NPT parties. Ukraine has reaffirmed its commitment to uphold its nuclear non-proliferation commitments, including its obligations under the NPT as a non-nuclear-weapon state.

8. Senator FISCHER. Ms. Hersman and Ms. Harrington, the 2010 Nuclear Posture Review states that U.S. disarmament and reducing the role of U.S. nuclear weapons "can make a major contribution to our goal of preventing nuclear proliferation and nuclear terrorism." Do you believe Russian aggression exerts greater influence on potential aspiring nuclear powers than recent U.S. arms control efforts and pronouncements about the role of U.S. nuclear weapons?

Ms. HERSMAN. Non-nuclear-weapon states that are parties to the NPT value the NPT for its contribution to international peace and stability, and understand that their commitment under the NPT to not develop or acquire nuclear weapons is an important element to promoting global security. By standing united against Russia's aggressive actions, the international community is sending a strong message that non-nuclear-weapon states need not reconsider the merits of nuclear disarmament, nonproliferation, and security-based on Russia's actions. The U.S. commitment to address these issues through practical steps and international collaboration will maintain our credibility on all of these issues despite Russia's actions.

Ms. HARRINGTON. U.S. arms control and disarmament efforts, as well as other means of reducing the role of nuclear weapons and moving toward a world without them, continue to make a major contribution to our goal of preventing nuclear proliferation and nuclear terrorism. By demonstrating that we take seriously our NPT obligation to pursue nuclear disarmament, we strengthen our ability to mobilize broad international support for the measures needed to reinforce the non-proliferation regime and secure nuclear materials worldwide. I do not believe that Russia's

actions will lead non-nuclear-weapon states parties to the NPT to reconsider the merits of nuclear disarmament, nonproliferation, and security.

FISCAL YEAR 2015 BUDGET REQUEST

9. Senator FISCHER. Ms. Hersman, Ms. Harrington, and Mr. Myers, does the 2015 budget allow you to continue your highest priority work?

Ms. HERSMAN. I support the President's fiscal year 2015 budget request. It is sufficient for the requirements that the Department of Defense (DOD) CTR program has identified, to date. We will be able to continue the highest priority work currently underway. However, we cannot anticipate all of the threat reduction requirements that may emerge. For example, we do not have available funds to respond to another emerging threat of the same magnitude as Syria.

Ms. HARRINGTON. The administration and DOE/NNSA remain committed to our nuclear nonproliferation and nuclear modernization objectives, consistent with the President's vision of reducing nuclear dangers and our reliance on nuclear weapons. As a demonstration of our continued commitment to nuclear security as a priority, the fiscal year 2015 budget request provides funding to continue remaining high-priority nuclear and radiological threat reduction efforts, following completion of the accelerated 4-year effort activities. For example, we plan to remove an additional 125 kilograms of HEU and plutonium from high priority countries; protect an additional 105 buildings with high-activity radioactive sources; and initiate some important new activities in the Middle East.

Mr. MYERS. The fiscal year 2015 budget allows the Defense Threat Reduction Agency (DTRA) to maintain appropriate funding in our highest priority combating weapons of mass destruction (CWMD) research, development, test, and evaluation (RDT&E) research categories and is sufficient for DTRA to meet its support responsibilities to DOD, the Joint Staff, and the Services.

LIBYA CHEMICAL WEAPONS DESTRUCTION

10. Senator FISCHER. Ms. Hersman and Mr. Myers, on February 5, 2014, Libya declared that all of its chemical weapons were destroyed. Reportedly, the last 2 tons of mustard agent were destroyed about 400 miles south of Tripoli. According to the New York Times, $45 million of CTR funds were used to safeguard, rebuild, and help finish destruction at the remote site. The paper also reported that, "the effort also helped inspire the use of the technology in the much bigger disposal plan in Syria." Obviously, the amount of chemical agents in Libya are much less than those in Syria, but what are the lessons learned from destroying Libyan chemical weapons that apply to Syria?

Ms. HERSMAN. DOD learned the importance of having flexible solutions available to deal with an emergent, austere situation in which a stockpile of chemical materials needs to be destroyed in an expedient, environmentally friendly fashion. In Libya, we moved from thinking about chemical weapons destruction as a problem requiring large, fixed infrastructure to one that can sometimes best be addressed with transportable technologies to enable rapid elimination, a concept that has proven its importance in the Syria chemical weapons destruction mission.

In the end, our experts at DTRA were able to help the Libyans eliminate their chemical munitions stockpile in about a year, which is a testament to the expertise and flexibility of our experts and contracted support.

Additionally, the support from and partnership with the German Government also reaffirmed the importance of the CTR program's external contributions authority and the importance of finding like-minded partners so the United States does not shoulder the entire financial burden of these major efforts alone.

Mr. MYERS. DTRA's work in Libya helped us to understand the importance of contingency planning in an early phase and coordination with key members of the U.S. Government chemical weapons demilitarization community. The lessons learned in Libya have been applied to our work related to Syria.

SYRIAN CHEMICAL WEAPONS DESTRUCTION

11. Senator FISCHER. Ms. Hersman and Mr. Myers, as of December 31, 2013, Assad missed the deadline for removal of the most toxic chemical agents (Priority 1) from Syria, reportedly due to poor security conditions on transit routes. As of March 19, the Organization for the Prohibition of Chemical Weapons (OPCW) reported 49.3 percent of chemicals had been removed: 34.8 percent of Priority 1 chemicals and 82.6 percent of Priority 2 chemicals. Have you seen a slowdown that is re-

lated to events in Crimea and do you perceive that the Russians are cooperating? In your opinion, what seems to motivate the Syrians to make shipments of chemical agents to Latakia?

Ms. HERSMAN. Thus far, we have seen no indications that Russia is trying to link the Syria chemical weapons elimination efforts to the situation in Ukraine. Having made a public commitment to accomplish the destruction of Syria's chemical weapons stockpile, Russia continues to demonstrate its interest in the successful completion of the elimination mission.

It is the Syrian Government's responsibility to transport the chemicals to Latakia safely, securely, and efficiently to ensure a rapid and successful hand-off. We observe that Syrian removal efforts accelerate when international pressure and attention are high, and efforts slow when attention drifts elsewhere. Meetings of the Organization for the OPCW and the U.N. Security Council where Syrian performance in fulfilling its obligations is reviewed tend to serve as a forcing function that prompts the Syrian Government to increase the pace of removal.

Mr. MYERS. DTRA–SCC assess that the pace of removal of chemicals from Syria is not related to events in Crimea. Before and after the situation in Ukraine began, the Syrians would stipulate that equipment malfunctions and security concerns required extensions of the removal timeline.

12. Senator FISCHER. Ms. Hersman and Mr. Myers, the United States is providing key enablers for the Syrian chemical weapons destruction plan being overseen by the OPCW–U.N. Joint Mission. How much U.S. funding is going towards destruction of chemical weapons, through what funding mechanism, and for what specific lines of effort?

Ms. HERSMAN. The DOD CTR program has allocated approximately $165 million through fiscal year 2014 for the removal and destruction of Syria's chemical materials. DOD has already spent approximately $15.5 million on logistics and equipment to support the OPCW–U.N. Joint Mission efforts to inspect, transport, and remove the Syrian chemicals from the country. The joint mission will ensure that all equipment is consumed, expended, removed, or destroyed upon completion of the mission, so that Syria is not left more capable than when this effort began. The balance of the funding is for preparing the *Cape Ray* and the Field Deployable Hydrolysis System (FDHS) for the neutralization operation, projected transit and operating costs, security and demobilization, and recapitalization. The Canadian Government contributed approximately $4.5 million through the CTR program's external contributions authority to support the destruction operations. The U.S. Navy will fund some security requirements for the *Cape Ray* via its operation and maintenance account.

The Department of State (DOS) also provided approximately $6 million in financial and in-kind assistance to the OPCW–U.N. Joint Mission's inspection team, including armored vehicles, training, protective equipment, and medical countermeasures.

Mr. MYERS. The DOD Nunn-Lugar CTR program has allocated approximately $165 million toward the destruction of Syria's chemical materials. This includes $160 million in U.S. contributions and $4.5 million contributed by the Canadian Government through the CTR program's external contributions authority. CTR funding has been used to supply the OPCW–U.N. Joint Mission with logistics equipment for the safe decanting, packaging, and transporting of the Syrian chemicals to the Port of Latakia. It has also been used to fund the modifications to outfit the *Cape Ray* for neutralization operations. CTR will also fund all operational costs for the destruction of sulfur mustard and the sarin precursor difluoro on the *Cape Ray*.

13. Senator FISCHER. Ms. Hersman and Mr. Myers, how much do you expect it will cost overall and how much of the overall funding required is from the United States?

Ms. HERSMAN. It is unclear how much the entire operation to eliminate Syria's chemical weapons will cost once all of the requirements from inspecting the sites, to manning and protecting the chemical agent transport ships, to the actual neutralization operation, to verifying the complete elimination of the Syrian chemical weapons program, are taken into account. Nevertheless, the international community has banded together to share the burdens of this operation.

Broadly, the OPCW expects to receive approximately $70 million from a number of partners for its trust fund to cover costs associated with the destruction of Syrian chemical weapons in commercial facilities outside of Syria, and the United Nations received about $8 million from several partners to address the logistics requirements of the operation inside Syria.

More specifically, the international community is poised and ready to destroy Syria's chemical materials as soon as the Syrians complete their movements to the port of Latakia for removal. Danish and Norwegian ships (with Finnish support) continue to load the bulk agent for removal from Syria. Russia and China are providing security for the marine loading operation in Syrian territorial waters. The United Kingdom is providing additional security for the vessels outside of Syrian territorial waters. The Italian Government has agreed to allow transloading operations from the Danish ship to the *Cape Ray*, the U.S. vessel being used for the neutralization operation, in one of Italy's ports. The United Kingdom and Germany have agreed to fund and destroy a portion of the precursor chemicals and hydrolysis effluent at facilities in their countries. The Spanish Government is allowing the *Cape Ray* port access while awaiting the removal of chemicals from Syria. The Portuguese Government has agreed to allow port access to the *Cape Ray* for refueling, personnel transfers, or other logistical support requirements, as required. Finally, the U.S. European Command is currently working with a number of partners to finalize a plan to supplement the U.S.-provided security for the *Cape Ray* while it conducts neutralization operations.

The United States is also a major contributor to this effort, with a preponderance of funding from the DOD CTR program. The DOD CTR program has allocated approximately $165 million for the U.S. operation to destroy the majority of Syria's Priority 1 chemicals. The Canadian Government has also contributed directly to the U.S. portion of the destruction effort, providing $4.5 million under the DOD CTR program's external contributions authority.

Mr. MYERS. The United States, through the Nunn-Lugar CTR program, will fund approximately $165 million toward the removal of all chemicals from Syria and the neutralization of sulfer mustard and difluoro. This includes $160 million in U.S. contributions and $4.5 million contributed by the Canadian Government through the CTR program's external contributions authority. The cost of CTR operations will vary based on the Syrian removal timeline, weather in the Mediterranean Sea during operations, and the amount of equipment that can be returned to vendors or resold after demobilization and decontamination.

14. Senator FISCHER. Ms. Hersman and Mr. Myers, will any assistance remain with the Syrian Government including equipment or money after destruction is complete?

Ms. HERSMAN. No assistance from the United States will remain with the Syrian Government. DOD spent approximately $15.5 million on logistics and equipment to support the OPCW–U.N. Joint Mission efforts to inspect, transport, and remove declared chemicals from the country, and destroy the remaining chemicals and other parts of the Syrian program within the country. This support included, for example, trucks, packing and handling equipment, shipping containers, cranes, and fork-lifts. The OPCW–U.N. Joint Mission accepted all equipment, and will ensure that it is consumed, expended, removed from Syria, or destroyed upon completion of the mission.

Mr. MYERS. No DOD-provided equipment will remain in Syria following the removal of the Syrian chemical weapons. All U.S.-supplied equipment which was provided to the OPCW–U.N. Joint Mission will be verified in writing by the Joint Mission to the United States as either consumed, expended, removed, or destroyed.

15. Senator FISCHER. Ms. Hersman and Mr. Myers, what, if anything, hasn't been declared by Syria related to their chemical weapons and what is the plan for any undeclared materials or facilities?

Ms. HERSMAN. [Deleted.]

Mr. MYERS. Issues related to policy decisions on undeclared Syrian materials or facilities will be made by DOS and/or OSD Policy. I respectfully defer to their office for the appropriate response to your question.

16. Senator FISCHER. Ms. Hersman and Mr. Myers, what is the status of chemical weapons production facilities that have yet to be destroyed, and what is the plan to destroy them?

Ms. HERSMAN. Syria failed to meet the March 15, 2014, destruction date established by the OPCW Executive Council in November 2013 for the destruction of 12 chemical weapons production facilities. The U.S. Government position remains that Syria's facilities must be physically destroyed so they cannot be used in the future to reconstitute a chemical weapons program. At the March 28, 2014, OPCW Executive Council meeting, the Syrian delegation submitted a revised destruction plan for these facilities, based on recommendations received from the OPCW Technical Secretariat. Although the new Syrian plan is an improvement over its previous destruc-

tion by inactivation approach, the plan does not go far enough to ensure these facilities are physically destroyed, as required by the Chemical Weapons Convention (CWC) and U.N. Security Council Resolution (UNSCR) 2118. The U.S. Government remains committed to ensuring that the Syrian regime physically destroys each of these 12 chemical weapons production facilities, consistent with the CWC and past practices under the CWC.

Mr. MYERS. The OPCW is still negotiating with the Syrian Government on plans for destruction of chemical weapons production facilities.

17. Senator FISCHER. Ms. Hersman and Mr. Myers, if the next deadline is missed, what are the potential leverage points to get Assad to move forward and what is the U.S. Government's plan?

Ms. HERSMAN. We expect the Syrian Government to comply fully with its responsibilities under UNSCR 2118 and the relevant decisions of the OPCW Executive Council. We also expect Russia, as the co-designer of the framework and the timelines for Syrian chemical weapons elimination, to press Syria to comply with the requirements of UNSCR 2118 immediately and to accelerate Syria's most recent removal plan. UNSCR 2118 allows for regular review of Syria's progress, or lack thereof, and provides for referral of cases of non-compliance with OPCW decisions or UNSCR 2118 to the U.N. Security Council to consider imposition of measures under Chapter VII of the U.N. Charter. We continue to monitor Syria's progress closely.

Mr. MYERS. Issues related to policy decisions on Syrian deadlines will be made by DOS and/or OSD Policy. I respectfully defer to their office for the appropriate response to your question.

COOPERATIVE BIOLOGICAL ENGAGEMENT PROGRAM

18. Senator FISCHER. Ms. Hersman and Mr. Myers, we have pressing problems of nuclear proliferation in North Korea and Iran, and a serious chemical weapons proliferation threat in the Middle East. However, in fiscal year 2014 we spent more than half of the CTR budget on biological engagement and in fiscal year 2015 the President's budget proposes increasing that to 70 percent of the budget. Please explain why 70 percent of the CTR budget will go toward biological proliferation prevention instead of nuclear or chemical weapons proliferation prevention?

Ms. HERSMAN. A number of factors led to the emphasis on the DOD CTR program's Cooperative Biological Engagement Program (CBEP) in the CTR program's fiscal year 2015 budget.

First, rapid decline in certain budgetary categories that were associated with our cooperation with Russia, including global nuclear security and chemical weapons destruction, meant that the CTR program had resources available that it could resource against other priorities.

Second, the CTR program's chemical weapons destruction account funding is projected to be much lower in fiscal year 2015 than in recent years because the Libya chemical weapons elimination effort will have concluded in fiscal year 2014, and the Syria chemical weapons elimination effort is projected only to require residual funding in fiscal year 2015. There are no other major chemical weapons-destruction efforts projected at this point that would require a high level of funding.

Finally, with these shifts in resources, the requirements identified for biological security-related efforts were both changing and expanding. Broadly, we see biological security as a major challenge that requires additional attention. The CBEP has an important role to play in advancing the U.S. Government's efforts to prevent the theft, misuse, or the release of biological agents of security concern, in coordination with other interagency partners. Our efforts continue to adapt with the expansion of our authorities and the evolving threats. For example, as the CTR program moves into the completion phase of fairly large CBEP construction efforts in Georgia and Kazakhstan, we are expanding opportunities in other priority regions, such as Southeast Asia.

At the same time, the CTR program continually works to ensure that our resources are used to confront the threats that DOD is best positioned to address. DOD is part of an interagency team that covers the spectrum of chemical, biological, radiological, and nuclear threats. Our biological security-related efforts are coordinated very closely with DOS, relying on its diplomatic outreach and expertise, and the Centers for Disease Control (CDC), since we recognize that we can provide a very important security component to the public health mandate of the CDC. By working together, we can leverage expertise and access, as well as prevent inappropriate duplication of effort.

We mirror this close cooperation with DOE/NNSA on countering nuclear threats. DOE/NNSA has a robust budget for securing nuclear material worldwide, and we cooperate with them to help augment specific projects and areas in which DOD can offer its expertise.

Finally, given the flexibility of the CTR program's authorities, we are continually reevaluating the CTR program's overall requirements and funding allocated against them, and can use our budgetary renotification processes for adjustments, as needed.

Mr. MYERS. Our CWMD efforts are guided by the threats that we are facing. Pathogens of security concern are endemic in many countries, i.e., B. anthracis and Y. pestis and the emergence of new microbes and drug-resistant pathogens is on the rise. Geopolitical instability and the relatively small infrastructure foot print for terrorist acquisition, development, and use of biological agents of security concern, combined with weak biosafety, biosecurity, and biosurveillance capacity in many countries make the biological threat the most likely we are going to face in the coming years. The acceleration of biological science capabilities and inherent dual-use potential of laboratory facilities and related equipment necessitate focus on ethical codes of conduct, transparency, and enhanced biosafety and biosecurity protocols. The risk of the spread of infectious diseases through increased global trade and travel requires a continued and concerted international effort.

QUESTIONS SUBMITTED BY SENATOR LINDSEY GRAHAM

MIXED OXIDE FUEL FACILITY

19. Senator GRAHAM. Ms. Harrington, how much plutonium is currently at the Savannah River Site (SRS)?

Ms. HARRINGTON. About 13 metric tons.

20. Senator GRAHAM. Ms. Harrington, how much of this plutonium can be converted into mixed oxide (MOX) fuel?

Ms. HARRINGTON. About 8 metric tons.

21. Senator GRAHAM. Ms. Harrington, where is the rest of the 34 metric tons of plutonium that is designated for conversion?

Ms. HARRINGTON. The majority of the remaining plutonium is stored at Pantex in pit form.

22. Senator GRAHAM. Ms. Harrington, what is the current disposition path for this plutonium?

Ms. HARRINGTON. The current program of record is the MOX fuel approach. However, it has become clear that the MOX fuel approach will be significantly more expensive than anticipated. Given a total lifecycle cost estimate for the program of more than $30 billion, we are looking at our options. It makes sense to look at the list of options again, given the increased cost estimates for MOX, and given improved technologies with the passage of time since the original National Academies studies.

23. Senator GRAHAM. Ms. Harrington, how much does DOE spend each year storing and monitoring this material?

Ms. HARRINGTON. The Fissile Materials Disposition budget is $5 million for storage and surveillance of the surplus pits at Pantex. This is incremental funding on top of what Pantex already spends to provide storage and surveillance of all pits stored there.

24. Senator GRAHAM. Ms. Harrington, the President's fiscal year 2014 budget request asked for money for construction of the MOX facility. Congress authorized and appropriated funds in fiscal year 2014 for this purpose. However, DOE now plans to use the money to put MOX in cold standby. Can you explain the legal authority you are using to spend money in this manner?

Ms. HARRINGTON. DOE has determined and communicated to the contractor, MOX Services, that we will continue with construction activities through 2014, retaining the key nuclear engineers and other highly-skilled workers that will be needed regardless of the path forward. NNSA intends to work with the contractor on a plan for placing the project in cold standby during fiscal year 2015, and we are continuing our ongoing discussions with Congress as they review and evaluate the fiscal year 2015 budget request.

25. Senator GRAHAM. Ms. Harrington, what is the Secretary of Energy's preferred method to dispose of surplus weapons grade plutonium?

Ms. HARRINGTON. DOE is conducting an ongoing options analysis to identify more efficient options for plutonium disposition. This analysis includes the MOX fuel approach.

26. Senator GRAHAM. Ms. Harrington, who made the decision to place MOX in cold standby?

Ms. HARRINGTON. The MOX project will not be placed in cold standby in fiscal year 2014.

27. Senator GRAHAM. Ms. Harrington, the President's budget states that the administration "is committed to the U.S–Russia Plutonium Management and Disposition Agreement (PMDA)," yet it puts the only disposition path for plutonium in "cold standby." These statements seem to conflict. How do you reconcile them?

Ms. HARRINGTON. The administration recognizes the importance of the U.S.-Russia PMDA, whereby each side committed to dispose of at least 34 metric tons of weapon-grade plutonium. The United States remains committed to working with Russia to dispose of surplus weapon-grade plutonium per the terms of the PMDA.

28. Senator GRAHAM. Ms. Harrington, will the budget request require the United States to renegotiate that agreement with Russia?

Ms. HARRINGTON. Under the PMDA, disposition "shall be by irradiation . . . or any other methods that may be agreed by the Parties in writing." Since the PMDA already gives the Parties the right to agree on other disposition methods, incorporation of a non-irradiation disposition method would not require amendment of the PMDA. We will continue to work with Russia and consider what arrangements, if any, need to be made regarding disposition.

29. Senator GRAHAM. Ms. Harrington, how will DOE comply with the terms of 50 U.S.C. 2566 which mandate a metric ton of plutonium leave South Carolina by January 2016?

Ms. HARRINGTON. We understand our commitments under the current legislation, and we will look to ensure compliance with the law.

30. Senator GRAHAM. Ms. Harrington, on March 30, 2014, the New York Times reported that the administration is seeking to bring over 700 pounds of weapons grade plutonium from Japan to the United States for disposition. Where does the United States plan to store this material?

Ms. HARRINGTON. NNSA continuously looks to identify additional proliferation sensitive materials that should be removed to eliminate the risk that they could fall into the hands of terrorists. In all cases, NNSA works with its foreign partners to identify the best disposition pathway to eliminate material, and anticipates removing or dispositioning approximately 1,100 kg of additional HEU and plutonium through 2022.

DOE has yet to make final determination as to where the material from Japan will be received and stored. When a final determination is made, DOE will follow all requirements of the National Environmental Policy Act.

31. Senator GRAHAM. Ms. Harrington, what is the disposition path for this material?

Ms. HARRINGTON. DOE has yet to make final determination as to where the material from Japan will be received and stored.

32. Senator GRAHAM. Ms. Harrington, under 50 U.S.C. 2566, can you send this material to the SRS?

Ms. HARRINGTON. 50 U.S.C. 2566 applies only to defense plutonium and defense plutonium materials to be processed by the MOX facility. The material from Japan has not been designated to be processed by the MOX facility.

33. Senator GRAHAM. Ms. Harrington, how much would it cost taxpayers to terminate the MOX program?

Ms. HARRINGTON. The MOX project has not been terminated.

34. Senator GRAHAM. Ms. Harrington, what is the value of purchased material awaiting installation?

Ms. HARRINGTON. The total value of purchased equipment, commodities, and construction support items (tools, measurement and test equipment, et cetera) is ap-

proximately $1.2 billion of which approximately $200 million of equipment/commodities has been installed in the MOX Fuel Fabrication Facility. Therefore, there is about $1 billion of materials/equipment that has been purchased but yet to be installed.

35. Senator GRAHAM. Ms. Harrington, what will you do with all of that material if MOX is placed in cold standby?

Ms. HARRINGTON. This material would be stored in conditions to protect its usefulness and value. Appropriate analyses would be conducted to determine if other uses, consistent with applicable law and regulation on the disposition/use of government property, can be identified that are cost effective for taxpayers. Those uses could include storage until a decision is made on the path forward for the MOX project or use by other projects/programs, in which case the purchase of new materials would be required if it is later decided to complete the MOX project.

36. Senator GRAHAM. Ms. Harrington, I am concerned that a $30 billion lifecycle cost figure is being circulated. This number is strenuously disputed by the contractors. Will you release the detailed cost estimate?

Ms. HARRINGTON. The $30 billion lifecycle cost is included in the options analysis, which has been released. In addition, GAO is conducting further analysis on the lifecycle costs of the plutonium disposition program and DOE has provided the same data to the GAO, using updated data from DOE which includes the most recent estimates for the MOX facility, assumes an optimal funding profile for fiscal year 2013 and the out-years (which has not been achieved), and includes other cost increases in the program.

37. Senator GRAHAM. Ms. Harrington, would you please provide both the U.S. and the Russian names, dates, and what was said during all meetings/discussions between DOE/NNSA and their Russian counterparts regarding changes to the plutonium disposition plan as outlined in the PMDA?

Ms. HARRINGTON. The administration engaged in eight consultations that took place in April 2013, December 2013, and March 2014.

The discussions covered the fiscal year 2014 and fiscal year 2015 budget requests as they related to the plutonium disposition program. The evolving analysis of U.S. disposition options was also discussed.

DEPARTMENT OF DEFENSE AUTHORIZATION OF APPROPRIATIONS FOR FISCAL YEAR 2015 AND THE FUTURE YEARS DEFENSE PROGRAM

TUESDAY, APRIL 8, 2014

U.S. SENATE,
SUBCOMMITTEE ON EMERGING
THREATS AND CAPABILITIES,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

THE ROLE OF THE DEPARTMENT OF DEFENSE SCIENCE AND TECHNOLOGY ENTERPRISE FOR INNOVATION AND AFFORDABILITY

The subcommittee met, pursuant to notice, at 2:14 p.m. in room SR–222, Russell Senate Office Building, Senator Kay R. Hagan (chairwoman of the subcommittee) presiding.

Committee members present: Senators Hagan and Fischer.

OPENING STATEMENT OF SENATOR KAY R. HAGAN, CHAIRWOMAN

Senator HAGAN. Good afternoon, everybody. The Emerging Threats and Capabilities Subcommittee meets today to continue our review of the Department of Defense's (DOD) fiscal year 2015 budget request. Today's hearing will focus on a small but incredibly important piece of the defense budget, namely its science and technology (S&T) programs. I am pleased that we have the DOD's S&T leadership team with us here today, led by Mr. Alan R. Shaffer, the Acting Assistant Secretary of Defense for Research and Engineering. Along with him are the distinguished executives who are charged with leading these programs, namely: Ms. Mary J. Miller from the Army, Ms. Mary E. Lacey from the Navy, Mr. Kevin Gooder from the Air Force, standing in for Dr. David Walker, who was unable to attend today's hearing, and Dr. Arati Prabhakar from the Defense Advanced Research Projects Agency (DARPA). We welcome all of you and we look forward to your testimony.

Our defense S&T enterprise plays many important roles within DOD. For example, ensuring that today's and tomorrow's warfighters are equipped with the best systems possible, from the most advanced spacecraft to protective gear to defend troops against chemical attacks, to cyber security defenses that protect our networks against hackers; rapidly solving the real problems of our deployed forces, for example, moving quickly to develop new

body armor or defenses against roadside bombs during the operations in Iraq and Afghanistan.

So we know that in some cases our currently deployed systems will not be good enough and more S&T development needs to be done. Delivering capabilities that most warfighters didn't realize they needed or were even possible, things like the Global Positioning System or unmanned aircraft; delivering solutions that are reducing costs. One of the highest priorities these days is the development of energy efficient engines or low-cost manufacturing techniques; and maintaining our technical workforce in universities and industry; and helping create the pipeline of new talent into that workforce.

The enterprise has developed systems that have found their way out of DOD and into the commercial world and general public, growing the economy and changing the way we live, things as small as the computer mouse and as large as the Internet.

This subcommittee has been briefed by Under Secretary Kendall on the changes to our military's technological superiority by our competitors. So we know that in some cases our currently deployed systems will not be good enough and more S&T development needs to be done. Additionally, global commercial industry and foreign research programs are sometimes developing new technologies quicker than we can field new capabilities to our military forces. We need to be better and faster.

Given the importance of these programs, it's surprising to note that the budget request reduces funding for S&T programs by $500 million relative to the fiscal year 2014 appropriations. I want to understand what the impacts of these types of reductions will have on the system.

Beyond the budget reductions, this subcommittee will also look for ways to streamline processes or reduce red tape, to enhance our ability to innovate and deliver new capabilities to our military and to the Nation. I'm interested in hearing your recommendations in this area as well.

Ranking Member Fischer will be here later and we can pause then for her opening remarks.

I do now want to recognize our witnesses. Please give less than 5 minutes of testimony before we move on to questions. With that, we will start with Mr. Shaffer. Thank you.

STATEMENT OF ALAN R. SHAFFER, ACTING ASSISTANT SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING

Mr. SHAFFER. Thank you, Chairwoman Hagan. I am pleased to come before you today to testify about the state of DOD's S&T program and ask that all the members on the panel's statements be placed into the record.

Senator HAGAN. Without objection.

Mr. SHAFFER. I am proud to be here today to represent the roughly 100,000 scientists and engineers in the science and engineering workforce, a workforce with remarkable achievements, but one that has now shown the earlier stages of stress due to downsizing and combined sequester, furlough, and government shutdown challenges of the last year. These events affected the health of our workforce and the programs they execute in ways we

are just beginning to understand. We have begun to address these challenges, but they remain a concern for us.

The 2015 budget request is down about 5 percent, as you said, to $11.5 billion compared to last year's $12 billion appropriation. While the DOD tries to balance our overall program, there are factors that led Secretary Hagel to conclude in his February 2014 budget rollout that we are entering an era where American dominance on the seas, in the skies, and in space can no longer be taken for granted.

DOD is in the third year of a protracted budget drawdown. As highlighted by Secretary of Defense Hagel, there are three major investment areas that comprise DOD's budget: force size, readiness, and modernization. The curbed DOD budget is driving the force size reduction, but this reduction will take several years to yield significant savings. Therefore, in the fiscal year 2016 budget, readiness and/or modernization will pay a larger percentage of the bill.

To address the challenges, we need to examine the strategy we are using to focus the S&T investment on high-priority areas. From that emergent strategy comes investments. DOD invests in S&T first to mitigate new and emerging threat capabilities. We see significant needs in electronic warfare, cyber, weapons of mass destruction (WMD), and preserving space capabilities.

The second reason is to affordably enable new or extended capabilities in existing military systems and future military systems. We see significant need in advanced system engineering, modeling and simulation, and prototyping.

The third reason we invest in S&T is to develop technology surprise. We see significant opportunity in autonomy, human systems, quantum sensing, and big data.

While there are challenges, DOD continues to perform. I would like to highlight some recent successes in some very diverse areas. Advances in understanding the treating of traumatic brain injury (TBI) and in understanding the brain writ large. In addition to the DARPA brain initiative, DOD has developed some successful technologies in this area. The combination of DARPA's small blast gauge to measure blast overpressures and acceleration in the head, coupled with the Defense Health Program's advanced therapeutics and photonic medicine, provides promise to allow us to treat TBI more quickly and effectively.

Photonics advancements show real potential. Growing out of photonic medicine, researchers discovered that intense light outside the skull prevents brain tissue decay after induced by TBIs. This treatment is now in clinical trials.

The second example: The Air Force X–51 Waverider Hypersonic Demonstration, which occurred last year. This was the second successful demonstration of powered scramjet technology, demonstrating that we are getting close to developing a full hypersonic system. No one else in the world has done this even one time.

The Navy is making dramatic progress on High Energy Laser (HEL) systems and the Electromagnetic Rail Gun. In fact, the Navy has been testing and will demonstrate a 32-megajoule multishot electromagnetic rail gun in 2015. This promises to bring a whole new capability to both indirect fires and missile defense.

Finally, the Army is forging the next generation of military helicopters with their Joint Multi-Role Technology Demonstrator, a program currently in the design phase with four vendors, leading to the next generation of military-relevant helicopters.

These successes highlight that, in spite of the difficult year, the DOD S&T program continues to produce and will continue to produce capabilities for our future force. With your continued support, I am confident we will continue to do so in the future.

Thank you.

[The prepared statement of Mr. Shaffer follows:]

PREPARED STATEMENT BY MR. ALAN R. SHAFFER

Madam Chairwoman Hagan, Ranking Member Fischer, members of the committee, I am pleased to come before you today to testify about the state of the Department of Defense's science and technology (S&T) program. I am proud to be here representing the roughly 100,000 scientists and engineers in the science and engineering (S&E) workforce, a workforce that has had remarkable achievements in the past, but is now a workforce showing the early stages of stress due to downsizing and the budget challenges of the last year. This past year has been unlike previous years in our community; the collective impact of the sequester-forced civilian furlough and program curtailment, the October 2013 government shutdown, and the indirect impacts of the sequester, such as restrictions on our young scientists and engineers attending technical conferences, has impacted the health of our workforce and the programs they execute in ways that we are just beginning to understand. We have begun to address these challenges but they remain a concern for us.

INTRODUCTION

The fiscal year 2015 budget request for S&T[1] is relatively stable, when compared to the overall DOD top line[2] and modernization accounts. The DOD fiscal year 2015 S&T request is $11.51 billion, compared to an fiscal year 2014 appropriation of $12.01 billion. This request represents a 4.1 percent decrease (5.8 percent in real buying power) in the Department's S&T compared to Research, Development, Test and Evaluation (RDT&E) account that was virtually unchanged. While we continue to execute a balanced program overall, there are factors that led Secretary Hagel to conclude in his February 24, 2014 fiscal year 2015 budget rollout that "we are entering an era where American dominance on the seas, in the skies, and in space can no longer be taken for granted".[3]

Simultaneous with the challenges of balancing a reduced budget and continuing to engage the total defense workforce in meaningful research and engineering (R&E), the capability challenges to our R&E program are also increasing. This is attributable to changes in the global S&T landscape and the acceleration globally of development of advanced military capabilities that could impact the superiority of U.S. systems. The convergence of declining budgets, in real terms, and increased risk is not a comfortable place to be. However, as I will highlight in the latter sections of my statement, the Department has begun to reshape the focus of our technical programs to address some of our new challenges. We are also beginning to shift our programs to better position the Department to meet our national security challenges. Finally, we have some areas where we need your help in order to be successful executing our fiscal year 2015 budget. I will cover these areas at the end of my statement.

FISCAL YEAR 2015 PRESIDENT'S BUDGET REQUEST

The current fiscal environment presents significant challenges to the DOD budget. The Department is in the third year of a protracted overall topline and RDT&E budget drawdown. As highlighted by Secretary Hagel, there are three major areas that comprise the Department's budget: force size, readiness, and modernization.

[1] Science and Technology is defined as program 6, budget activities 1, 2, and 3; frequently called 6.1, 6.2, and 6.3 (basic research, applied research, and advanced technology development); Research and Engineering adds Advanced Capability Development and Prototyping (6.4).

[2] Top line refers to the total funds appropriated by Congress to include "supplemental" or Oversees Contingency Operations funds

[3] Remarks by Secretary Hagel on the fiscal year 2015 budget preview in the Pentagon Briefing Room on 24 February 2014.

The current budget is driving a force reduction, but this reduction will take several years to yield significant savings. In the fiscal year 2015 budget, readiness and/or modernization will pay a larger percentage of the "bill". As a former airman who entered service in the 1970s, I am very well aware of what happens when savings are gleaned from readiness—the hollow force is not acceptable. Over the next several years of the budget we expect modernization accounts (Procurement and RDT&E) to pay a large portion of the Department's fiscal reduction bill. At the same time, Secretary Hagel's strategy is to protect advanced technologies and capabilities. The fiscal year 2015 budget must balance all of these drivers; we believe we have done well, but do acknowledge there is increased risk.

The last several budgets have been characterized by instability and rapid decline of the modernization accounts. The fiscal year 2013 sequestration reduced all accounts by 8.7 percent; for S&T, this amounted to a loss of about $1 billion. The December 2013 Bipartisan Budget Act increased the discretionary caps in fiscal year 2014 and fiscal year 2015 to provide some relief, but less in fiscal year 2015 than fiscal year 2014. From fiscal year 2013 to 2015, the S&T program operated with reductions of $1.4 billion compared to what had been planned in the fiscal year 2013 budget.

One of the key points for S&T of the fiscal year 2015 budget is a shift in focus at the macro scale from basic research to advanced technology development and a shift from the Services to DARPA to develop advanced capabilities. In fiscal year 2015, we funded DARPA at the same level, after inflation, as was planned in fiscal year 2014 PBR. These numbers are shown in Tables 1 and 2.

	FY 2014 Appropriated ($M)	PBR 2015 (FY 14 CY $M)	% Real Change from FY 2014 Appropriated (FY 14 CY $)
Basic Research (BA 1)	2,167	2,018 (1,982)	-8.55%
Applied Research (BA 2)	4,641	4,457 (4,378)	-5.66%
Advanced Technology Development (BA 3)	5,201	5,040 (4,951)	-4.81%
DoD S&T	**12,009**	**11,515 (11,311)**	**-5.81%**
Advanced Component Development and Prototypes (BA 4)	11,635	12,334 (12,116)	4.14%
DoD R&E (BAs 1 – 4)	**23,644**	**23,849 (23,427)**	**-0.92%**
DoD Topline	496,000	495,604 (486,841)	-1.85%

Table 1— Defense Budget for Science &Technology; Research & Engineering; and DoD Top Line Budget (FY 2014 Appropriated and PBR 2015).

	FY 2014 Appropriated ($M)	PBR 2015 (FY 14 CY $M)	% Real Change from FY 2014 Appropriated (FY 14 CY $)
Army	2,455	2,205 (2,166)	-11.77%
Navy	2,102	1,992 (1,957)	-6.91%
Air Force	2,308	2,129 (2,091)	-9.39%
DARPA	2,707	2,843 (2,793)	3.17%
Missile Defense Agency (MDA)	255	176 (173)	-32.20%
Defense Threat Reduction Agency (DTRA)	476	473 (465)	-2.39%
Chem Bio Defense Program (CBDP)	393	407 (400)	1.73%
Other Defense Agencies	1,313	1,290 (1,267)	-3.49%
DoD S&T	**12,009**	**11,515 (11,311)**	**-5.81%**

Table 2 - Service and Agencies S&T Budgets (FY 2014 Appropriated and PBR 2015)

RESEARCH AND DEVELOPMENT IS NOT A VARIABLE COST

Over the past decade, the research and development (R&D) accounts have been quite variable, but this counters one of the key tenets of R&D investment made by the Honorable Frank Kendall in discussing the fiscal year 2015 budget. There has been a tendency in the past to reduce R&D more or less proportionately to other budget reductions. This tendency, if acted upon, can be detrimental because R&D costs are not directly related to the size of our force or the size of the inventory we intend to support. The cost of developing a new weapons system is the same no matter how many units are produced. In a recent speech, Secretary Kendall explained the invariant nature of R&D this way:

> R&D is not a variable cost. R&D drives our rate of modernization. It has nothing to do with the size of the force structure. So, when you cut R&D, you are cutting your ability to modernize on a certain time scale, period—no matter how big your force structure is.[4]

If we don't do the R&D for a new system than the number of systems of that type we will have is zero. It is not variable.

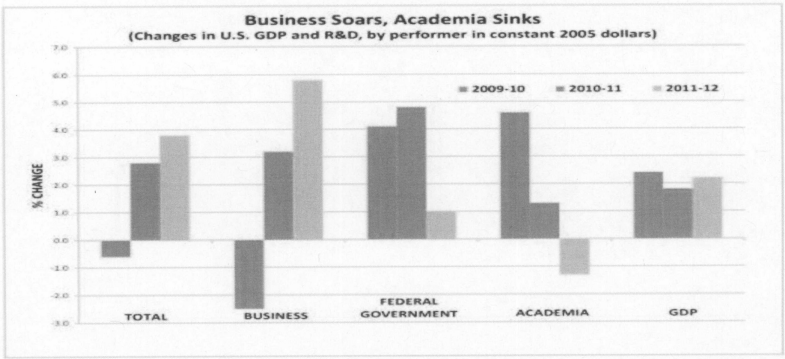
Secretary Kendall said it this way:

[T]he investments we're making now in technology are going to give us the forces that we're going to have in the future. The forces we have now came out of investments that were made, to some extent, in the 1980s and 1990s . . . if you give up the time it takes for lead time to get . . . a capability, you are not going to get that back."[5]

There is another trend impacting the Department's ability to deliver advanced capabilities. Recent data from the Nation Science Foundation shows an upward trend in industry R&D spending compared to a downward trend in Federal Government R&D spending (Figure 1). Industry in the United States performs roughly 70 percent of the Nation's R&D with the Federal Government and academia making up the remaining 30 percent. Figure 1 also shows the dependence of academic researchers on Federal Government funding, as noted by the National Science Board:

Most of U.S. basic research is conducted at universities and colleges and funded by the Federal Government. However, the largest share of U.S. total R&D is development, which is largely performed by the business sector. The business sector also performs the majority of applied research.[6]

This implies that DOD needs to be more cognizant of industry R&D as part of our overall capability development and remain sensitive to the importance of federally funded academic research. We continue to push in these areas through our continued support of the university research portfolio and our recent emphasis on Independent Research and Development (IR&D).



[4] Honorable Frank Kendall presentation to McAleese/Credit Suisse Fiscal Year 2015 Defense Programs Conference on 25 February 2014.

[5] Kendall, 25 February 2014.

[6] National Science Board. 2014. Science and Engineering Indicators 2014. Arlington VA: National Science Foundation (NSB 14–01).

Figure 1—Changes in U.S. GDP and R&D by Performer [7]

SCIENCE AND ENGINEERING WORKFORCE

The Department's scientist and engineering (S&E) workforce consists of in-house labs, engineering centers, test ranges, acquisition program offices and so forth, and is augmented by our partners in the federally funded research and development centers (FFRDCs) and University Affiliated Research Centers (UARCs). The talented scientists and engineers working within these organizations form the foundation of the Department's technology base and are responsible for conceiving and executing programs from basic research through demilitarization of weapon systems. The technical health of this workforce is a priority for me and the Department.

Our in-house labs have been designated by Congress as Science & Technology Reinvention Laboratories (STRL) providing the directors of these facilities special authorities to manage their workforce via pay-for-performance personnel systems. Each director is granted flexibility to create workforce policies unique to his/her lab with new personnel initiatives being transferable to other STRLs if proven to be effective in the hiring, retention and training of S&Es. Each year my office works with the Services and their labs to ensure they have the authorities our lab directors need. Recent accomplishments include direct hiring authority for bachelors, masters and doctoral level graduates, increase in the number of technical senior executive billets, and authority for lab directors to manage their workforce based upon available budgets.

Data from the Strategic Human Capital Workforce Plan published in September 2013 indicates that our lab workforce is getting older. From 2011 to 2013, the average age of our scientists and engineers in our labs has grown from 45.6 years to 45.7 years for scientists and from 43.2 years to 43.9 years for our engineers. Although the change seems minimal over the past 2 years, it reverses the trend over the past decade when we had been driving the average age down. Data from the Science and Technology Functional Community indicate that the combination of fewer new hires and retirement-eligible employees working longer both contribute to the increase in average age. In 2013, there were only 731 new hires in the S&T Functional Community, whereas in 2010 there were 1,884. In 2010, retiring workers were retirement-eligible for an average of only 4.1 years. From 2011–2013, that average grew to 4.5 years. The trend indicates that we may not be replacing our seasoned employees with enough young scientists and engineers who will shape our future. This could be an indicator of older employees working longer because of a down economy or it could be an indicator that we are not hiring or retaining enough young scientists and engineers.

Although anecdotal, we are seeing a trend in why younger workers may be leaving. We saw a number of young scientists and engineers leave in 2013, early in their career. In conducting exit interviews, our laboratory directors reported that these young workers consistently cited travel and conference restrictions, as well as perceived instability of a long-term career as motivating factors for their departure. This information, although anecdotal, is of concern; consequently, we are attempting to gather data to see if we can discern a definite signal.

Another area of significant Department and national interest is building a robust science and engineering workforce through various Science, Technology, Engineering, and Mathematics (STEM) initiatives. My office recently created the STEM Executive Board who has the authority and continues to provide strategic leadership for the Department's STEM initiatives.

Significant change to the Federal portfolio of STEM programs has occurred over the past year. In response to the requirements of the America Competes Reauthorization Act of 2010, Federal STEM-education programs were reorganized with the goals of greater coherence, efficiency, ease of evaluation, and focus on the highest priorities. This resulted in the Federal STEM Education 5-Year Strategic Plan designating the Smithsonian, Department of Education and National Science Foundation as lead agencies in implementing this plan. The DOD STEM Strategic plan is aligned with the Federal plan to achieve Federal and Departmental STEM education goals.

We are also developing department-wide guidance on STEM program evaluation, coordinating within the Department and across the Federal Government to improve effectiveness and efficiencies in these investments in future workforce needs. A DOD STEM Annual Report, expected to be delivered in fiscal year 2015 based on fiscal year 2014 data, will communicate the activities and results in achieving Departmental goals.

[7] Science magazine, 13 January 2014, Retrieved from http://news.sciencemag.org.

In summary, budget constraints, furloughs, and conference and travel restrictions have contributed to a drain on our most valuable resource—people. To replace our losses and rebuild our workforce for the future, we are working on bringing stability back to our S&E programs, give our people challenging while enriching environments in which to work.

CHALLENGES TO MAINTAINING TECHNOLOGICAL SUPERORITY

The United States has relied on a DOD that has had technological superiority for the better part of the post-World War II era. There are factors that are converging such that the DOD maintaining technological superiority is now being challenged. These challenges come from both changes in the way technology matures and in advanced capabilities being developed in the rest of the world. The Department is emerging from over a decade of focusing on countering terrorism and insurgency. While the challenges of counter terrorism remain, new national security challenges are emerging. Other nations are developing advanced capabilities in areas such as: cyber operations, advanced electronic warfare, proliferation of ballistic missiles for strategic and tactical intent, contested space, networked integrated air defenses, and a host of other capabilities stressing the Department's capability advantages. The Department's S&T program is being re-vectored to meet these new challenges. In addition, the Department is shifting to a focus on the Asia-Pacific region, a region with unique and challenging geographic and cultural features. Most notably, the geographic extent of the Asia Pacific region adds new challenges in terms of fuel efficiency and logistics.

In short, the Department and Nation are at a strategic crossroads—the funds available to the Department (and national security infrastructure in general) are decreasing, while the complexity and depth of the national security challenges are growing. The world we live in is an uncertain place. Secretary Hagel said it best in his recent roll out of the fiscal year 2015 budget:

> "The development and proliferation of more advanced military technologies by other nations that means that we are entering an era where American dominance on the seas, in the skies, and in space can no longer be taken for granted."[8]

Secretary Hagel went on to say:

> "To fulfill this strategy DOD will continue to shift its operational focus and forces to the Asia-Pacific, sustain commitments to key allies and partners in the Middle East and Europe, maintain engagement in other regions, and continue to aggressively pursue global terrorist networks."[9]

Global Changes in S&T Impact Technology Development

The nature of the international technology landscape is much different than it was even 20 years ago in two fundamental ways:

(1) Many technologies of importance to the Department's capability developments are driven by the commercial sector, and have become a global commodity.
(2) The pace of maturation of technology is accelerating; that is, technology maturation occurs on a more rapid scale than in the past.

Our DOD S&T community needs to identify areas where technology has become a global commodity and not expend resources working to develop the same capability. We must track global technology developments, harness them and apply the technology to our needs. This year, we have initiated a project at the Defense Technical Information Center to improve our ability understand global technology development, and are in pilot phase to use automated tools to assess technology advances.

We already know that industry drives most microelectronics and semiconductors development; older infrared focal planes, routine communications, computers. The technology coming from these sectors is sufficient to meet most DOD capability needs. The DOD should be an adopter, not a leader in these areas while addressing the unique security concerns of these technologies used in our military, cyber and IT systems. The DOD should focus our research in technology integration or in developing technologies into products at performance levels beyond those commercially available or planned. Examples would include electronic travelling wave tubes (led by Naval Research Lab), which provide higher frequency and higher power output than is needed in commercial applications; and infra-red (IR) "super lattice" semi-

[8] Remarks by Secretary Hagel on the fiscal year 2015 budget preview in the Pentagon Briefing Room on 24 February 2014.
[9] Hagel, 24 February 2014.

conductors (led by the Army's Night Vision Laboratory), which give high enough resolution in IR to make "movies" out of simple data and images. The DOD should monitor and apply these technologies to meet our needs.

At the same time, we know that the time to mature many technologies is decreasing. We have seen the time from invention to market penetration decrease by a factor of two over the past half century. Consequently, I would like to cite comments made by Mr. Frank Kendall, Under Secretary of Defense for Acquisition, Technology, and Logistics, who states that one of the key factors to maintaining technological superiority is to maintain a steady investment in technology.

"The effects of time (lost) cannot be reversed. It is well understood in the R&D community, and most particularly in the S&T community, that the investments we make today may not result in capability for a generation. It takes upwards of 5, 10, even 20 years to develop a new system, test it, and put it into production. By taking higher risks and accepting inefficiencies and higher costs we can reduce the "time to market" of new weapon systems; in fact, we have reduced this time . . . with reforms put in place in recent years."

Even during World War II we fought with the systems that had been in development for years before the war began. We can shorten, but not eliminate the time required to field new cutting edge weapons systems. But one thing is for sure, if we do not make R&D investments today, we will not have the capability in the future.

Capability Changes to DOD Technology Superiority

More significant than the changes in how technology is developed and delivered globally are changes in military capabilities being developed by other nations.

I will cite just one example; there are many more. The convergence of advanced digital signals and computer processing has given rise to proliferation of a new class of system—the digital radio frequency memory (DRFM) jammer. DRFM jammers are fairly inexpensive electronic systems that ingest the radar (or communications) signal, analyze the digital waveform, and then generate random signals, with the same waveform, back to the transmitting radar receiver. The result is the radar system sees a large number of "electronic" targets. If the United States employed conventional weapons systems using the traditional methods, we could shoot at or chase a lot of false targets. The consequence is that the United States needs to develop a counter to DRFM jammers.

The convergence of computer processing, digital signal processing, digital electronics, optical fibers, and precise timekeeping are giving rise to inexpensive enablers that can improve the ability to counter conventional weapons platforms. We are starting to see other nations advance technologies to counter U.S. overmatch by combining the components listed above to enhance capabilities in electronic warfare, longer range air-to-air missiles, radars operating in non-conventional bandwidths, counter-space capabilities, longer range and more accurate ballistic and cruise missiles, improved undersea warfare capabilities, as well as cyber and information operations. We see these types of new capabilities emerging from many countries; to include China, Iran, Russia and North Korea. This has led to a situation where, in the next 5 to 10 years, U.S. superiority in many warfare domains will be at risk. Accordingly, the following section highlights some of the areas where we are watching.

Proliferation of Weapons of Mass Destruction

The 2013 National Security Interests published by the Chairman of the Joint Chiefs of Staff lists as the top priority interest "Survival of the Homeland". The one existential threat to the United States comes from Weapons of Mass Destruction (WMD). Traditionally, WMD has included nuclear, chemical and biological weapons and their delivery systems. The emergence of new countries with nuclear ambitions, such as North Korea and Iran, make today's world much more dangerous. Chemical and biological weapons, used in both World Wars, have been resurgent in the past 2 decades. Perhaps the gravest danger for the United States and the rest of the world is the possibility of WMD falling into the hands of terrorist groups and other groups in the midst of instability. We must continue our vigilance in this area and continue to develop ways to deal with their use.

The United States is currently rebalancing to the Asia Pacific region. As we do so, the Department is faced with a host of new challenges. I will discuss some of the challenges over the next several paragraphs.

Vulnerability of the U.S. Surface Fleet and Forward Bases in the Western Pacific

U.S. Navy ships and Western Pacific bases are vulnerable to missile strikes from ballistic and cruise missiles already in the inventory. China has prioritized land-based ballistic and cruise missile programs to extend their strike warfare capabili-

ties further from its borders. Chinese military analysts have concluded that logistics and power projection are potential vulnerabilities in modern warfare, given the requirements for precision in coordinating transportation, communications, and logistics networks. China is fielding an array of conventionally armed ballistic missiles, ground- and air-launched land-attack cruise missiles, special operations forces, and cyber-warfare capabilities to hold targets at risk throughout the region. The most mature theater missiles are the DF–21 C/D, which both have 1,500 km radius. They are also developing a longer range missile that would be able to strike as far as Guam. These ballistic missiles are coupled with advanced cruise missiles that could threaten any surface warfare fleet by 2020.

The People's Liberation Army (PLA) Navy has the largest force of major combatants, submarines, and amphibious warfare ships in Asia. China's naval forces include some 79 principal surface combatants,[10] more than 55 submarines, 55 medium and large amphibious ships, and roughly 85 missile-equipped small combatants. The first Chinese-built carrier will likely be operational sometime in the second half of this decade. In the next decade, China will likely construct the Type 095 guided-missile attack submarine (SSGN), which may enable a submarine-based land-attack capability. In addition to likely incorporating better quieting technologies, the Type 095 will likely fulfill traditional anti-ship roles with the incorporation of torpedoes and anti-ship cruise missiles (ASCMs). Since 2008, the PLA Navy has also embarked on a robust surface combatant construction program of various classes of ships, including guided missile destroyers (DDG) and guided missile frigates in addition to more modern diesel powered attack submarines.

U.S. Air Dominance. We see the same trend—development of systems to push U.S. freedom of movement further from the Asia mainland. China is developing an integrated air defense system that could challenge U.S. air dominance and in some regions, air superiority is challenged by 2020. The challenge to our air dominance comes primarily through the aggregation of capabilities starting with an extensive integrated air defense system (IADS), moving to development of advanced combat aircraft, to enabling technologies, primarily electronic warfare capabilities. China is demonstrating a systems approach through advanced aircraft design of fifth generation fighters, advanced combat systems, and advanced dense long range, networked air defense systems. It should be noted that others (such as Iran, Syria, and North Korea) are developing well integrated air defense systems. The PLA Air Force is continuing a modernization effort to improve its capability to conduct offensive and defensive off-shore operations such as strike, air and missile defense, strategic mobility, and early warning and reconnaissance missions. China continues its development of stealth aircraft technology, with the appearance of a second stealth fighter following on the heels of the maiden flight of the J–20 in January 2011, a fifth generation fighter scheduled to enter the operational inventory in 2018.

Vulnerability of U.S. Satellites in Space

China has been rapidly expanding both the number, and quality of space capabilities; expanding its space-based intelligence, surveillance, reconnaissance, navigation, meteorological, and communications satellite constellations. In parallel, China is developing a multi-dimensional program to rapidly improve its capabilities to limit or prevent the use of space-based assets by others during times of crisis or conflict.

China continues to develop the Long March 5 (LM–5) rocket, intended to lift heavy payloads into space, doubling the size of the Low Earth Orbit (LEO) and Geosynchronous Orbit (GEO) payloads China can place into orbit. During 2012, China launched six Beidou navigation satellites completing a regional network and the in-orbit validation phase for the global network, expected to be completed by 2020. From 2012–2013 China launched 15 new remote sensing satellites, which can perform both civil and military applications. China will likely continue to increase its on-orbit constellation with the planned launch of 100 satellites through 2015. These launches include imaging, remote sensing, navigation, communication, and scientific satellites, as well as manned spacecraft.

RESEARCH AND ENGINEERING STRATEGY

To address the challenges of an accelerating, globalized research and development environment coupled with pressurized DOD budgets and the rapid growth of capabilities in other nations, we needed to examine the strategy we are using to focus the DOD investment on high priority areas.[11] To develop the research and engineer-

[10] As of 2013.

[11] While the priorities listed below capture the cross-DOD priorities, there are still individual Service priorities they must address. These priorities do not address naval responsibilities for

ing strategy, we had to go back to first principals. Why does the Department conduct research and engineering? What does the Department expect the DOD R&E program to deliver? After examination, we contend the Department conducts research and engineering for three reasons, in priority order:

(1) Mitigate new and emerging threat capabilities—the Department must defend the homeland and overseas forces and national interests against threats that exist today, and threats that are still in development.
(2) Affordably enable new or extended capabilities in existing military systems—Coincident with a tighter budget, and the fact that time is not recoverable, the DOD R&E program should focus on controlling costs, both in existing and future weapons systems.
(3) Develop technology surprise—Finally, throughout the past century, the Nation and the Department have looked to the Department's R&E program to continually develop and mature new capabilities that surprise potential adversaries.

PRIORITY 1: MITIGATING OR ELIMINATING NEW AND EMERGING THREATS TO NATIONAL SECURITY

The Department must be prepared to meet its current and future national security missions, which include defending the Homeland, securing freedom of navigation, and being able to project power. The research and engineering priorities inherent in this principal also include protecting the Nation against nuclear, chemical, and biological weapons, from both state and non-state actors. This principal also includes protecting the Nation against new threats, such as cyber operations and the proliferation of cruise missiles and UAVs. The final emerging vector in this area is to find solutions to the new capabilities that would prevent the U.S. Armed Forces from fulfilling our global mission, such as electronic warfare and maintaining space capabilities.

Countering Weapons of Mass Destruction

The Department's investment in countering weapons of mass destruction (C–WMD) is made primarily by the Defense Threat Reduction Agency and the Chemical Biological Defense Program, as well as the Army. All totaled, the Department's investment in C–WMD is about $800 million per year. C–WMD poses some unique challenges because of the urgency and immediacy of the threats, the fact that threats present low probability but high consequence events, and that there is a need for on-call, comprehensive expertise. The Defense Threat Reduction Agency emphasis for fiscal year 2015 include kinetic and non-kinetic means to counter and defeat WMD in non-permissive environments, low visibility search (and identification) for all threats (nuclear and chemical/biological), global situational awareness through mining large, diverse datasets, application of autonomy to reduce risk to the human, persistent intelligence, surveillance and reconnaissance (ISR) for WMD, WMD modelling and simulation, and operating in a high electromagnetic pulse environment. To date, we have not identified the "silver bullet" solution, so a sizable portion of the C–WMD program involves international and interagency partnership.

Emerging trends over the last year includes the need to counter threats as far "upstream" or left of event as possible. Therefore, the entire C–WMD community is strengthening their program to interdict/render safe WMD before they are used.

Missile Defense

In fiscal year 2015, the investment in missile defense S&T dropped from roughly $350 million in fiscal year 2014 to $176 million in fiscal year 2015. Yet, missile defense remains a priority. The reduction in missile defense is more than offset the Navy and by the Office of the Secretary of Defense efforts in electromagnetic rail gun technology; a nearly $200 million investment in fiscal year 2015. This push in rail gun is being made to determine if the technology is mature enough to field an inexpensive, kinetic kill system to intercept theater ballistic missiles in terminal and mid-course. The current investment supports demonstration of an advanced rail gun against a missile surrogate in 2015.

Although not a capability that will be fielded soon, the Missile Defense Agency continues to look at Directed Energy for missile defense. They are the primary investor in both hybrid (diode pumped alkaline laser) and fiber lasers. Significant demonstrations for both of these directed energy capabilities will occur in 2015 to 2016.

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the Ocean, Army responsibilities for the ground or Air Force for the Air. Rather, they comprise a set of areas that must be addressed across component. It is interesting to note the large efforts in the Services and DARPA largely align with the strategy.

A strategy based on only kinetic defense which requires a high-end U.S. missile intercept against this proliferation of missiles is cost-imposing on the United States. Our research and engineering program is also working on developing non-kinetic capabilities and less expensive kinetic capability to reduce the effectiveness of potential adversaries' missiles; we are making strides in this area.

Cyber and Information Operations

The Department's investment in Cyber S&T in fiscal year 2015 is $510 million. With the growing reliance of modern military forces on information technology, cyber operations will play an increasingly important role in ensuring continuity of missions in the physical domains. Having effective technologies to support those cyber operations makes cyber security research an essential element in our long-term abilities to defend the Nation.

This year, the Department rebuilt the cyber S&T investment around warfighting capability requirements. We have then built a strong integrated technical foundation across the Cyber research and engineering enterprise through our Cyber Community of Interest, a group made up of Senior Executive Service representatives from the Services, NSA, and my organization. Our cyber S&T investments are guided by an S&T Capabilities Framework that captures new and emerging mission requirements including improved situation awareness and course of action analysis. The framework has been developed with participation of all the Services as well as the Intelligence Community, National Laboratories, and our federally Funded Research and Development Centers. We are placing emphasis on broadening the research beyond standard computing systems to include defending against cyber threats to tactical and embedded systems. Our cyber research includes investments in providing a testing and evaluation environment for the experimentation and testing of cyber technology across the full spectrum of capabilities to help validate and accelerate research. Additionally, and very importantly, it is a priority for the DOD to be an early adopter of emerging technologies in cyber defense and to ensure the transition of those products to our warfighters and the programs supporting them.

Though challenges remain in all areas, Cyber S&T is making progress and having significant impacts. Over the past few years, our cyber investments, from fundamental research through advanced technology demonstrations have resulted in many successes that directly benefit our warfighters and the broader defense enterprise. Some highlights are:

- Securing our telecommunications infrastructure through vulnerability assessment, tool development, and best practice dissemination;
- Developing technologies to accurately geo-locate illicit commercial wireless devices to protect our networks;
- Producing a gamechanging approach to signature-free malware detection capable of defending against zero-day attacks;
- Designing a flexible, mission-based interoperability framework enabling rapid, low-cost capability integration for our cyber operation forces; and
- Developing tools and techniques that assure the secure operation of microprocessors within our weapons platforms and systems.

This year, in concert with White House Priorities,[12] we created the Cyber Transition to Practice (CTP) Initiative. The goal of this initiative is to mature and ultimately transition S&T products to operational use. The development of cyber tools frequently happens on a time scale much less than the traditional acquisition process. The CTP initiative is intended to accelerate fielding of cyber tools.

Loss of Assured Space

Other nations have developed both kinetic and non-kinetic means to degrade or deny the U.S. space layer. Consequently, the DOD S&T program is working on developing the space capabilities our forces rely on whether or not the space layer exists. The capability may be degraded, but will also not be vulnerable. Other nations are seeking to asymmetrically disrupt our military capabilities that depend upon assured satellite communications; global systems for positioning, navigation, and timing; and on-demand ISR, even in denied areas. The United States will respond to these actions through increasing the resilience of our space assets so they are free from interference as well as develop alternative means to deliver the capabilities we currently obtain from our space assets.

Current technologies in development include, but are not limited to the following: improving our space situational awareness capabilities employing improved ground- and space-based systems (such as the Air Force Research Lab's 2006 demonstration

[12] This is in direct response to the NSS Cybersecurity fiscal year 2014 Budget Priority of September 11, 2012 (section 4.a of the annex).

of on-orbit, localized Space Situational Awareness), enhanced terrestrial and airborne communications or jam resistant communications (such as laser communications); novel timing devices decoupled from continuous access to global positioning system (GPS) (like the Tactical Grade Atomic Clock, projected for transition to the acquisition community in 2017); high performance Inertial Measurement Units (like DARPA's High Dynamic Range Atom Sensor (HiDRA), projected for 2016, and small-form-factor anti-jam GPS antennas); and alternative ISR capabilities (which may incorporate advanced electro-optic coatings and thermal protections measures under development at the Air Force Research Lab). Finally, we have several Joint Capability Technology Demonstrations (JCTDs) to determine the viability of capabilities delivered from very small satellites. Kestrel Eye and Vector JCTDs will demonstrate the viability of small satellite tactical communications and ISR by 2016.

Electronic Warfare (Both Attack and Protection)

The Department's investment in electronic warfare (EW) S&T is about $500 million per year. This is an area that is evolving rapidly because of technology advances. The two key parameters in EW are the frequency the system operates and how complex is the signal. The concept behind electronic warfare is simple—the goal is to control your electronic signature or confuse an opponent's system if you are defending and to simplify the overall situation (reject false targets and clutter) if you are attempting to use your own electronic systems (radar, communications and radio frequency).

Electronic warfare is becoming important and more critical because the enabling technologies underlying frequency and complexity are progressing very rapidly. To address the underlying technologies, the components have coalesced around a concept called Advanced Components for EW (ACE), which is focusing on Integrated Photonic Circuits, Millimeter Wave, Electro-Optical and Infrared (EO/IR), and Reconfigurable and Adaptive RF electronics. As a whole, these technologies should improve simultaneous transmit and receive; expand instantaneous bandwidth, and allow a huge leap ahead in complexity. ACE kicked off in fiscal year 2013, with the components continuing to develop components.

In addition to the underlying technology, the Services are involved in building advanced electronic systems. We will cover two of them. The Navy's Integrated Topside program is just completing attempting to use multifunction transmitters on the top of a ship. This will reduce the number of individual systems with a unique electronic signature, and improve ship survivability.

The Home on GPS–Jam (HOG–J) is a small munition that will identify foreign GPS jammers and vector the munition into the jammer. HOG–J has had some preliminary successful tests, and could be ready to enter the inventory in 2–3 years. There are other EW systems that could be covered at the appropriate security level.

PRIORITY 2: AFFORDABLY ENABLING NEW OR EXTENDING MILITARY CAPABILITIES

The cost of Defense acquisition systems continues to be a challenge for the Department. Over the past 3 years, the Department introduced "Better Buying Power" initiatives to improve the cost effectiveness of the Defense acquisition system. Cost effectiveness and affordability of defense systems starts before the acquisition enterprise kicks in. There are two vectors to increasing affordability; technology to lower cost and extend life cycle, and research and engineering processes to address costs early in system development.

Systems Engineering

The Department's systems engineering capability and capacity are critical to enabling affordability across the system life cycle of an acquisition program. The Department's systems engineers drive affordable designs, develop technical plans and specifications to support cost-effective procurement, and conduct trade-off analyses to meet program cost, schedule, and performance requirements. Systems engineers are enabling strategies to identify opportunities to reduce life-cycle costs. My organization has taken a lead role in improving the Department's ability to achieve affordable programs through strong SE policy, guidance, dissemination of best practices, execution oversight and support for a healthy, qualified engineering workforce.

Through an emphasis on affordability in recently updated policy and guidance, the Department has established a clear role for systems engineers in defining, establishing, and achieving affordability goals and processes throughout the life cycle. Through required systems engineering trade space analyses, individual acquisition programs establish the cost, schedule and affordability drivers and can demonstrate the cost-effective design point for the program.

These trade space analyses will be conducted across the program's lifecycle to continuously assess system affordability and technical feasibility to support require-

ments, investments, and acquisition decisions and depict the relationships between system life-cycle cost and the system's performance requirements, design parameters, and delivery schedules. Recent emphasis on better reliability engineering has focused the Department's acquisition programs on reducing overall lifecycle costs. My systems engineering staff maintains regular and frequent engagement with acquisition programs to support the planning and execution of effective technical risk management, as well as affordability considerations. They provide regular oversight and guidance to assist the programs as they mature through the lifecycle.

Developmental Test and Evaluation

Developmental Test and Evaluation (DT&E) efforts focus on engaging major acquisition programs early in their lifecycle to ensure efficient and effective test strategies, thereby ensuring a better understanding of program technical risks and opportunities before major milestone decisions. In 2013, the Deputy Assistant Secretary of Defense for Developmental Test and Engineering (DASD(DT&E)) introduced the "shift left" concept—specifically to drive DT earlier in the acquisition process. Early DT&E engagement with programs not only reduces acquisition costs through efficient testing, but finding and fixing deficiencies early, well before production and operations, drastically reduces overall lifecycle costs. The DASD(DT&E) is focusing on a few key areas to improve the overall effectiveness of developmental test and evaluation; use of the Developmental Evaluation Framework, increased emphasis on testing in a mission context, earlier cyber security testing, and an increased emphasis on system reliability testing.

The Developmental Evaluation Framework is a disciplined process that results in a clear linkage between program decisions, capability evaluation, evaluation information needs, and test designs. Using the Developmental Evaluation Framework provides an efficient, yet rigorous T&E strategy to inform the program's decisions. Developmental Test and Evaluation is also moving beyond the traditional technical test focus to include testing in a mission context to characterize capabilities and limitations before production. Robust DT&E should also include early cyber security testing that previously was not tested until late in the acquisition life cycle, where deficiencies are costly to fix. Finally DT&E is focusing on increased system reliability testing. System reliability is a major driver in the affordability of future weapon systems. Improved reliability information early in the program allows acquisition leadership to understand the program technical and cost risks and take steps to improve system reliability and therefore the affordability of the system.

Prototyping

Another way to drive down costs of weapons systems is through the expanded use of prototypes, which we use to prove a concept or system prior to going to formal acquisition. Consequently, in fiscal year 2015, we look to expand the use of developmental and operational prototyping to advance our strategic shift to a greater emphasis on future threats. In fiscal year 2015, the Department's investment in prototypes or prototype like activities is around $900 million. This includes activities that are not classical prototype efforts, but will demonstrate capabilities, such as the Navy's Future Naval Capabilities, Integrated Naval Prototypes, the Army's Joint Multi-role Helicopter and Future Fighting Vehicle, as well as Air Force Flagship programs, and the revamping of the Department's Joint Capability Technology Demonstrations and Emerging Capabilities Technology Development programs.

The RAND Corporation provides a good definition for prototyping, describing it as "a set of design and development activities to reduce technical uncertainty and to generate information to improve the quality of subsequent decisionmaking."[13] We distinguish between two types of prototyping activities. Developmental prototyping demonstrates feasibility of promising emerging technologies and helps those technologies overcome technical risk barriers. Operational prototyping focuses on assessing military utility and integration of more mature technologies.

A recent example of an operational prototype is Instant Eye, a one pound quadcopter. We outfitted Instant Eye with an electro-optical camera and IR illuminator, bringing a field repairable, overhead surveillance capability to the soldier in the field at a unit cost of less than $1,000. Instant Eye would go on to provide targeting information for the neutralization of seven insurgents waiting to ambush a U.S. combat patrol.

Joint Multi-Effects Warhead System (JMEWS) is a good example of a higher-risk, higher reward developmental prototype. The JMEWS project took on the challenge of in-flight targeting and re-tasking of the Tomahawk Land Attack Missile (TLAM).

[13] "From Marginal Adjustments to Meaningful Change", pg. 64, Jeffrey Drezner and Meilinda Huang, RAND Corporation, 2010.

JMEWS' flexible lethality increases the combat power of these expensive weapons by tailoring the TLAM flight profile for best effect, taking advantage of information often not available until after the weapon has launched. With the developmental prototyping effort demonstrating the essential technical aspects, all that remains for Navy is to integrate JMEWS into the TLAM program of record.

Throughout the history of the Department, periods of fiscal constraint have been marked by the use of prototypes to mature technology and keep design teams active in advancing the state of practice. We will use prototyping to demonstrate capability early in the acquisition process. Prototyping will also be used to improve capability development methods and manufacturing techniques, evaluate new concepts, and rapidly field initial quantities of new systems. Prototyping's ability to evaluate and reduce technical risk, and clarify the resource picture that drives costs makes it a critical piece of the larger research and engineering strategy. Put simply, by prototyping in research and engineering, we can focus on key knowledge points and burn down the risk before the risk reduction becomes expensive.

Energy and Power

Energy and Power Technology has a strong focus of reducing DOD operational energy risks and costs. Power requirements of new DOD systems continue to grow every year, and energy is a major cost driver and logistic burden. The Department spends approximately $300 million per year on Energy and Power science and technology. Some significant programs are:

Unmanned Underwater Vehicles—Air Independent Propulsion (UUV–AIP)

The Navy program is developing and delivering long endurance, scalable air-independent propulsion solutions for UUVs. Highly efficient fuel cell technologies will provide extended mission duration in excess of 60 days, well beyond the current and projected capability of batteries. Fuel cells are also being assessed by other Services to extend duration of UAVs and UGVs. These systems are already spinning out to industry.

The Integrated Vehicle Energy Technology (INVENT)

The Air Force INVENT program is developing power and thermal management technologies and architectures that not only address today's aircraft performance limits but also work with adaptive cycle engines to enable next generation gamechanging high power airborne capabilities. There are related Service initiatives to realize higher performance, more fuel efficient designs for rotorcraft and ground vehicles.

Advanced Vehicle Power Technology Alliance (AVPTA)

The Army is working collaboratively with DOE (with secondary partners from the National Labs, industry and academia) to accelerate energy-related R&D initiatives into new vehicle designs. Current efforts include: (1) advanced combustion, engines and transmission with the help of Sandia National Laboratory; (2) examination of lightweight structures for vehicles (partnering with General Dynamics); (3) energy recovery and thermal management for improved efficiency and reduced emissions (industry partner, Gentherm); (4) advanced fuels and lubricants; (5) integrated starter-generators (ISGs) without rare earth permanent magnet materials (partners, Remy Intl and Oak Ridge National Laboratory); and (6) computer-aided engineering for electric drive batteries (CAEBAT).

Engineered Resilient Systems

To address the need for more affordable and mission-resilient warfighting systems, we are developing an integrated suite of modern computational modeling and simulation (M&S) capabilities and engineering tools aligned with acquisition and operational business processes to transform engineering environments under the Engineered Resilient Systems (ERS) initiative. The ERS tool suite allows warfighters, engineers, and acquisition decisionmakers to rapidly assess the cost and performance of potential system designs by providing many data-driven alternatives resulting in systems which are less sensitive to changes in external threats, mission needs, and program constraints. ERS has already demonstrated that the insertion of advanced S&T models, tools and techniques into early phases of engineering processes and decisionmaking will positively impact effectiveness, affordability and sustainability of defense systems, thus addressing these most critical challenges head on. These new M&S-based frameworks adopt the most advanced design and modeling approaches of government, industry and academia to enable our Nation to meet emergent threat, while insuring that we can do that affordably, today and in an uncertain future.

PRIORITY 3: CREATING TECHNOLOGY SURPRISE THROUGH SCIENCE AND ENGINEERING

The third and final reason the Department conducts research and engineering is to create surprise to potential adversaries. Previous Department of Defense investment in basic and applied research has a long history of developing technologies that led to superior capabilities. The DOD research program led to stealth, the internet, synthetic aperture radar, precision weapons, infra-red focal planes and night vision devices, among others. Frequently, when investing in basic research, we don't know the specific application that will emerge; in fact, by definition, basic research is conducted without a specific product or system in mind.

The Department invests in a structured way to create surprise. Creation of surprise requires a robust basic research program coupled with a strong applied research. While it is not really possible to know where technology surprise will come from, there are several areas that highlight the possibility; we will discuss several of them in increasing level of maturity. The least mature is quantum science, followed by nanotechnology, autonomous systems, human systems, and then finally, directed energy systems.

Quantum Sciences

The discoveries a century ago of the quantum properties of the atom and the photon defined and propelled most of the new technology of the 20th century—semiconductors, computers, materials, communication, lasers—the technological basis of much of our civilization. Now, the next quantum revolution may define new technological directions for the 21st century, building upon the intersection of quantum science and information theory. Consequently, the DOD is increasing its basic research investment in Quantum Information Science (QIS). QIS exploits our expanded quantum capabilities in the laboratory to engineer new properties and states of matter and light literally at the atomic scale. We are already developing new capabilities in secure communication, ultra-sensitive and high signal to noise physical sensing of the environment, and a path to exponentially faster computing algorithms in special purpose computers. The DOD research funding has driven quantum sciences in the past decade. This funding has led to the demonstration to measure time through cold atom research at 1000 times more accurate than GPS. Using quantum sciences, the DOD is likely within 10 years of fielding an affordable timekeeping system that will cut our tether to GPS. We are building in the laboratory gravity sensors of unprecedented sensitivity, opening the possibility of remote detection of tunnels (or submarines). Other military applications are just being realized, but quantum science is a technology that will provide surprise.

Nanoengineering/Nanotechnology

QIS is based on the ability to control atoms. Nanoengineering also deals with the ability to develop and engineer systems at the molecular level. This will, in turn, lead to new system level capabilities. For instance, one of the limitations to systems like directed energy is thermal management. By designing systems at the molecular level, it is possible to increase thermal management by several orders of magnitude. Materials like "metamaterials" (engineered materials for specific properties) provide a promise of development of radars and electromagnetic systems that operate much more effectively at much broader frequency ranges. Metamaterials are especially intriguing because through clever design and dissimilar materials integration, properties that are never seen in nature's materials may be obtained. An example from the Navy's fundamental research realm is the investigation of a metamaterial suitable for antennas. This material system could become transparent to radio frequency waves when exposed to high power radio frequency radiation or pulses, preventing the coupling of this energy to an aircraft's electronic systems and, thereby, avoiding damage. Engineered nanomaterials and nanotechnology research remain very competitive in our research portfolio for their potential to provide capability advantage. Both the Navy and Army have explored coatings based on materials with nanometer dimensions that have wear and corrosion resistance superior to traditional and often hazardous metals. Most recently a nanocrystalline coating based on nickel-tungsten alloys has demonstrated properties exceeding hard chromium coatings without the potential environmental problems of chromium. One of the most exciting applications for engineered nanomaterials for defense and the whole economy is catalysts. The Air Force is supporting research on nanoparticle catalysts that are much more efficient in eliminating methane, a greenhouse gas, from exhausts while using the same quantity of the precious metal palladium and the rare earth element cerium. Energetic nanomaterials comprise one area of nanotechnology that is of interest primarily to defense at this time. The Army is examining highly reactive, energetic materials based on metals and metal oxides that are much less sensitive that traditional explosives. Because the DOD is committed to prudent develop-

ment and application of new materials, we are studying the materials for any potentially unusual toxic properties based on their chemistry or extremely small particle size.

Autonomy

A major cost driver to the Department of Defense is the force structure but, technology is maturing to augment the human, possibly keeping the warfighter out of harm's way and reducing the numbers of warfighters needed to conduct operations. Autonomous capabilities range from software to aid the intelligence analyst in processing exploitation dissemination (PED) through very complex networked autonomous air systems working in tandem with unmanned ground or undersea vehicles. We could field simple autonomous systems within a couple of years, but true autonomy will take years to realize. Autonomous systems are truly multidisciplinary, in that they rely on technologies ranging from sensors that understand the environment, to software algorithms that aid decisionmaking or decide to seek human assistance. Through autonomy, we seek to reduce the manpower required to conduct missions, while extending and complementing human capabilities. The Department has four technical areas of focus for investments in Autonomy: Human and Agent System Interaction and Collaboration; Scalable Teaming of Autonomous Systems; Machine perception, Reasoning and Intelligence; and Test, Evaluation, Validation, and Verification. Built around these four technical areas, we launched an experiment last year to develop an in-house capacity in autonomous systems. This experiment, called the Autonomy Research Pilot Initiative (ARPI), funded seven proposals to work on technologies in one of the four technical areas above. The awards were for 3 years, and had to be completed in DOD laboratories by DOD personnel. ARPI efforts include: Autonomous Squad Member—enabling robots to participate in squad-level missions alongside soldiers; and Realizing Autonomy via Intelligent Adaptive Hybrid Control—increasing robustness and transparency of autonomous control to improve teaming of unmanned vehicles with each other and with their human operators. Advancement of technologies from the successful Department investment in the four technical areas will result in autonomous systems that provide more capability to warfighters, reduce the cognitive load on operators/supervisors, and lower overall operational cost.

Human Systems

Previous wars were won by massing power through weapons systems. It is not clear that will be the case in future conflicts. With the proliferation of sensors and data, future conflicts may well be won by the person that can react quickest. Studies of human cognition suggest that cognitive response times can be reduced by using display systems that present information using multiple sensory modalities. Such a reduction would give the force that is enabled with these technologies the ability to process more information, faster than their adversaries. Additionally, we are learning how to tailor training to adapt to individual students' unique needs, leading to reductions in the time needed to acquire expertise. Reducing the time to train forces to an advanced level of competence offers another way to respond faster than our adversaries. Additionally, robots, unmanned vehicles and other advanced technologies continue to be deeply integrated with our warfighters. We are developing new methodologies and technologies to enable our warfighters to interact with these systems as naturally as they do with their human counterparts leading to faster and more accurate responses by these "hybrid teams". Lastly, we are optimizing warfighter physical and cognitive performance for long durations, in dynamic and unpredictable environments, through personalized conditioning and nutritional regimens.

Directed Energy

One of the most mature "gamechanging" technology areas is Directed Energy, and specifically, High Energy Lasers. High Energy Lasers have been promised for many years, but these lasers were always based on chemical lasers, which are difficult to support logistically, and the byproducts are toxic. Over the past several years, however, solid state (electric) lasers have matured, largely through the Joint High Power Solid State Laser, a cross DOD effort to develop a 100 kilowatt (KW) laser. At close range, 10–30 KW is lethal. The JHPSSL was demonstrated in 2009. Since then, the Services have worked on packaging a solid state laser that could be deployed. In the summer of 2014, a 30 KW laser will be prototyped on the USS *Ponce* in the CENTCOM area of responsibility. In December 2013, the Army demonstrated the High Energy Laser Mobile Demonstrator at White Sands missile range. This 10 KW laser successfully engaged nearly 90 percent of the available targets. This system will be further demonstrated in a maritime environment at Eglin Air Force Base.

RELIANCE 21

The Department's Research and Engineering (R&E) Enterprise is wide-ranging, and is the foundation of the Department's technological strength. The enterprise includes DOD laboratories and product centers, other government laboratories, federally funded research and development centers (FFRDC) and University affiliated research centers (UARCs), U.S. and allied universities, our allied and partner government laboratories, as well as industry. Last year I took the opportunity to brief the members of this committee as my impetus to develop a strategy for the R&E Enterprise; this strategy was discussed earlier. What is important this year is putting in place the structure to attempt to optimize the S&T investment. Consequently, the Department's S&T Executives and I have worked to put in place Reliance 21. Under Reliance 21, most of the Department's S&T program will be managed in one of 17 cross-cutting portfolios. Each of these portfolios will be made up of Senior Executive or Senior Leader from each Service and Agency with investment in the area. These teams are building integrated roadmaps, and beginning the process of integrating allied and industry efforts onto our roadmaps. Each year, about one third of the portfolios will be reviewed, in depth to the S&T Executives, who will approve or redirect the roadmaps. The roadmap will include the technical and operational objective, the critical technical efforts needed to meet the objective, the gaps to reaching the objectives, and an assessment of where the portfolio leads recommend changes. The 17 portfolios are all called Communities of Interest (COI). Done correctly, management of a large portion of the Department's S&T execution will be collaboratively achieved by the COIs.

WHAT CONGRESS CAN DO FOR THE DEFENSE S&T PROGRAM

We are the most technologically advanced military in the world but, as Secretary Hagel so aptly stated in his remarks on the 24th of February of this year, "we must maintain our technological edge over potential adversaries"[14]. I have outlined what we are doing with the resources that we have been given and what we plan to do with the resources in the fiscal year 2015 President's budget. Success, however, will depend on your support. In that regard I have two requests.

I ask that you enact the Research, Development, Test and Evaluation portion of the President's budget as submitted. We spent a lot of time to balance the program to best meet DOD priorities.

The President's budget seeks funding for fiscal year 2016–2021 that is above the estimated sequestration levels under current law. As pointed out earlier, with no relief from the BCA in the out years, we expect modernization and readiness accounts to bear the brunt. This would heighten the increased risk we are already seeing. Simply, at that sequestration level, we expect continued erosion of the S&T and RDT&E accounts.

Second, I would ask that you support our efforts in prototyping. We are expanding the use of developmental and operational prototyping in lieu of formal acquisition programs. Throughout the history of the Department, during periods of fiscal constraint, the Department has used prototypes to mature technology and keep design teams intact and moving forward.

Prototyping has another advantage—it allows the Department to build a capability early in the acquisition process, before all the structure affiliated with the acquisition process begins. By prototyping in research and engineering, we can acquire valuable knowledge and buy down risk and lead time to production at relatively low cost.

CLOSING

In summary, the last year has been a challenge to the Department's S&T program. The risk to our force is growing, and the need for the S&T community is likewise increasing. We have shifted our focus to protecting the future by countering anti-access, area-denial threats, addressing the increasing complexity of adversary's weapons systems, shortening the maturation time of developing our own systems, and addressing the erosion of the United States' stature in international science markers. We need your help to remove the crippling uncertainty associated with sequestration so that we can transition to the balance of force structure, readiness, and modernization the country needs and deserves from us.

Senator HAGAN. Thank you, Mr. Shaffer.

[14] Hagel, 24 February 2014.

It's interesting you were speaking about the rail gun. I just happened to have CBS News on this morning and they had a demonstration of that rail gun. It was a very positive piece.

Mr. SHAFFER. It's 40 minutes down the road, ma'am. If you'd like to go, I'll speak to Ms. Lacey. I'm sure it would be a great day trip to get out of Washington, not that anybody wants to get out of Washington. [Laughter.]

Senator HAGAN. I do like a field trip. [Laughter.]

Mr. SHAFFER. Yes, ma'am.

Senator HAGAN. Ms. Miller.

STATEMENT OF MARY J. MILLER, DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH AND TECHNOLOGY

Ms. MILLER. Madam Chairwoman, thank you for the opportunity to discuss the Army's S&T program for fiscal year 2015. After 13 years of conflict, the United States finds itself in a familiar situation, faced with a declining defense budget and a strategic landscape which continues to evolve. Given the budget downturn at DOD, the Army has been compelled to face some difficult choices in force structure, operational readiness, and modernization to maintain a capability to prevent, shape, and win in any engagement. The Army will adapt, remaining the ever-present land force unparalleled throughout the world.

As a result of these difficult budget decisions, however, we face a situation where modernization will be slowed over the next 5 years, new programs will not be initiated as originally envisioned, and the Army's S&T enterprise will be challenged to better prepare for the programs and capabilities of the future.

At the end of all major conflicts, we begin to plan for what's next. Perhaps the most successful example of this planning was found at the end of the Vietnam conflict, when the Army focused on developing the big five: Abrams, Bradley, Black Hawk, Apache, and Patriot, platforms that still dominate the fight today. It is this mind set that led the Army leadership to protect our S&T investment, their seed corn for the future, despite these great budget challenges.

When I testified to this subcommittee last year, I spoke about an initiative to generate a comprehensive modernization strategy that would facilitate informed strategic decisions based on long-term objectives within a resource-constrained environment. I am happy to report that this new process has been extremely beneficial to the Army and is a process that we have continued. This long-term look, over 30 years, was exceptionally powerful in facilitating the strategic decisions made within the Army as we built the fiscal year 2015 President's budget. It allowed Army leadership to make tough program decisions based on providing the most capability to our soldiers, knowing that in some cases that meant delaying desired capabilities.

Last year, I also discussed the need for flexibility to balance across our investment portfolios. For fiscal year 2015 we were allowed to do this. It made a critical difference in the Army's strategy, allowing us to make deliberate increase in our advanced technology demonstration funding, budget activity 3, from previous years. This is essential as the Army looks to its S&T community

to conduct more technology demonstration and prototyping initiatives that will focus on maturing technology, reducing program risk, defining realistic requirements, and conducting experimentation with soldiers to refine new capabilities and operational concepts.

The S&T community will be challenged to bring forward not only new capabilities, but capabilities that are affordable for the Army of the future.

I'd like to highlight a success story that exemplifies the value of experimentation and prototyping. In the early 2000s the Army S&T community developed a capability under the Hunter-Standoff Killer Team technology demonstration called VWIT 2. This capability transitioned to Program Executive Officer (PEO) aviation in 2006 and was implemented in Afghanistan using Kiowa Warriors, helicopters, and Shadow Unmanned Aerial Vehicles (UAV).

VWIT 2 allows pilots to see real-time video from UAVs while they are conducting operational missions. This experimentation in theater resulted in a new concept of operations (CONOPS) for conducting manned-unmanned teaming within the Army. VWIT 2 is currently going into the Apache Block 3 fleet.

In the President's budget for fiscal year 2015, you will see the Army S&T portfolio increasing emphasis on research areas that support the next generation of combat vehicles, anti-access/area denial (A2/AD) technologies, such as Assured Position, Navigation, and Timing, soldier selection tools, training technologies, and long-range fires. We are also increasing vulnerability assessment investments, red-teaming our technologies, systems, and systems-of-systems to identify potential vulnerabilities, including performance degradation in contested environments, interoperability, adaptability, and training and ease of use.

None of this would be possible without the world-class cadre of over 12,000 scientists and engineers that make up the Army S&T enterprise. Despite this current environment of unease within the government civilian workforce, exacerbated over this past year, we continue to have an exceptional workforce. They are up to the challenge that the Army has given to them.

This is an interesting, yet challenging, time to be in the Army. Despite this, we remain an Army that is looking towards the future while taking care of our soldiers today. I hope that we can count on your support as we move forward. Thank you again for all that you do for our soldiers.

[The prepared statement of Ms. Miller follows:]

PREPARED STATEMENT BY MS. MARY J. MILLER

Madam Chairwoman, Ranking Member Fischer, and distinguished members of the subcommittee, thank you for the opportunity to discuss the Army's Science and Technology (S&T) Program for fiscal year 2015.

> "Over the past 12 years of conflict, our Army has proven itself in arguably the most difficult environment we have ever faced. Our leaders at every level have displayed unparalleled ingenuity, flexibility and adaptability. Our soldiers have displayed mental and physical toughness and courage under fire. They have transformed the Army into the most

versatile, agile, rapidly deployable, and sustainable strategic land force in the world."[1]—Secretary John W. McHugh, General Raymond T. Odierno

After 13 years of persistent conflict, the United States finds itself in a familiar situation . facing a declining defense budget and a strategic landscape that continues to evolve. As our current large-scale military campaign draws down, the United States still faces a complex and growing array of security challenges across the globe as "wars over ideology have given way to wars over religious, ethnic, and tribal identity; nuclear dangers have proliferated; inequality and economic instability have intensified; damage to our environment, food insecurity, and dangers to public health are increasingly shared; and the same tools that empower individuals to build enable them to destroy."[2] Unlike past draw downs, where the threats we faced were going away, there remain a number of challenges that we still have to confront—challenges that call for a change in America's defense priorities. Despite these challenges, the U.S. Army is committed to remaining capable across the spectrum of operations. While the future force will become smaller and leaner, its great strength will lie in its increased agility, flexibility, and ability to deploy quickly, while remaining technologically advanced. We will continue to conduct a complex set of missions ranging from counterterrorism, to countering weapons of mass destruction, to maintaining a safe, secure and effective nuclear deterrent. We will remain fully prepared to protect our interests and defend our Homeland.[3]

The Army depends on its Science and Technology (S&T) program to help prepare for the future, mitigate the possibility of technical surprise and ensure that we remain dominant in any environment. The Army's S&T mission is to foster discovery, innovation, demonstration and transition of knowledge and materiel solutions that enable future force capabilities and/or enhance current force systems. The Army counts on the S&T Enterprise to be seers of the future—to make informed investments now, ensuring our success for the future.

The Army is ending combat operations in Afghanistan and refocusing on the Asia-Pacific region with greater emphasis on responses to sophisticated, technologically proficient threats. We are at a pivotal juncture—one that requires us to relook the past 12 years of conflict and capitalize on all the lessons that we have learned, while we implement a strategic shift to prepare for a more capable enemy. As the Department of Defense prepares for the strategic shift, the Army will adapt—remaining an ever present land force—unparalleled throughout the world.

We are grateful to the members of this committee for your sustained support of our soldiers, your support of our laboratories and centers and your continued commitment to ensure that funding is available to provide our current and future soldiers with the technology that enables them to defend America's interests and those of our allies around the world.

STRATEGIC LANDSCAPE

As we built the fiscal year 2015 President's budget request, the Army faced a number of significant challenges. While the Army has many priorities, the first and foremost priority is and always will be to support our soldiers in the fight. We are pulling our troops and equipment out of Afghanistan by the end of this December, we are drawing down our force structure, we are resetting our equipment after 12 plus years of war and we are trying to modernize. Given the budget downturn within the Department of Defense the Army has been compelled to face some difficult choices. The Army is in the midst of a significant force structure reduction—taking the Army to pre-World War II manning levels. The Chief of Staff of the Army has had to make difficult decisions balancing force structure, operational readiness, and modernization to maintain a capable force able to prevent, shape and win in any engagement. As a result, over the next 5 years we face a situation where modernization will be slowed, new programs will not be initiated as originally envisioned and the Army's Science and Technology Enterprise will be challenged to better prepare for those programs of the future. We will focus on maturing technology, reducing program risk, developing prototypes that can be used to better define requirements and conducting experimentation with soldiers to refine new operational concepts. The S&T community will be challenged to bring forward not only new capabilities, but capabilities that are affordable for the Amy of the future.

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[1] The Posture of the U.S. Army, Committee on Armed Services, U.S. House of Representatives, April 23, 2013.

[2] National Security Strategy, May 2010.

[3] "The Posture of the U.S. Army," The Honorable John M. McHugh, Secretary of the Army and General Raymond T. Odierno, Chief of Staff, U.S. Army before the Senate Committee on Appropriations, Subcommittee on Defense, May 22, 2013.

"Going forward, we will be an Army in transition. An Army that will apply the lessons learned in recent combat as we transition to evolving threats and strategies. An Army that will remain the best manned, best equipped, best trained, and best led force as we transition to a leaner, more agile force that remains adaptive, innovative, versatile and ready as part of Joint Force 2020."[4]—General Raymond T. Odierno, 38th Chief of Staff, Army

GOALS AND COMMITMENTS

The emerging operational environment presents a diverse range of threats that vary from near-peer to minor actors, resulting in new challenges and opportunities. In this environment, it is likely that U.S. forces will be called upon to operate under a broad variety of conditions. This environment requires a force that can operate across the range of military operations with a myriad of partners, simultaneously helping friends and allies while being capable of undertaking independent action to defeat enemies, deter aggression, and shape the environment. At the same time, innovation and technology are reshaping this environment, multiplying and intensifying the effects that even minor actors are able to achieve.

The Army's S&T investment is postured to address these emerging threats and capitalize on opportunities. The S&T investment continues to not only focus on developing more capable and affordable systems, but understanding the complexity of the future environment. We are also focused on assessing technology and system vulnerabilities (from both a technical and operational perspective) to better effect future resilient designs and to prepare countermeasures that restore our capabilities when necessary.

There are persistent (and challenging) areas where the Army invests its S&T resources to ensure that we remain the most lethal and effective Army in the world. As the Army defines its role in future conflicts, we are confident that these challenges will remain relevant to the Army and its ability to win the fight. The S&T community is committed to help enable the Army to achieve its vision of an expeditionary, tailorable, scalable, self-sufficient, and leaner force, by addressing these challenges which include:

- Enabling greater force protection for soldiers, air and ground platforms, and bases (e.g., lighter and stronger body armor, helmets, pelvic protection, enhanced vehicle survivability, integrated base protection)
- Ease overburdened soldiers in small units (e.g., lighter weight multi-functional material)
- Enabling timely mission command and tactical intelligence to provide situation awareness and communications in ALL environments (mountainous, forested, desert, urban, jamming, etc.)
- Reduce logistic burden of storing, transporting, distributing and retrograde of materials
- Create operational overmatch (enhance lethality and accuracy)
- Achieve operational maneuverability in all environments and at high operational tempo (e.g., greater mobility, greater range, ability to operate in high/hot environment)
- Enable early detection and treatment for Traumatic Brain Injury (TBI) and Post Traumatic Stress Disorder (PTSD)
- Improve operational energy (e.g., power management, micro-grids, increased fuel efficiency engines, higher efficiency generators, etc.)
- Improve individual and team training (e.g., live-virtual-constructive training)
- Reduce lifecycle cost of future Army capabilities

In addition to these enduring challenges, the S&T community conducts research and technology that impacts our ability to maintain an agile and ever ready force. This includes efforts such as establishing environmentally compatible installations and materiel without compromising readiness or training, leader selection methodologies, new test tools that can save resources and reduce test time, and methods and measures to improve soldier and unit readiness and resilience.

The Army S&T strategy acknowledges that we must respond to the new fiscal environment and changing technology playing field. Many critical technology breakthroughs are being principally driven by commercial and international concerns. We can no longer do business as if we dominate the technology landscape. We must find

[4] "Marching Orders," General Raymond T. Odierno, 38th Chief of Staff, U.S. Army, January 2012.

new ways of operating and partnering. We realize that we should invest where the Army must retain critical capabilities but reap the benefits of commercially driven technology development where we can. No matter the source, we will ensure the Army is aware of the best and most capable technologies to enable a global, networked and full-spectrum joint force in the future. As the U.S. rebalances its focus by region and mission, it must continue to make important investments in emerging and proven capabilities. In a world where all have nearly equal access to open technology, innovation is the most important discriminator in assuring technology superiority.

The Chief of Staff of the Army has made his vision clear.

> "The All-Volunteer Army will remain the most highly trained and professional land force in the world. It is uniquely organized with the capability and capacity to provide expeditionary, decisive landpower to the Joint Force and ready to perform across the range of military operations to prevent, shape, and win in support of combatant commanders to defend the Nation and its interests at home and abroad, both today and against emerging threats.[5]"—General Raymond T. Odierno, 38th Chief of Staff, Army

The Army is relying on its Science and Technology community to carry out this vision for the Army of the future.

IMPLEMENTING NEW PROCESSES

Turning science into capability takes a continuum of effort including fundamental research, the development and demonstration of technology, the validation of that technology and its ultimate conversion into capability. From an S&T materiel perspective, this includes the laboratory confirmation of theory, the demonstration of technical performance, and the experimentation with new technologies to identify potential future capabilities and to help refine/improve system designs. But the S&T Enterprise is also charged to help conceptualize the future—to use our understanding of the laws of physics and an ability to envision a future environment to broaden the perspective of the requirements developers as well as the technology providers.

As part of this continuum, the Army has adopted a 30-year look forward to help facilitate more informed program planning and budget decisions. A major part of the S&T strategy is to align S&T investments to support the acquisition Programs of Record throughout all phases of their lifecycle and across the full Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF). By expanding the perspective, areas where there are unaffordable alignments of activities (such as multiple major Engineering Change Proposals in the same portfolio within the same 2–3 year timeframe) or unreasonable alignments (such as planned technology upgrades to a system that has already transitioned into sustainment) are made obvious. With that information in mind, the Army has established "tradespace" to generate options that inform strategic decisions that allow the Army to stay within its fiscal top line and still maximize its capabilities for the warfighter.

This new and ongoing process, known as the Long Range Investment Requirements Analysis (LIRA), has put additional rigor into the development of the Army's budget submission and creates an environment where the communities who invest in all phases of the materiel lifecycle work together to maximize the Army's capabilities over time. From an S&T perspective, it clearly starts to inform the materiel community as to WHEN technology is needed for insertion as part of a planned upgrade. It also cues us as to when to start investing for replacement platforms. In addition, this long-range planning can introduce opportunities for convergence of capabilities such as the development of a single radar that can perform multiple functions for multiple platforms or the convergence of cyber and EW capabilities into one system. Aside from the obvious benefit achieved by laying out the Army's programs and seeing where we may have generated unrealizable fiscal challenges, it has reinvigorated the relationships and strengthened the ties between the S&T community and their Program Executive Office (PEO) partners. We are working together to identify technical opportunities and the potential insertion of new capabilities across this 30-year timeframe.

The LIRA process was used to inform the development of the fiscal year 2015 President's budget. As the Army faced a dramatic decline in its modernization accounts (a 40 percent decrement over the next 2 years), we used the results of the LIRA to ensure that we had a fiscally sound strategy.

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[5] General Raymond Odierno, 38th Chief of Staff Army, "CSA Strategic Priorities, Waypoint 2", 2014

THE S&T PORTFOLIO

The nature of Science and Technology is such that continuity and stability have great importance. Starting and stopping programs prevents momentum in research and lengthens the timelines for discovery and innovation. While the Army S&T portfolio gains valuable insight from the threat community, this only represents one input to the portfolio and likely describes the most probable future. To have a balanced outlook across all the possible futures requires that the portfolio also address the "possible" and "unthinkable." The Army's S&T portfolio is postured to address these possible futures across the eight technology portfolios identified Figure 1.

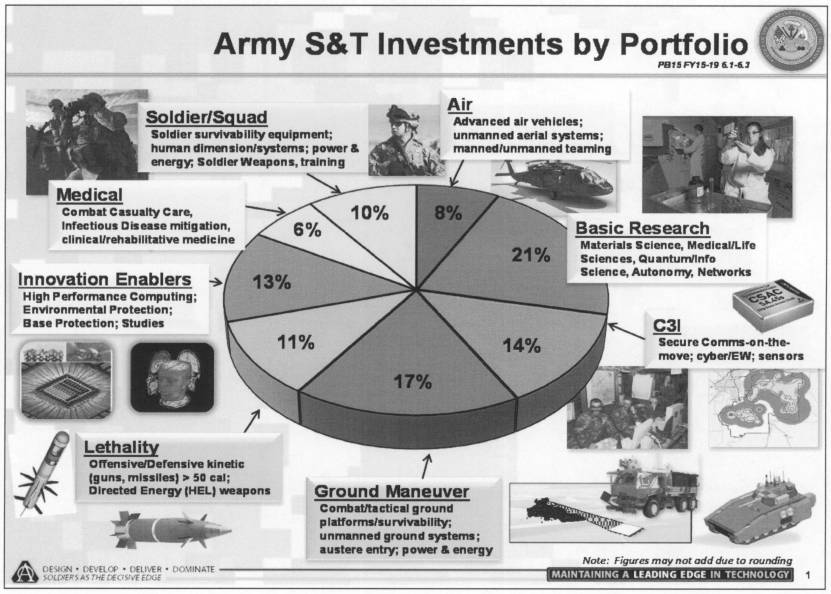

Figure 1. Army S&T Investments by Portfolio

The efforts of the S&T Enterprise are managed by portfolio to ensure maximum synergy of efforts and reduction of unnecessary duplication. The S&T program is organized into eight investment portfolios that address challenges across six Army-wide capability areas (Soldier/Squad; Air; Ground Maneuver; Command, Control, Communications, and Intelligence (C^3I); Lethality; and Medical) and two S&T enabling areas (Basic Research and Innovation Enablers). The 2014 Quadrennial Defense Review (QDR) protects and prioritizes key investments in technology to maintain or increase capability while forces grow leaner. This is an opportunity to look at innovative applications of technology. As a result, in the fiscal year 2015 President's budget request, the Army is maintaining, and shifting where necessary, its emphasis on technology areas that enable the Army to be leaner, expeditionary, and more lethal.

We are now in an era of declining acquisition budgets and are mindful of the challenges this brings to our S&T programs. We will have fewer opportunities for transition to programs of record in the next few years. This "pause" in acquisition does however afford us the opportunity to further develop and mature technologies, ensuring that when acquisition budgets do recover, S&T will be properly positioned to support the Army's next generation of capabilities. This year finds the Army beginning to rebalance its S&T funding between basic research, applied research and advanced technology development. We appreciate the flexibility that was provided to the DOD S&T executives to better align our funding to our Service/Agency needs after years of proscriptive direction.

In fiscal year 2015, our Advanced Technology Development investments increase to 42 percent of our $2.2 billion budget. This is a deliberate increase from previous years as the Army looks to its S&T community to conduct more technology dem-

onstration/prototyping initiatives that will inform future Programs of Record. Specifically you will see the Army shifting or increasing emphasis on research areas that support the next generation of combat vehicles (including power and energy efficiency and Active Protection systems), Anti-Access/Area Denial (A2/AD) technologies such as assured Position Navigation and Timing (PNT) and austere entry capabilities, soldier selection tools and training technologies, as well as long-range fires. Two of these efforts, the Future Infantry Fighting Vehicle (FIFV) and the PNT efforts are being done in collaboration with the respective PEOs to ensure that the capability developed and demonstrated not only helps to refine the requirements for the future PoRs but establishes an effective link for transition. We are also increasing our investments in vulnerability assessments of both technology and systems as well as expanding our Red Teaming efforts to identify potential vulnerabilities in emerging technologies, systems and systems-of-systems, including performance degradation in contested environments, interoperability, adaptability, and training/ease of use. This year begins the realignment necessary to implement our strategy of investing in areas critical to the Army—areas where we have critical skills sets, and leveraging others (sister services, other government agencies, academia, industry, allies) for everything else.

We anticipate a future where rapidly advancing technologies such as autonomous systems, disruptive energetics, immersive training environments, alternative power and energy solutions, and the use of smart phones and social media will become critical to military effectiveness. The Army will continue to develop countermeasures to future threat capabilities and pursue technological opportunities. Enemies and adversaries however, will counter U.S. technological advantages through cover, concealment, camouflage, denial, deception, emulation, adaptation, or evasion. Finally, understanding how humans apply technology to gain capabilities and train will continue to be at least as important as the technologies themselves.

We are mindful however that the Army will continue to be called on for missions around the globe. The Army is currently deployed in 160 countries conducting missions that range from humanitarian support to stability operations to major theater warfare. As we have seen in the last month, the world is an unpredictable place, and our soldiers must have the capabilities to deal with an ever changing set of threats.

S&T PORTFOLIO HIGHLIGHTS

I'd like to highlight a few of our new initiatives and remind you of some of our ongoing activities that will help frame the options for the Army of the future.

Soldier/Squad Portfolio

One of the important initiatives currently underway that we anticipate will make major inroads into our lightening the soldier load efforts is the development of a Soldier Systems Engineering Architecture. This architecture, developed in concert with our acquisition and requirements community, will create an analytical decision-based model through which changes in soldier system inputs (loads, technology/equipment, physiological and cognitive state, stress levels, training, et cetera) may be assessed to predict changes in performance outputs of the soldier system in operationally relevant environments. By using a Systems Engineering approach, the model will result in a full system level analysis capable of predicting impacts of materiel and non-materiel solutions of fully equipped soldiers performing operational missions/task.

In keeping with the CSA's vision, our S&T efforts also support the Army's training modernization strategy by developing technologies for future training environments that sufficiently replicate the operational environment. We are also developing new training effectiveness measures and methods ensuring these technologies rapidly and effectively transfer emerging warfighting experience and knowledge into robust capabilities. In addition, the need to reduce force structure has increased the importance of our research in the area of personnel selection and classification. This research will provide the Army with methods to acquire and retain candidates best suited for the Army—increasing our flexibility to adapt to changes in force size, structure and mission demands. Other important research includes developing scientifically valid measures and metrics to assess command climate and reduce conduct related incidences including sexual harassment and assault in units to ensure the Army can maintain a climate of dignity, respect and inclusion.

Air Portfolio

As the lead service for rotorcraft, owning and operating over 80 percent of the Department of Defense's vertical lift aircraft, the preponderance of rotorcraft technology research and development takes place within the Army. Our key initiative,

the Joint Multi-Role Technology Demonstrator (JMR TD) program, is focused on addressing the A2/AD need for longer range and more efficient combat profiles. As we shift to the Pacific Rim focus, future Areas of Operation (AO) may be 16 times larger than those of our current AOs. The Army needs a faster, more efficient rotorcraft, capable of operating in high/hot environments (6000 feet and 95 degrees) with significantly decreased operating costs and maintenance required. The new rotorcraft will also require improved survivability against current and future threats. JMR is the Department of Defense's next potential "clean sheet" design rotorcraft. The overall JMR TD effort will use integrated government/industry platform design teams and exercise agile prototyping approaches. At the same time, the Army is collaborating with DARPA on their x-plane effort. While the DARPA program is addressing far riskier technologies that are not constrained by requirements, we will look to leverage technology advancements developed under the DARPA effort where possible.

Another initiative that we are beginning in fiscal year 2015 is addressing one of the biggest causes of aircraft loss—accidents that occur while operating in a Degraded Visual Environments (DVE). DVE is much more than operating while in brown out—this effort looks at mitigating all sources of visual impairment, either those caused by the aircraft itself (brownout, whiteout) or other "natural" sources (rain, fog, smoke, etc.). We are currently conducting a synchronized, collaborative effort with PEO Aviation to define control system, cueing, and pilotage sensor combinations which enable maximum operational mitigation of DVE. This S&T effort will result in a prioritized list of compatible, affordable DVE mitigation technologies, and operational specification development that will help inform future Army decisions. This program is tightly coupled with the PEO Aviation strategy and potential technology off-ramps will be transitioned to the acquisition community along the way, when feasible.

Ground Maneuver Portfolio

The Ground Maneuver Portfolio is focused on maturing and demonstrating technologies to enable future combat vehicles, including the Future Infantry Fighting Vehicle. In fiscal year 2015, you will see the beginning of a focused initiative done in collaboration with PEO Ground Combat Systems, to develop critical subsystems prototypes to inform the development and requirements for the Army's Future Fighting Vehicle. These subsystem demonstrators focus on mobility (e.g., engine, transmission, suspension); survivability (e.g., ballistic protection, underbody blast mitigation, advanced materials); Active Protection Systems (APS); a medium caliber gun and turret; and an open vehicle power and data architecture that will provide industry with a standard interface for integrating communications and sensor components into ground vehicles.

Armor remains an Army-unique challenge and we have persistent investments for combat and tactical vehicle armor, focusing not only on protection but affordability and weight. We continue to invest in advanced materials and armor technologies to inform the next generation of combat and tactical vehicles.

In fiscal year 2015, this portfolio continues its shift to focus to address A2/AD challenges. We've increased efforts on technologies to enable stand-off evaluation of austere ports of entry and infrastructure to better enable our ability to enter areas of conflict. We are also maintaining technology investments in detection and neutralization of mines and improvised explosive devices to ensure freedom of maneuver.

C^3I Portfolio

The C^3I portfolio provides enabling capability across many of the challenges, but specifically seeks to provide responsive capabilities for the future in congested electromagnetic environments. These capabilities are supported by sustained efforts in sensors, communications, electronic warfare and information adaptable in dynamic, congested and austere environments to support battlefield operations and non-kinetic warfare. New efforts in the C^3I portfolio include reinvigorating efforts in sensor protection. We continue to invest in Electronic Warfare (EW) vulnerability analysis to perform characterization and analysis of radio frequency devices to develop detection and characterization techniques, tactics, and technologies to mitigate the effects of contested environments (such as jamming) on Army Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance systems.

Given the potential challenges that we face while operating in a more contested environment, we are placing additional emphasis in assured Position, Navigation, and Timing, developing technologies that allow navigation in Global Positioning System (GPS) denied/degraded environments for mounted and dismounted soldiers

and unmanned vehicles such as exploiting signals of opportunity. Improvements will be studied for high sensitivity GPS receivers that could allow acquisition and tracking under triple tree canopy, in urban locations, and inside buildings, which is not currently possible. We are developing an Anti-Jam capability as well as supporting mission command with interference source detection, measurement of signal strength, and locating interference sources, enabling the Army to conduct its mission in challenging electromagnetic environments.

The C^3I Portfolio also houses our efforts in cyber, both defensive and offensive. Defensive efforts in cyber security will investigate and develop software, algorithms and devices to protect wireless tactical networks against computer network attacks. We are developing sophisticated software assurance algorithms to differentiate between stealthy life cycle attacks and software coding errors as well as investigating and assessing secure coding methodologies that can detect and self correct against malicious code insertion. We will research and design sophisticated, optimized cyber maneuver capabilities that incorporate the use of reasoning, intuition, and perception while determining the optimal scenario on when to maneuver, as well as the ability to map and manage the network to determine probable attack paths and the likelihood of exploitation.

On the offensive side of cyber operations, we will develop integrated electronic attack (EA) and computer network operations (CNO) hardware and software to execute force protection, EA, electronic surveillance (ES) and signals intelligence (SIGINT) missions in a dynamic, distributed and coordinated fashion.

We will demonstrate protocol exploitation software and techniques that allow users to remotely coordinate, plan, control and manage tactical EW and Cyber assets; develop techniques to exploit protocols of threat devices not conventionally viewed as Cyber to expand total situational awareness by providing access to and control of adversary electronic devices in an area of operations.

Lethality Portfolio

In fiscal year 2015, you will see continued emphasis on the development of A2/AD capabilities through Long Range Fires and Counter Unmanned Aircraft technologies. S&T is focusing on advanced seeker technologies to enable acquisition of low signature threats at extended ranges, along with dual pulse solid rocket motor propulsion to provide longer range rockets and extend the protected areas of air defense systems.

To support these capabilities, we are conducting research in new energetic materials focused on both propulsive and explosive applications. These materials have significantly higher energetic yield than current materials and will increase the both effectiveness of our systems and reduce their size.

We also continue to develop Solid State High Energy Lasers to provide low cost defeat of rockets, artillery, mortars and unmanned aircraft. We have had multiple successes in High Energy Lasers, as we demonstrated successful tracking and defeat of mortars and unmanned aircraft in flight this year (fiscal year 2014) from our mobile demonstrator.

Additionally, we are supporting the Ground Portfolio in the development of a medium caliber weapon system to enable Future IFV requirements for range and lethality including an airburst munition.

Medical

The Medical portfolio addresses the wellness and fitness of our soldiers from accession through training, deployment, treatment of injuries and return to duty or to civilian life. Ongoing efforts address multiple threats to our soldiers' health and readiness. Medical research focuses on areas of physiological and psychological health that directly support the Chief of Staff of the Army Ready and Resilience Campaign and the Army Surgeon General's Performance Triad (Activity, Nutrition and Sleep). Research in these portfolios includes important areas such as Traumatic Brain Injury (TBI) and Post-Traumatic Stress Disorder (PTSD). In fiscal year 2015, you will see continued focus on research to mitigate infectious diseases prevalent in the Far East as well as combat casualty care solutions at the point of injury that will extend soldier's lives during the extended distances associated with conducting operations in the Pacific.

TBI research efforts include furthering our understanding of cell death signals and neuroprotection mechanisms, as well as identifying critical thresholds for secondary injury comprising TBI. The Army is also evaluating other non-traditional therapies for TBI, and identifying "combination" therapeutics that substantially mitigate or reduce TBI-induced brain damage. Current Army funded research efforts in the area of PTSD are primarily focused upon development of pharmacologic solutions for the prevention and treatment of PTSD. A large-scale clinical trial is

currently underway evaluating the effectiveness of Sertraline, one of two Selected Serotonin Reuptake Inhibitors (SSRIs) approved for the treatment of civilian PTSD, but not combat-related PTSD. This study will evaluate Sertraline's effectiveness in the treatment of combat-related PTSD both alone and in combination with psychotherapy.

Innovation Enablers

As the largest land-owner/user within the DOD, it is incumbent upon the Army to be good stewards in their protection of the environment. As such, the Army develops and validates lifecycle models for sustainable facilities, creates dynamic resource planning/management tools for contingency basing, develops decision tools for infrastructure protection and resiliency and assesses the impact of sustainable materials/systems on the environment.

In addition, we conduct blast noise assessment and develop mitigation technologies to ensure that we remain "good neighbors" within Army communities and work to protect endangered species while we ensure that the Army mission can continue.

The High Performance Computing (HPC) Modernization Program supports the requirements of the DOD's scientists and engineers by providing them with access to supercomputing resource centers, the Defense Research and Engineering Network (DREN) (a research network which matures and demonstrates state of the art computer network technologies), and support for software applications (experts that help to improve and optimize the performance of critical common DOD applications programs to run efficiently on advanced HPC systems maturing and demonstrating leading-edge computational technology.

The Army's Technology Maturation Initiatives effort, established in fiscal year 2012 enables a strategic partnership between the S&T and acquisition communities. This effort has become especially important as the Army heads into a funding downturn. We plan to use these funds to prepare the Army to capitalize on S&T investments as we come out of the funding "bathtub" near the end of the decade. We are using these BA4 resources to target areas where acquisition programs intended to provide necessary capabilities have been delayed, such as assured PNT, the Future Fighting Vehicle and Active Protection Systems. We are investing resources that will either provide capability or inform/refine requirements for the Army's future systems (all of which will be done via collaborative programs executed with our acquisition/PEO partners).

This portfolio includes our ManTech efforts as well. Last month, President Obama announced the launch of the Digital Manufacturing and Design Innovation Institute (DMDI). Headquartered in Chicago, IL, the DMDI Institute spearheads a consortium of 73 companies, universities, nonprofits, and research labs. The president announced a government investment of $70 million and matching private investments totaling $250 million for the institute. DMDI is part of the President's National Network of Manufacturing Innovation and will focus on the development of novel model-based design methodologies, virtual manufacturing tools, and sensor and robotics based manufacturing networks that will accelerate the innovation in digital manufacturing and increase U.S. competitiveness.

Basic Research

Underpinning all of our efforts and impacting all of the enduring Army challenges is a strong basic research program. Army basic research includes all scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. The vision for Army basic research is to advance the frontiers of fundamental science and technology and drive long-term, game-changing capabilities for the Army through a multi-disciplinary portfolio teaming our in-house researchers with the global academic community to ensure overwhelming land-warfighting capabilities against any future adversary.

While we have made some significant adjustments within the Basic Research investments within the Army, we will continue to emphasize several areas that we feel have a high payoff potential for the warfighter. These areas include: Materials in Extreme Environments; Quantum Information and Sensing; Intelligent Autonomous Systems; and Human Sciences/Cybernetics.

For centuries, the fabrication of solid materials has hinged largely on manipulating a narrow range of temperatures and pressures. Our Materials in Extreme Environments initiative invests in new revolutionary and targeted scientific opportunities to discover and exploit the fundamental interaction of matter under extreme static pressures and magnetic fields, controlled electromagnetic wave interactions (microwave, electrical) and acoustic waves (ultrasound) to dramatically enhance fab-

rication and create engineered materials with tailored microstructures and revolutionary functionalities.

We are in the midst of a second quantum revolution. Scientists have moved from merely computing quantum properties of systems to exploiting them to drive applications in computation, communication, sensing, and imaging. Areas identified for particular Army focus include quantum enhanced sensing and imaging, quantum communications, quantum algorithms, and quantum simulations. A potential Army-specific quantum-enabled capability is an exact polynomial-time quantum-chemistry algorithm to directly impact design of propellants, explosives, medicines, and materials.

To enable the warfighter, animal-like intelligence is desired for simple autonomous platforms, such as robotic followers, and for aerial and ground sensor platforms. We are investing in research that will enable highly intelligent systems that allow platforms to set waypoints autonomously, increasing mission effectiveness; followers that recognize the actions of their unit, that can perceive when the unit is deviating from a previously prescribed plan and know enough to query why; that recognize when the unit is resting and be capable of doing so without explicit instructions from the soldier.

Regardless of specific definition, human sciences are critical and can safely be predicted to become pervasive across all Army research activities. Cognitive predictions of social person-to-person communication based on observed gestures, eye movement, and body language are becoming possible. In addition, brain-to-brain interaction is emerging as a potential paradigm based on external sensors and brain stimulation. The Army will continue to study these and other possible techniques, to understand shared knowledge, social coordination, discourse comprehension, and detection and mitigation of conflict. Cognitive models combined with sensors also have the potential for dramatic breakthroughs in human-autonomy interaction, including aspects such as active learning algorithms, real-time crowd-sourcing with humans and machines in the cloud, and maximizing AI prediction accuracy. Devices and sensors that are wearable or implantable (including biomarkers and drug therapy) have the potential to enhance performance dramatically and to augment sensory information through new human-sensor-machine interface designs.

The role of Basic Research to provide the knowledge, technology, and advanced concepts to enable the best equipped, trained and protected Army to successfully execute the national security strategy, cannot be understated. The key to success in basic research is picking the right research challenges, the right people to do the work, and to provide the right level of resources to maximize the likelihood of success.

IMPACT OF SEQUESTRATION

I am often asked what impact sequestration had on the Army's S&T portfolio, so I would like to address some of the impacts we have seen. The fiscal year 2013 application of sequestration targets (hitting every Program Element in the S&T portfolio by a set percentage) forced the Army into a scenario where we decremented programs that we would have protected, if given the opportunity. This lack of flexibility made for some very bad business and technical ramifications. Within the S&T community, we were able to make adjustments to balance our sequestration targets at the Program Element, vice Project level—giving us the ability to avoid civilian Reduction in Force (RIF) actions where possible. That said, sequestration did result in unfunded efforts and delays in applied research and technology development areas across the S&T portfolio. More generally, the sequestration cuts added unnecessary risk to acquisition programs and delayed the transition of critical capabilities to the warfighter.

However, by far the most serious consequence of sequestration (and the related pay freezes, shutdowns, conference restrictions, et cetera) has been the impact on our personnel. Without a world-class cadre of scientists and engineers, the Army S&T enterprise would be unable to support the needs of the Army. The Army Labs and Research, Development and Engineering Centers have reported multiple personnel leaving for other job opportunities or early retirement. For example, the Night Vision and Electronic Sensors Directorate lost eight personnel in the 2 months prior to the well-publicized DOD-wide furloughs, compared to an average annual loss of around 19 personnel. These losses include personnel across experience levels with specialized expertise critical to the Army. While the average attrition rate over the past 2 years is running at about 8 percent (similar to a typical attrition rate found in prior years), the concerning impact is that 60 percent of the personnel leaving the Army are not eligible for retirement. This is a big change. During our exit interviews, reasons cited included conference restrictions (impeding

the ability to progress professionally) coupled with increasing job insecurity due to budget decrements and planned manpower reductions. Complicating this loss of technical expertise is the restriction on hiring replacements for the lost government civilians. We are on a replacement cycle that varies between 1 hire per every 3 losses at one lab, to 1 hire for every 20 losses at another. This pattern of loss is unsustainable if we hope to maintain a premier technical workforce. Finally, as we address the 2013 National Defense Authorization Act (NDAA), section 955 language which mandates a reduction in the civilian workforce commensurate with a reduction in the military, we must confront the impacts of any civilian reductions, which are implemented through a personnel process that tends to primarily impact those employees who have less tenure in the government. For the S&T community that typically impacts those areas of new technical emphasis within the DOD—key areas such as cyber research and systems biology.

While the Bipartisan Budget Act has provided some relief and stability for fiscal year 2014 and fiscal year 2015, the uncertainty again looming on the horizon makes it even more difficult to recruit and retain the scientists and engineers the Army depends on. The key to any success within the Army lies with our people.

THE S&T ENTERPRISE INFRASTRUCTURE AND WORKFORCE

Our laboratory infrastructure is aging, with an average approximate age of 50 years. Despite this, the S&T Enterprise manages to maximize the scarce sustainment, restoration, and modernization funding and the authorities for minor military construction using Sec. 219 funding to minimize the impact on the R&D functions with the Enterprise. However, we are only making improvements to our infrastructure at the margins, and where possible we have used military construction, through your generous support and unspecified minor construction to modernize facilities and infrastructure. However, we do acknowledge that much of the Army is in a similar position. This is not a long-term solution. While the authorities that you have given us have been helpful, they alone are not enough, and we are still faced with the difficulty of competing within the Army for ever-scarcer military construction dollars at the levels needed to properly maintain world-class research facilities. This will be one of our major challenges in the years to come and I look forward to working with the Office of the Secretary of Defense and Congress to find a solution to this issue.

The S&T community affords us the flexibility and agility to respond to the many challenges that the Army will face. Without the world-class cadre of over 12,000 Federal civilian scientists and engineers and the infrastructure that supports their work, the Army S&T Enterprise would be unable to support the needs of the Army. To maintain technological superiority now and in the future, the Army must maintain an agile workforce. Despite this current environment of unease within the government civilian workforce, exacerbated by conference restrictions, budget uncertainty, furloughs, and near zero pay increases, we continue to have an exceptional workforce. But, as I mentioned earlier, attracting and retaining the best science and engineering talent into the Army Laboratories and Centers is becoming more and more challenging. Our laboratory personnel demonstrations give us the flexibility to enhance recruiting and afford the opportunity to reshape our workforce, and I appreciate Congress' continued support for these authorities to include the flexibilities given to the laboratories and centers in section 1107 in the NDAA for Fiscal Year 2014. With two exceptions (the Army Research Institute (ARI) for the Behavioral and Social Sciences and the Space and Missile Defense Command Technical Center (SMDCTC)), all of our laboratories and centers are operating under this program (ARI and SMDCTC were never designated as Science and Technology Reinvention Laboratories). The flexibilities given to the laboratories and centers allow the laboratory directors the maximum management flexibility to shape their workforce and remain competitive with the private sector.

The Army S&T Enterprise cannot survive without developing the next generation of scientists and engineers. We continue to have an amazing group of young scientists and engineers that serve as role models for the next generation. For example, last year Dr. Ronald Polcawich, a researcher at the U.S. Army Research Laboratory (ARL), was named by President Obama to receive a 2012 Presidential Early Career Award for Scientists and Engineers as one of the Nation's outstanding young scientists for his work in Piezoelectric-Micro Electro-Mechanical Systems (PiezoMEMS) Technology. Dr. Polcawich, is leading a team of researchers at the ARL in studying Piezo-Micro mechanical electrical systems (PiezoMEMS) with a focus on developing solutions for RF systems and millimeter-scale robotics. These actuators combined/integrated with low power sensors are being developed to enable mm-scale mechanical insect-inspired robotic platforms.

The need for STEM literacy—the ability to understand and apply concepts from science, technology, engineering, and mathematics (STEM) in order to solve complex problems—goes well beyond the traditional STEM occupations of scientist, engineer and mathematician. The Army also has a growing need for highly qualified, STEM-literate technicians and skilled workers in advanced manufacturing, logistics, management and other technology-driven fields. Success and sustainment for the Army S&T Enterprise depends on a STEM-literate population to support innovation and the Army must contribute to building future generations of STEM-literate and agile talent.

Through the Army Educational Outreach Program (AEOP), the Army makes a unique and valuable contribution to meet the National STEM challenge—a challenge which includes the growing demand for STEM competencies; the global competitiveness for STEM talent; an unbalanced representation of our Nation's demographics in STEM fields; and the critical need for an agile and resilient STEM workforce. AEOP offers a cohesive, collaborative portfolio of STEM programs that provides students, as well as teachers, access to our world-class Army technical professionals and research centers. Exposure to STEM fields and STEM professionals is critical to growing the next generation of STEM-literate young men and women who will form the Army's workforce of tomorrow.

In the 2012–2013 academic years, AEOP directly engaged more than 66,000 students and nearly 1,500 teachers in authentic research experiences. Almost 2,351 Army Scientists and Engineers (S&E) provided mentorship, either from our in-house research laboratories or through our university partnerships.

Additionally in fiscal year 2013, we initiated a comprehensive evaluation strategy (the first of its kind) that uses the government and a consortium of STEM organizations known for their nationwide education and outreach efforts to annually assess our program. Aligned with Federal guidance, AEOP requires the evaluation of all program elements based on specific, cohesive, metrics and evidence-based approaches to achieve key objectives of Army outreach; increased efficiency and coherence; the ability to share and leverage best practices; as well as focus on Army priorities. The AEOP Priorities are:

- STEM Literate Citizenry: Broaden, deepen and diversify the pool of STEM talent in support of the Army and our defense industry base.
- STEM Savvy Educators: Support and empower educators with unique Army research and technology resources.
- Sustainable Infrastructure: Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.

For fiscal year 2015, we are concentrating on further program assessment, implementing evidence-based program improvements, strengthening additional joint service sponsored efforts, and identifying ways to expand the reach and influence of successful existing programs by leveraging partnerships and resources with other agencies, industry, and academia.

NEW APPROACHES TO ENHANCE INNOVATION

It is widely acknowledged that innovation depends on bringing multiple scientific disciplines together to engage in collaborative projects that often yield unpredictable, yet highly productive results. Formal and informal interactions among scientists lead to knowledge-building and research breakthroughs. These types of collaborations are happening on a day-to-day basis across our labs and engineering centers to produce the superior technology that our Army needs today, tomorrow and beyond. With shrinking budgets and huge leaps in the pace of technological change, our Army science and technology organizations must do more with less and faster than ever before to develop technology that will ensure mission success for the Army's first battle after next. To this end, we must more succinctly leverage scientific discovery from our academic and industry base by increasing the scientific engagement and flow of ideas that leads to ground breaking innovation.

In 1945, Vannevar Bush's concepts documented in "Science—the Endless Frontier" stressed the necessity of a robust/synergistic university, industry and government laboratory research system. Over the years, the rigid and insular nature of the defense laboratories have caused an erosion of that university/industry/government lab synergy that is critical to the discovery, innovation, and transition of science and technology important to national security.

In an effort to reenergize that synergy, the U.S. Army Research Laboratory (ARL) is working to extend their alliances through an Open Campus Concept that brings together under one roof the triad of industry, academia, and government. Leveraging the cutting-edge innovation of academia, the system development and

transition expertise of industry and their own Army focused fundamental research; ARL can harness the power of the triad to produce revolutionary science and technology more efficiently and effectively. The Open Campus Concept creates an ecosystem for academia, defense labs, and industry to share people, facilities and resources to develop and deliver transformative science oriented on solving complex Army problems. It will provide the means for our world class scientific talent to work together in state-of-the-art facilities to provide innovation that allows rapid transition of technology to our soldiers. ARL's Open Campus Concept could lead to a new business model that would transform the defense laboratory enterprise into an agile, efficient and effective laboratory system that supports the continuous flow of people and ideas to ensure transformative scientific discovery, innovation and transition critical to national security.

Finally, we are increasingly mindful of the globalization of S&T capabilities and expertise. Our International S&T strategy provides a framework to leverage cutting edge foreign science and technology enabled capabilities through Global S&T Watch, engagement with allies and leadership initiatives. Global Science and Technology Watch is a systematic process for identifying, assessing, and documenting relevant foreign research and technology developments. The Research, Development and Engineering Command's (RDECOM) International Technology Centers (ITCs), Engineer Research and Development Center (ERDC) international research office and the Medical Research Materiel Command's OCONUS laboratories identify and document relevant foreign S&T developments. We have initiated a new process to strategically identify and selectively engage our allies when their technologies and materiel developments can contribute to Army needs and facilitate coalition interoperability. The resultant engagements will augment the existing bilateral leadership forums we currently maintain with the United Kingdom Canada, Germany and Israel which provide both visibility of and management decisions on allied developments that merit follow-up for possible collaboration.

SUMMARY

As the Army S&T Program continues to identify and harvest technologies suitable for transition to our force, we aim to remain ever vigilant of potential and emerging threats. We are implementing a strategic approach to modernization that includes an awareness of existing and potential gaps; an understanding of emerging threats; knowledge of state-of-the-art commercial, academic, and government research; as well as a clear understanding of competing needs for limited resources. Army S&T will sharpen its research efforts to focus upon those core capabilities it needs to sustain while identifying promising or disruptive technologies able to change the existing paradigms of understanding. Ultimately, the focus remains upon soldiers; Army S&T consistently seeks new avenues to increase the soldier's capability and ensure their technological superiority today, tomorrow, and decades from now. The Army S&T mission is not complete until the right technologies provide superior, yet affordable, overmatch capability for our soldiers. I will leave you with a last thought from the Secretary of the Army, the Honorable John McHugh.

> "Our Strategic Vision is based on a decisive technological superiority to any potential adversary."[6]—Honorable John W. McHugh, 21st Secretary of the Army

This is an interesting, yet challenging, time to be in the Army. Despite this, we remain an Army that is looking towards the future while taking care of the soldiers today. I hope that we can continue to count on your support as we move forward, and I would like to again thank the members of the committee again for all you do for our soldiers. I would be happy to take any questions you have.

Senator HAGAN. Thank you, Ms. Miller.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chairwoman. I would just ask that my opening statement be included in the record, please.

[The prepared statement of Senator Fischer follows:]

PREPARED STATEMENT BY SENATOR DEB FISCHER

Thank you, Madam Chairwoman. I join you in welcoming our witnesses; thank you for being here today, it's good to see you all again.

[6] Terms of Reference, Fiscal Year 2012 Army Science Board Summer Study, Secretary of the Army, John M. McHugh, October 28, 2011.

I'11 keep my remarks brief so we can quickly move on to the witnesses.

I would just note that this subcommittee has heard a lot from Secretary Kendall about the threat to our technological edge. Open source media reports detail the growing capabilities of potential adversaries and the proliferation of advanced technologies. We've heard directly from the Secretary of Defense that U.S. superiority can no longer be taken for granted. These are sobering words to hear, especially when science and technology dollars are decreasing. We know the Department of Defense has to reset and retrain after more than a decade of war, but it must also modernize and invest in next-generation technology.

I look forward to hearing from our witnesses on their efforts to develop new and innovative technologies that will sustain the advantage our warfighters currently enjoy.

I thank the chairman and look forward to hearing from our witnesses.

Senator HAGAN. So done.

Ms. Lacey.

STATEMENT OF MARY E. LACEY, DEPUTY ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH, DEVELOPMENT, TEST AND EVALUATION

Ms. LACEY. Senator Hagan, Senator Fischer: It's really an honor to appear before you again to report on the efforts of the Department of the Navy's research and development (R&D) enterprise. In these exceptionally challenging times, our goal continues to be to provide our sailors and marines with technically superior capabilities while focusing on the affordability of our current and future weapon systems.

I would like to concentrate my remarks this afternoon on the Navy Laboratory, Warfare, and System Center. The Department of the Navy has historically made deliberate and measured investments to ensure stability, competence, and technical capacity within the organic workforce. Over the last 2 years we have made great progress in aligning our labs and understanding the health of the facilities and the people.

Last year, I talked to you about understanding the capabilities that we had in our various facilities. I'd like to report that we have now baselined our capabilities. We have an understanding of over 500 individual laboratories and we are using that understanding to shape our investments, to improve the capabilities that we have in each one of those individual facilities.

To be competent, people must do actual hands-on work. We have made that a priority within DOD. The Navy labs are deeply engaged in the technical work that brings technologies from the lab bench, through demonstration, to a realistic option for the Service. An example of this is in the news today, and not the rail gun, ma'am, the laser system. Our success in the laser weapons systems is a part of our solid-state laser maturation effort at the Naval Surface Warfare Center, Dahlgren, and the Naval Research Laboratory right here in Anacostia.

Our laser weapon system is referred to as LAWS. It leverages advances in the commercial technology for use in a rugged, robust prototype weapon capable of identifying, illuminating, tracking, and lasing enemy surface and air threats. We expect that we'll be able to dramatically change the cost equation from an expendable round to a dollar a shot with this laser weapon. That's a lot of money. The Navy is installing the LAWS as we speak on board the USS *Ponce* in the Arabian Gulf.

We are mindful of the need to affordably modernize our systems and reduce the workload on our sailors and marines. The Navy's very low frequency transmitters are located around the world and provide the Navy with the capability to communicate over large distances one way to our submarines while they are submerged. The problem with the system is that it was put in place in the 1960s with technology that dated from the 1930s. It is very expensive to maintain and many of the parts no longer exist. It's a very costly repair to maintain it in operational status.

An engineer at one of our centers developed a solid-state high-power electronics and control circuit that replaces this technology in the systems out there. Once implemented at all six vertical launching system sites, the Navy will save $20 million a year in energy and maintenance costs on that alone.

At another warfare center, in less than 4 months a Navy team of scientists and engineers developed an inexpensive chemical detection kit for homemade explosives. The kit is easy to use, only requires a few minutes of training, and includes a one-page manual, about the size of a 4 x 6 index card. It weighs in at only 6 ounces. The unit is portable and it costs about $85 a unit.

This replaces and outperforms the impractical kits that they had, which weighed anywhere from 2 to 20 pounds and cost anywhere from $5,000 to $15,000 a unit.

As part of the Navy's technology transfer program, we have made these detection kits available to Federal, State, and local law enforcement agencies.

We get these types of results through disciplined processes focused on affordability and executed by a skilled workforce with technical capabilities second to none.

Even with the challenges we faced this past year assessment sequestration and furloughs' attrition of our technical workforce in the Navy is down. In large part, I believe that this is because the workforce is motivated by the mission and the opportunity to work on innovative solutions to tough problems such as those that I just mentioned.

I'd like to thank the subcommittee for your continued support as we provide new and improved affordable warfighting capabilities to our sailors and marines. Thank you.

[The prepared statement of Ms. Lacey follows:]

PREPARED STATEMENT BY MS. MARY E. LACEY

INTRODUCTION

Madam Chairwoman and distinguished members of the subcommittee, it is an honor to appear before you today to report on the efforts of the Department of Navy (DoN) Science and Technology (S&T) Laboratory Enterprise. I would like to begin by thanking the committee for your continued support of our Nation's science and engineering base who continue to provide new and improved, affordable warfighting capabilities to sustain the technology superiority our sailors and marines enjoy. The Department remains committed to developing and rapidly delivering innovation to our warfighters more efficiently through the effective use of the technological resources of our Nation within the commercial sector, Federally Funded Research and Development Centers (FFRDC), University Affiliated Research Centers (UARC), and our Naval Laboratory and Warfare/Systems Centers.

In the year since I last appeared before you, DoN has continued to actively manage our research, development, test, and evaluation (RDT&E) accounts, workforce, and infrastructure. We still have many significant challenges, including an examination of how best to use FFRDCs and UARCS to address the challenges ahead, but

we continue to make strides in understanding the full strategic potential of our national resources to affordably deliver advanced technologies to Naval Forces.

The budget has offered its own set of challenges. Since 2008, the rate at which DoN's Budget is decreasing is at historical levels, , equaling or exceeding the decreases we saw after the Reagan Build-up and Vietnam War. These kinds of reductions call for a new investment strategy. In the fiscal year 2015 budget request, DoN reduced a number of RDT&E programs, including Marine Corps Assault Vehicles and Airborne Mine Countermeasures. DoN continues to develop and expand the scope of its Business Transformation efforts, looking to the RDT&E portfolio for savings within programs, high pay-off technology transitions, or better product outcomes for ACAT programs.

STRATEGIC REVIEWS

To ensure the future technological superiority of our Fleet and Force, DoN must make prudent RDT&E investments that provide combat effectiveness, affordability and improved reliability and maintainability of our current and future weapon systems. The inherent mismatch in timescales for our budget processes, operational needs and S&T development are amplified in this time of declining budgets. DoN must ensure RDT&E investments continue to target the correct warfighter missions, are aligned across all RDT&E accounts, and expeditiously transition required technologies to Fleet and Force operators. To answer these new challenges and ensure the right investments are being made, DoN has formed the Naval RDT&E Corporate Board consisting of the Under Secretary of the Navy; Assistant Secretary of the Navy for Research, Development and Acquisition (ASN(RDA)); Vice Chief of Naval Operations (VCNO); and the Assistant Commandant of the Marine Corps (ACMC) to help guide our RDT&E strategy. These DoN RDT&E investment decisions could greatly influence the battlefield of our next conflict.

In 2013, we completed our second round of reviews of DoN RDT&E investments. Our focus during these reviews is to ensure we are effectively balancing tactical and strategic requirements against our current and future technical capabilities. We want to shift our decisions from reactive and stove-piped to a proactive and holistic approach where decisions are made at the appropriate level and wisely use our resources and intellectual capital. As a result of these reviews, we have made some tactical course corrections that will better align RDT&E projects in a more accurate budget activity and allow for more orderly deployment of advanced technology from the bench to the fleet.

Our continuing efforts in Integration and Interoperability (I&I), looking across the "kill chains" to understand how systems really work together and where best to make our investments to maximize warfighting capabilities, are providing great insight. The Naval Integrated Fire Control Counter Air (NIFC–CA) project serves as a great example of the benefits of this approach. The objectives of this system-of-systems engineering, integration and test effort are to extend the Naval Theater Air and Missile Defense battlespace to the maximum kinematic range of our active missiles, increase tactical decisionmaking time, offer additional flexibility to platform operators and operational commanders, and to improve survivability and operational effectiveness of warfighting assets. The capability focuses on targets beyond the detection range of the shooter, enabling Engage-On-Remote at targets Over-the-Horizon, with the ultimate objective of improving performance against multiple simultaneous targets, and providing the fleet operator with maximum re-engagement capability. Formal scoping and structure were required based on detailed examinations using effects/kill chains, virtual simulation analysis, and operational test data to determine operational needs, develop integrated architectures, and validate System of Systems (SoS) Federated model performance predictions. A critical governance element of this formal integrated warfighting capability structure involved the decision to direct Program Executive Office—Integrated Warfare Systems (PEO IWS) to establish a NIFC–CA Systems Engineering, Integration and Test (SEI&T) Project Office to integrate across the elemental programs to develop and acquire a NIFC–CA capability. This instantiation of a formal NIFC–CA project began with the critical elements identified by the I&I activity, namely the determination of facts-based operational gaps and recommended solution sets that maintain alignment between pillar programs. The Department is proceeding in a "crawl, walk, run" approach to System of Systems engineering, integration and test to reduce test risk and cost, while maximizing efficiencies by leveraging pillar program test opportunities. As we do, we are capturing lessons learned to assist the Fleet in the future development of fully vetted and approved Concept of Operations and Training Tactics and Procedures (TTPs). This essential work relies on a collaborative Govern-

ment/Industry team that includes government laboratories, academia, and engineering expertise within the pillar programs.

In the next few years, DoN will expand I&I efforts to include new technologies into the kill chain analysis to enable mission planning for advanced technologies in development. One example of an advanced technology we are developing is the Large Displacement Unmanned Undersea Vehicle (LDUUV). The LDUUV will provide a reliable, fully autonomous, long-endurance UUV capable of extended operation (over 60 days) in cluttered littoral environments. The program is developing the energy, autonomy and core systems to operate in a complex ocean environment near harbors, shorelines, and other high-traffic locations. Key approaches include using open architecture to lower cost and enable full pier-to-pier autonomy in over-the-horizon operations. Achieving these goals will reduce platform vulnerability, enhance warfighter capability and safety, and close gaps in critical and complex mission areas by extending the reach of the Navy into denied areas.

Another example of advanced technology development is the Electromagnetic Railgun. Fired by electric pulse, the Railgun eliminates gun propellant from magazines, resulting in greater survivability. The Railgun has multi-mission potential for long-range, land-attack Naval Surface Fire Support, ballistic and cruise missile defense, and anti-surface warfare against ships and small boats. The Naval Sea Systems Command (NAVSEA) and the Office of the Secretary of Defense (OSD) Strategic Capabilities Office are coordinating development efforts to ensure commonality and reduce the need for expensive redesign. OSD is sponsoring a land-based Railgun experiment to explore its potential to defend land bases. NAVSEA is executing this effort and also preparing for Railgun integration in navy war ships. The team will conduct key system demonstrations both at a land-based location and aboard a Joint High Speed Vessel in 2016.

WORKFORCE

I have oversight of systems engineering and overall stewardship responsibilities for the Naval Laboratory and Warfare/Systems Centers. DoN has 15 activities that compose the in-house research and development capacity. It is comprised of the Naval Research Laboratory (NRL) and Warfare/Systems Centers aligned to three Systems Commands (SYSCOMs): NAVSEA, Naval Air Systems Command (NAVAIR), and Space and Naval Warfare Systems Command (SPAWAR). The Navy's Corporate Laboratory, the Naval Research Laboratory (NRL), was established by an act of Congress in 1916 and began operation as the NRL in 1923. Over half of the work NRL performs is fundamental science and technology, nearly all in partnership or in collaboration with academia and researchers in other government laboratories and activities. The Warfare and Systems Centers, while being involved in basic science, play most strongly in technology and engineering, often in partnership with industry. They too have long histories, some dating back to the 1800s, and were created to respond to a specific threat or technological challenge. The Naval Laboratory and Centers Coordinating Group is our principal coordinating body for our in-house activities. This group has been very active over the last year in:

- Aligning processes for the work we accept from customers;
- Establishing common processes for measuring the technical core capabilities and capacity of our workforce; and
- Establishing DoN-wide definitions for technical core capabilities and competencies as a part of measuring and maintaining the ability to deliver the Navy after Next while ensuring today's is always ready to fight.

The Naval Laboratory and Warfare/System Centers constitute a diverse, highly skilled workforce of over 45,000 employees with over 23,000 scientists and engineers. Among the scientists and engineers over 40 percent hold advanced degrees in science, engineering, or mathematics. The Navy continues its efforts to revitalize and maintain the technical capabilities of the acquisition workforce by maintaining over 5,000 technical personnel at the Warfare/Systems Centers in the technical career fields of Systems Planning, Research, Development and Engineering, Test and Evaluation (T&E), Information Technology (IT) and Production, Quality, and Manufacturing. As procurements draw down, we fully expect that a technical workforce that is trained and equipped to maintain and repair legacy systems will be more important than ever.

Investments in research and development as well as in our workforce and facilities to support the legacy systems and the systems of systems must be made. The Navy has taken several steps to achieve balance in our technical workforce and infrastructures to ensure technical capabilities critical to the Navy are maintained in our Naval Laboratory and Warfare/Systems Centers. While we place a priority on

the naval mission, clearly, non-naval work is an important element of the overall workload at many of our Warfare/Systems Centers. The accomplishment of this work can contribute to both the strength of the technical workforce at the Warfare/Systems Centers and the reduction of the centers' overhead rates. However, if the overall workload at the individual Warfare Center or across the network of Warfare/Systems Centers is not properly aligned to capability and capacity, their mission performance will suffer. A series of failures in this regard gave cause to a review of work acceptance practices across our Warfare/Systems Centers and the determination that the Navy needed to increase standardization, visibility and accountability to ensure the Navy fulfills its responsibility to both the warfighter and the taxpayer.

SECTION 219

DoN is focused on the quality of our technical workforce's capability and capacity and ensuring stability within the organic workforce. Section 219 of the National Defense Authorization Act (NDAA) for Fiscal Year 2009 has proven invaluable to maintaining the health of the Navy Laboratory, Warfare and Systems Centers. Naval Innovative Science and Engineering (NISE) investments, $105 million in fiscal year 2013, have been critical in refreshing aging infrastructure through investments in updating and creating new technical facilities. The NISE program has allowed the Navy Laboratory, Warfare and Systems Centers to revitalize and build new technical capabilities of the workforce through hands-on work as well as training and the support of advanced degrees and certifications. NISE programs have provided breakthrough research and been responsible for the maturation and transition of technology to the warfighter and programs of record. NISE has encouraged cross-organizational multi-disciplinary projects that include partnerships with academia and industry. Finally, the NISE program has allowed the Navy to recruit and retain top technical talent to support the Fleet. We want to thank you for extending the sunset clause until 2020. We encourage you to make this a permanent authorization.

INFRASTRUCTURE

Our investment in our workforce is critical but so is our investment in our infrastructure. I am pleased to report we have completed our initial Naval Infrastructure Capabilities Assessment (NICAP) effort started in fiscal year 2010 at NAVAIR, to include all RDT&E capabilities at the Warfare/Systems Centers. NICAP has captured and base lined technical information on more than 500 different capabilities spread across 68 different geographical locations of our 15 Laboratory and Warfare/Systems Centers. The depth and the breadth of their capabilities are exceptional in spite of some of the less-than-ideal facilities in which our scientists and engineers must perform their work. Because each of the SYSCOMs uses a different taxonomy to classify and manage their RDT&E capabilities, we have embarked on a strategy to make the data more consistent and comparable across the SYSCOMs. NICAP provides dynamically generated assessment views, statistical and tabular, that enable the comparative assessment of current Naval RDT&E capability baseline and relevant supporting analyses for emerging infrastructure reviews.

The Assistant Secretary of the Navy for Energy, Installations, and Environment (ASN(EI&E)) has identified $81 million in military construction funding for RDT&E projects:

- Atlantic Test Range Facility: $9,860K (Patuxent River, MD)
- Advanced Energetics Research Lab, Phase 2: $15,346K (Indian Head, MD)
- *Ohio* Replacement Power and Propulsion Facility: $23,985K (Philadelphia, PA)
- Electronics Science and Technology Lab: $31,735K (NRL, DC)

An additional challenge we face is the need for increasing maintenance on our facilities as they age. There needs to be balance between repairing and maintaining our infrastructure and the need to build new capability. Balancing the infrastructure needs of our Laboratories with the needs of the fleet and our warfighters will always be a challenge. With the current constrained budget environment, the minor construction authority granted under section 2805 becomes even more important and holds significant potential for the revitalization of Naval Laboratory and Warfare/Systems Centers' infrastructure.

IMPROVING PROCESSES TO IMPROVE EFFECTIVENESS

DoN is focused as well on achieving meaningful process improvements and striving to get these into the "DNA" of the DoN workforce to continue to push for technological innovation within the framework of affordability and information protection.

DoN is leading efforts for program protection planning in compliance with ASD AT&L/SE with policy and guidance. We are developing policy for the supply-chain risk management initiative required by section 815 of the NDAA for Fiscal Year 2010. We are also engaged with DOD in the development of the Concept of Operations and Implementation Plan for section 941 of the NDAA for Fiscal Year 2013, requiring cleared defense contractors to report cyber intrusion events occurring on their networks.

We continue to deploy Open Systems Architecture engineering and business approaches to improve our systems, increase competition, and speed technology insertion. Last summer we ran a business innovation war game using crowd sourcing to identify novel ways to expand the implementation of Open Systems Architecture in DoN. As part of the game, hundreds of participants from Government and Academia developed 15 action plans. We are currently in the process of considering these ideas for follow-on actions.

The defense industrial base is a critical component of the Navy's RDT&E strategy. As part of the Department's Better Buying Power initiative to incentivize productivity and innovation in industry and government, the Navy is leveraging the OSD-developed Defense Innovation Marketplace website. The Assistant Secretary of Defense for Research and Engineering (ASD(R&E)) created the Defense Innovation Marketplace in 2011 as a resource for both the Department and industry to better align industry Independent Research & Development (IR&D) efforts while providing DoN personnel stronger connection to IR&D projects for current programs and future planning. To enhance the impact of the Defense Innovation Marketplace on the DoN's RDT&E efforts, DASN(RDT&E) and ONR are undertaking pilot programs to provide feedback to ASD(R&E) on ways to increase the utility of the Marketplace.

Finally, I have initiated a Systems Engineering streamlining effort to identify cumbersome work practices, costs of doing systems engineering business, and to enhance our workforce capability and readiness. We are focused on delivering engineering excellence and lateral integration with program test and program support activities, reducing duplications, and linking requirement to test and support planning. We are also looking at inter-organizational responsibilities vertically so that organizational authorities and responsibilities at the Secretariat, SYSCOMs, and the Warfare/Systems Centers align appropriately. DoN addresses our Systems Engineering workforce qualifications and assignments through our Technical Authority qualification process at the SYSCOM level, with oversight by my office. We have aligned this process with DOD Acquisition Workforce Improvement Act goals for a highly qualified Systems Engineering workforce.

SUMMARY

We have faced technological and budgetary challenges in the past year, but our goal remains the same: to ensure our sailors and marines are armed with technically superior capabilities. We can make certain this superiority continues through disciplined processes focused on affordability, executed by a skilled workforce with second-to-none technical capabilities, performing innovative state-of-the-art science and engineering in facilities. We have made great strides over this last year, and we look forward to continuing progress. Thank you for your support and the opportunity to appear before you today.

Senator HAGAN. Thank you.

Mr. Gooder.

STATEMENT OF KEVIN GOODER, PROGRAM INTEGRATION DIVISION CHIEF OF THE OFFICE OF THE DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE FOR SCIENCE, TECHNOLOGY AND ENGINEERING

Mr. GOODER. Thank you. Chairwoman Hagan, Ranking Member Fischer, and staff: I'm pleased to have the opportunity to provide testimony on the fiscal year 2015 Air Force S&T program. Dr. Walker is ill today and he sends his regrets for not being able to be here.

Globalization and the proliferation of technology mean we face threats across a wide spectrum and competition across all domains. As stated in the vision of the Chief of Staff of the Air Force, despite the best analysis and projections by national security experts, the time and place of the next crisis are never certain and are rarely what we expect.

Success and the guarantee of security in this dynamic environment require that we both take lessons learned from the last decade of conflict and creatively visualize the future strategic landscape. It's in this space, between learning from the past and keeping an open eye to the future, where we find opportunity.

Air Force scientists and engineers continue to evolve and advance game-changing and enabling technologies which will transform the landscape of how the Air Force flies, fights, and wins in air, space, and cyber space. In close coordination with the requirements, intelligence, and acquisition communities, we have structured our S&T program to address the highest priority needs of the Air Force, to execute a balanced and integrated program that is responsive to Air Force core missions, and to advance critical technical competencies needed to address future research.

The Air Force has matured its S&T planning process by improving the alignment between S&T efforts and capability gaps outlined in the Air Force Core Function Master Plans. We have brought together subject matter experts from the major commands, centers, and the Air Force Research Laboratory into capability collaboration teams. These teams work to fully understand documented capability needs that may require materiel solutions, determine where S&T is required, and then formulate research for potential technology solutions.

Our improved S&T planning process ensures our S&T investments are well-understood, aligned to warfighters' top capability gaps, structured for success, and poised for transition when completed.

The Air Force as a whole had to make difficult trades between force structure, readiness, and modernization in this year's President's budget submission. The Air Force S&T budget request is approximately $2.1 billion, which represents a 6.2 percent decrease from the fiscal year 2014 President's budget request. However, when compared to the overall Air Force Research, Development, Test, and Evaluation (RDT&E) account, which was decreased by 9 percent, the Air Force S&T fared well in the planning and programming process.

Our budget request rebalances basic research spending as part of the overall portfolio to increase emphasis on conducting technology demonstrations. It also emphasizes our efforts in game-changing technologies of hypersonics, autonomy, directed energy, and fuel-efficient propulsion technologies, which can affordably provide us the necessary range, speed, and lethality for operations in highly contested environments described in the 2014 Quadrennial Defense Review.

Even as we push the realm of the possible with research in game-changing technologies, we are increasing the effectiveness of our warfighters today by transitioning innovative technologies. For example, the Air Force Research Laboratory has taken a leading

technological role in supporting the Joint Space Operations Center (JSPOC) missions systems program at the Space and Missile Systems Center.

The laboratory initially deployed a modern data fusion and display prototype, moving away from the text-based system for the last 50 years, and now it provides continued upgrades for space operations. Our space operators at the JSPOC now have an easy-to-use Windows-type interface to track some 20,000 space objects. Another key technology on the path to transition at the JSPOC, it enables the rapid attribution of environmental effects on DOD's satellites and services, a key step in identifying hostile activities in the increasingly congested space domain.

As I stated earlier, our scientific opportunities lie between learning from the past and creatively visualizing the future. The increased laboratory hiring and personnel management authorities and flexibilities provided by Congress over the last several years have done much to improve our ability to attract the Nation's best talent to explore these opportunities.

However, we still have work to do to ensure the sustained quality of our laboratories. Long-term budget decreases and funding uncertainty leads to countless opportunities lost to discover new innovative technologies. As a result of sequestration alone, in fiscal year 2013 we cancelled, delayed, or rescoped over 100 contracts, resulting in increased costs and extended technology development schedules, ultimately delaying improved capabilities to the warfighter.

For example, the rescoping of work on the very sophisticated Ground-based Imaging of Objects in Extremely High Altitude Orbits will delay technology availability at least 1 year beyond the Air Force Space Command technology need date.

In closing, I firmly believe maintaining and even expanding our technological advantage is vital to ensuring assured access and freedom of action in air, space, and cyber space. The focused, balanced investments of the Air Force fiscal year 2015 S&T program are hedges against the unpredictable future and provide pathways to a flexible, precise, and lethal force at a relatively low cost in relation to the return on investment.

On behalf of the dedicated scientists and engineers of the Air Force S&T enterprise, thank you again for the opportunity to testify today and thank you for your continuing support of the Air Force S&T program.

[The prepared statement of Dr. Walker follows:]

PREPARED STATEMENT BY DR. DAVID E. WALKER

INTRODUCTION

Chairwoman Hagan, Ranking Member Fischer, members of the subcommittee, and staff, I am pleased to have the opportunity to provide testimony on the fiscal year 2015 Air Force Science and Technology (S&T) Program, especially during this unprecedented time in our history.

Our Nation is one of a vast array of actors in a complex, volatile, and unpredictable security environment. Globalization and the proliferation of technology mean we face threats across a wide spectrum and competition across all domains. We're confronted by ever-evolving adversaries ranging from one person with a single interconnected computer to sophisticated capable militaries and everything in between. We're also challenged by the shear pace of change among our adversaries fueled by profound information and technology diffusion worldwide. As stated by the Chief of

Staff of the Air Force in the Global Vigilance, Global Reach and Global Power For Our Nation vision, "despite the best analyses and projections by national security experts, the time and place of the next crisis are never certain and are rarely what we expect." Success and the guaranty of security in this dynamic environment require that we both take lessons learned from the last decade of conflict and creatively visualize the future strategic landscape. It's in this space, between learning from the past and keeping an open eye to the future, where we find opportunity.

The focused and balanced investments of the Air Force fiscal year 2015 S&T program are hedges against the unpredictable future and provide pathways to a flexible, precise and lethal force at a relatively low cost in in relation to the return on investment. The Under Secretary of Defense for Acquisition, Technology, and Logistics recently reminded us that complacency now and in the future is simply not an option. Maintaining, and even expanding, our technological advantage is vital to ensuring sustained freedom of access and action in air, space and cyberspace.

AIR FORCE FISCAL YEAR 2015 S&T PROGRAM

The Air Force as a whole had to make difficult trades between force structure (capacity), readiness, and modernization (capability) in the Service's fiscal year 2015 President's budget submission to recover from budget uncertainty over the 2 previous fiscal years. The Air Force fiscal year 2015 President's budget request for S&T is approximately $2.1 billion, which includes nearly $178 million in support of devolved programs consisting of High Energy Laser efforts and the University Research Initiative. This year's Air Force S&T budget request represents a decrease of $141 million or a 6.2 percent decrease from the fiscal year 2014 President's Budget request, a slightly larger reduction as compared to the overall Air Force topline reduction. This budget request rebalances basic research spending as part of the overall portfolio to increase emphasis on conducting technology demonstrations. The Air Force was able to reduce funding in the aerospace systems and materials areas while still advancing capabilities for the Air Force and the Department of Defense (DOD) by smartly leveraging research being conducted by the Defense Advanced Research Projects Agency (DARPA) in the hypersonics area.

We've learned a great deal over the last decade. The dedicated scientists and engineers of the Air Force Research Laboratory (AFRL) have successfully supported warfighters during conflicts in Iraq, Afghanistan, and North Africa through the rapid development of systems and capabilities including persistent intelligence, surveillance, and reconnaissance (ISR); data fusion and integration from multiple sensors; and near real-time monitoring of some orbiting U.S. and commercial spacecraft assets. With the pivot to the Pacific as outlined in the Defense Strategic Guidance, we must continue to evolve and advance "game-changing" and enabling technologies which can transform the landscape of how the Air Force flies, fights and wins against the high-end threats in contested environments envisioned in the future.

In close coordination with the requirements, intelligence and acquisition communities, we have structured our Air Force fiscal year 2015 S&T Program to address the highest priority needs of the Air Force across the near-, mid-, and far-term; execute a balanced and integrated program that is responsive to Air Force core missions; and advance critical technical competencies needed to address the full range of product and support capabilities. The Air Force continues to focus efforts to deliberately align S&T planning, technology transition planning, development planning and early systems engineering. The linkages between these planning activities are critical to initiating acquisition programs with more mature technologies and credible cost estimates, and we are institutionalizing these linkages in Air Force policy. Air Force S&T provides critical inputs at several phases of the Chief of Staff of the Air Force's Air Force 2023 strategic planning effort including helping to shape the "realm of the possible" when envisioning long term strategy, offering technologies to expand the strategic viewpoint and identifying potential solutions to requirements and capability gaps. Our forthcoming updated Air Force S&T strategy focuses on investing in S&T for the future, as well as leverages our organic capacity, and the capacity of our partners (domestic and international), to integrate existing capabilities and mature technologies into innovative, affordable, and sustainable solutions. This flexible strategy provides us the technological agility to adapt our S&T Program to dynamic strategic, budgetary, and technology environments and will shape prioritized actionable S&T plans.

NEAR-TERM TECHNOLOGY TRANSITION

The Air Force continues to move our Flagship Capability Concept (FCC) projects toward transition to the warfighter. A well-defined scope and specific objectives desired by a Major Command (MAJCOM) are key factors in commissioning this type

of an Air Force-level technology demonstration effort. The technologies are matured by the Air Force Research Laboratory with the intent to transition to the acquisition community for eventual deployment to an end user. These FCCs are sponsored by the using MAJCOM and are vetted through the S&T Governance Structure and Air Force Requirements Oversight Council to ensure they align with Air Force strategic priorities. In fiscal year 2014, the Air Force successfully completed and transitioned the Selective Cyber Operations Technology Integration (SCOTI) FCC and will continue work on the High Velocity Penetrating Weapon (HVPW) and Precision Airdrop (PAD) FCCs.

AFRL delivered the SCOTI FCC to the Air Force Life Cycle Management Center (AFLCMC) in September 2013, on time, on budget and within specification. SCOTI consists of cyber technologies capable of affecting multiple nodes for the purposes of achieving a military objective and gaining cyberspace superiority. SCOTI's robust, modular architecture provides vital extensibility to allow cyber warriors to keep pace with rapidly evolving threats. AFLCMC is evaluating the delivered SCOTI architecture for integration with operational cyber mission software to directly meet the needs of a major capability area in the Air Force Cyberspace Superiority Core Function Master Plan. By successfully meeting the requirements of the stakeholder-approved Technology Transition Plan, SCOTI is the first FCC to transition and will serve as a baseline for current and future integrated cyber tools to provide needed effects for the warfighter.

The HVPW FCC was established to demonstrate critical technologies to reduce the technical risk for a new generation of penetrating weapons to defeat difficult, hard targets. This FCC matures technologies that can be applied to the hard target munitions acquisition including guidance and control, terminal seeker, fuze, energetic materials and warhead case design. This effort develops improved penetration capability of hard, deep targets containing high strength concrete with up to 2,500 feet per second (boosted velocity) impact in a GPS-degraded environment. This technology will demonstrate penetration capability of a 5,000 pound-class gravity weapon with a 2,000 pound weapon thus enabling increased loadout for bombers and fighters. Tests will demonstrate complete warhead functionality, and are scheduled to be completed the end of September 2014.

The PAD FCC was commissioned 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. To date, PAD FCC efforts have focused on: early systems engineering analysis to determine major error sources, data collection, flying with crews, wind profiling, bundle tracking, and designing modeling and simulation activities. The Air Force Research Laboratory completed the bundle tracker development in fiscal year 2013 and in fiscal year 2014 began wind profile sensor development.

GAME-CHANGING TECHNOLOGIES

The Air Force S&T Program provides technology options to enable operations in anti-access, area-denial environments and transform the way we fly, fight and win in air, space and cyberspace. To illustrate how, I will highlight some of our efforts in game-changing and enabling technology areas:

Hypersonics

Speed provides options for engagement of time sensitive targets in anti-access/area-denial environments, and improves the survivability of Air Force systems. Hypersonic speed weapons are also a force multiplier as fewer are required to defeat difficult targets and fewer platforms are required from greater standoff distances. The Air Force S&T community continues to execute the high speed technology roadmaps developed with industry over the last 3 years. We are also building on the success of the X–51A Waverider scramjet engine hypersonic demonstrator, which on 1 May 2013 reached an approximate Mach Number of 5.1 during its fourth and final flight. The Air Force has focused multi-faceted, phased investments in game-changing technology for survivable, time-critical strike in the near term and a penetrating regional intelligence, surveillance, and reconnaissance (ISR) and strike aircraft in the far term.

The near-term strike effort is the High Speed Strike Weapon (HSSW) program. This effort will mature cruise missile technology to address many of those items necessary to realize a missile in the hypersonic speed regime including: modeling and simulation; ramjet/scramjet propulsion; high temperature materials; guidance, navigation, and control; seekers and their required apertures; warhead and subsystems; thermal protection and management; manufacturing technology; and compact energetic booster technologies.

The Air Force conducts research and development in all aspects of hypersonic technologies in partnership with NASA, DARPA, and industry/academic sectors. The HSSW program will include two parallel integrated technology demonstration efforts to leverage DARPA's recent experience in hypersonic technologies that are relevant to reduce risk in key areas. One of the demonstrations will be a tactically-relevant demonstration of an air breathing missile technology that is compatible with Air Force fifth generation platforms including geometric and weight limits for internal B–2 Spirit bomber carriage and external F–35 Lightening II fighter carriage. This demonstration will build on the X–51 success and will include a tactically compliant engine start capability and launch from a relevant altitude.

For the other demonstration, the Air Force and DARPA will seek to develop technologies and demonstrate capabilities that will enable transformational changes in prompt, survivable, long-range strike against using the Tactical Boost Glide (TBG) concept. The objective of the TBG effort is to develop and demonstrate the critical technologies that will enable an air launched tactical range, hypersonic boost-glide missile. Both efforts will build upon experience gained through recent hypersonic vehicle development and demonstration efforts supported by DARPA and the Air Force. These demonstrations are traceable to an operationally relevant weapon that could be launched from existing aircraft. Technology and concepts from these efforts will provide options for an operational weapon system for rapidly and effectively prosecuting targets in highly contested environments.

Autonomy

Analysis of these future operating environments has also led the Air Force to invest in game-changing advances in autonomous systems. Autonomous systems can extend human reach by providing potentially unlimited persistent capabilities without degradation due to fatigue or lack of attention. The Air Force S&T Program is developing technologies that realize true autonomous capabilities including those that advance the state-of-the-art in machine intelligence, decisionmaking, and integration with the warfighter to form effective human-machine teams.

The greater use of autonomous systems increases the capability of U.S. forces to execute well within the adversaries' decision loops. Human decisionmakers intelligently integrated into autonomous systems enable the right balance of human and machine capability to meet Air Force challenges in the future. The Air Force S&T Program invests in the development of technologies to enable warfighters and machines to work together, with each understanding mission context, sharing understanding and situation awareness, and adapting to the needs and capabilities of the other. The keys to maximizing this human-machine interaction are: instilling confidence and trust among the team members; understanding of each member's tasks, intentions, capabilities and progress; and ensuring effective and timely communication. All of which must be provided within a flexible architecture for autonomy, facilitating different levels of authority, control and collaboration. Current research is focused on understanding human cognition and applying these concepts to machine learning. Efforts develop efficient interfaces for an operator to supervise multiple unmanned air systems (UAS) platforms and providing the ISR analyst with tools to assist identifying, tracking, targets of interest.

Autonomy also allows machines to synchronize activity and information. Systems that coordinate location, status, mission intent, and intelligence and surveillance data can provide redundancy, increased coverage, decreased costs and/or increased capability. Research efforts are developing control software to enable multiple, small UASs to coordinate mission tasking with other air systems or with ground sensors. Other research efforts are developing munition sensors and guidance systems that will increase operator trust, validation, and flexibility while capitalizing on the growing ability of munitions to autonomously search a region of interest, provide additional situational awareness, plan optimum flight paths, de-conflict trajectories, optimize weapon-to-target orientation, and cooperate to achieve optimum effects.

Finally, before any system is fielded, adequate testing must be conducted to demonstrate that it meets requirements and will operate as intended. As technologies with greater levels of autonomy mature, the number of test parameters will increase exponentially. Due to this increase, it will be impractical to verify and validate autonomous system performance, cost-effectively, using current methods. The Air Force is developing test techniques that verify the decisionmaking and logic of the system and validate the system's ability to appropriately handle unexpected situations. Efforts are focused at the software-level and build to overall system to verify codes are valid and trustworthy. The Air Force will demonstrate the tools needed to ensure autonomous systems operate safely and effectively in unanticipated and dynamic environments.

Directed Energy

With a uniquely focused directorate within AFRL, the Air Force is in a leading position in the game-changing area of directed energy. These technologies, including high powered microwave (HPM) and high energy lasers (HELs), can provide distinctive and revolutionary capabilities to several Air Force and joint mission areas. Laser technologies are rapidly evolving for infrared seeker jamming, secure communications in congested and jammed spectrum environments, space situational awareness, and vastly improved ISR and target identification capabilities at ever increasing ranges. To get HELs to a weapon system useful to the Air Force, our S&T program invests in research in laser sources from developing narrow line width fiber lasers to scaling large numbers of fiber lasers with DARPA and MDA. Since HEL devices are not sufficient for a weapon, the Air Force directed energy research also includes beam control, atmospheric compensation, acquisition, pointing, tracking, laser effects, and physics based end-to-end modeling and simulation. The Air Force also funds the High Energy Laser Joint Technology Office (HEL JTO) which supports all of the services by being the key motivator of high power laser devices such as the successful 100 kilowatt, lab-scale Joint High Power Solid State Laser (JHPSSL) and other funding many smaller successes. The current primer program, which is jointly funded with core Army and Air Force funds, is the Robust Electric Laser Initiative (RELI). The initiative funds efforts to develop designs for efficient and weaponizable solid state lasers with options leading to a 100 kilowatt laser device.

Our HPM S&T will complement kinetic weapons to engage multiple targets, neutralizing communication systems, computers, command and control nodes, and other electronics, with low collateral damage for counter-anti-access/area denial in future combat situations. The Air Force is using the results of from the highly successful Counter-Electronics High Power Microwave Advanced Missile Project (CHAMP) Joint Capabilities Technology Demonstration (JCTD) to inform an effort known as Non-Kinetic Counter Electronics (NKCE). NKCE is currently in pre-Alternative of Alternatives (AoA) phase, with an AoA potentially starting in fiscal year 2015. The AoA will examine the cost and performances for kinetic, non-kinetic, and cyber options for air superiority and seeks to have a procured and operational weapon system to support the targets and requirements of the combatant commanders in the mid-2020 timeframe. In parallel, the Air Force S&T Program is continuing HPM research and development to provide a more capable and smaller counter-electronics system that can fit onto a variety of platforms.

The DOD directed energy research community is highly integrated and the Air Force leverages the work of other agencies. For example, the Air Force is working with the Missile Defense Agency on integrated electro-optical/infrared pulsed-laser targeting to enhance situational awareness and increase survivability by enabling the use of legacy weapons in the 2016 timeframe. In addition, the Air Force is partnering with DARPA on the Demonstrator Laser Weapon System, a ground-based fully integrated laser weapon system demonstration over the next 2 fiscal years and an Air-to-Air Defensive Weapon Concept.

FUEL EFFICIENCY TECHNOLOGIES

For the longer term reduction in energy demand, the Air Force is investing in the development of adaptive turbine engine technologies which have the potential to reduce fuel consumption while also increasing capability in anti-access/area denial environments through increased range and time-on-station. The Air Force has several priority efforts as part of the DOD's Versatile Advanced Affordable Turbine Engine (VAATE) technology program. VAATE is a coordinated Army, Navy, and Air Force plan initiated in 2003 to develop revolutionary advances in propulsion system performance, fuel efficiency and affordability for the DOD's turbine engine powered air platforms.

The initial effort, Adaptive Versatile Engine Technology (ADVENT), began in fiscal year 2007 and is set to complete this year. General Electric is currently in final testing of the ADVENT engine technologies which include a next generation high pressure ratio core and an adaptive fan in a third stream engine architecture.

The Adaptive Engine Technology Development (AETD) program, our accelerated follow-on adaptive engine effort for the combat Air Force, is progressing very well. The objective of AETD is to fully mature adaptive engine technologies for low risk transition to multiple combat aircraft alternatives ready for fielding as soon as the early 2020's. The effort will deliver a preliminary prototype engine design, substantiated by major hardware demonstrations, that can be tailored to specific applications when the DOD is ready to launch new development programs. The overarching goal of AETD is to mature adaptive engine technologies so that these programs can

launch with significantly lower risk than previous propulsion development programs.

The High Energy Efficient Turbine Engine (HEETE) S&T effort is our flagship large engine effort under the VAATE technology program. The HEETE effort's primary objective is to demonstrate engine technologies that enable a 35 percent fuel efficiency improvement versus the VAATE year 2000 baseline, or at least 10 percent beyond current VAATE technology capabilities being demonstrated in the ADVENT program.

The Air Force Research Laboratory and industry have conducted a number of HEETE payoff studies that show significant potential benefits to future transport and ISR aircraft (e.g., 18 percent to 30 percent increase in strategic transport range, 45 percent to 60 percent increase in tactical transport radius, and 37 percent to 75 percent increase in ISR UAV loiter time). A study of Air Force's fleet fuel usage showed that introduction of HEETE-derived engines into the mobility and the tanker fleet would enable fuel savings of approximately 203 million gallons per year by the mid-2030s.

Investments in these efforts help us reduce energy demand, bridge the "valley of death" between S&T and potential acquisition programs, and help maintain the U.S. industrial technological edge and lead in turbine engines.

ENABLING TECHNOLOGIES

In addition to these game-changing technologies, the Air Force S&T Program also invests in many enabling technologies to facilitate major advances and ensure maximum effectiveness in the near-, mid-, and far term:

Cyber

Operations in cyberspace magnify military effects by increasing the efficiency and effectiveness of air and space operations and by helping to integrate capabilities across all domains. However, the cyberspace domain is increasingly contested and/or denied and the Air Force faces risks from malicious insiders, insecure supply chains, and increasingly sophisticated adversaries. Fortunately, cyberspace S&T can provide assurance, resilience, affordability, and empowerment to enable the Air Force's assured cyber advantage.

In 2012, the Air Force developed Cyber Vision 2025 which described the Air Force vision and blueprint for cyber S&T spanning cyberspace, air, space, command and control, intelligence, and mission support. Cyber Vision 2025 provides a long-range vision for cyberspace to identify and analyze current and forecasted capabilities, threats, vulnerabilities and consequences across core Air Force missions in order to identify key S&T gaps and opportunities. The Air Force's cyber S&T investments for fiscal year 2015 are aligned to the four themes identified in Cyber Vision 2025: Mission Assurance, Agility and Resilience, Optimized Human-Machine Systems, and Foundations of Trust.

Air Force S&T efforts in Mission Assurance seek to ensure survivability and freedom of action in contested and denied environments through enhanced cyber situational awareness for air, space, and cyber commanders. Current research efforts seek to provide dynamic, real-time mapping and analysis of critical mission functions onto cyberspace. This analysis includes the cyber situation awareness functions of monitoring the health and status of cyber assets, and extends to capture how missions flow through cyberspace. This work seeks to provide commanders with the ability to recognize attacks and prioritize defensive actions to protect assets supporting critical missions. Other research efforts develop techniques to measure and assess the effects of cyber operations and integrate them with cross-domain effects to achieve military objectives.

Research in Agility and Survivability develops rapid and unpredictable maneuver capabilities to disrupt the adversaries' cyber "kill chain" along with their planning and decisionmaking processes and hardening cyber elements to improve the ability to fight through, survive, and rapidly recover from attacks. Air Force S&T efforts are creating dynamic, randomizable, reconfigurable architectures capable of autonomously detecting compromises, repairing and recovering from damage, and evading threats in real-time. Cyber resiliency is enhanced through an effective mix of redundancy, diversity, and distributed functionality that leverages advances in virtualization and cloud technologies.

The Air Force works to maximize the human and machine potential through the measurement of physiological, perceptual, and cognitive states to enable personnel selection, customized training, and (user, mission, and environment) tailored augmented cognition. S&T efforts develop visualization technologies to enable a global common operational picture of complex cyber capabilities that can be readily manipulated to support Air Force mission-essential functions (MEFs). Other efforts seek

to identify the critical human skills and abilities that are the foundation for superior cyber warriors and develop a realistic distributed network training environment integrated with new individualized and continuous learning technologies.

The Air Force is developing secure foundations of computing to provide operator trust in Air Force weapon systems that include a mix of embedded systems, customized and militarized commercial systems, commercial off-the-shelf (COTS) equipment, and unverified hardware and software that is developed outside the United States. Research into formal verification and validation of complex, large scale, interdependent systems as well as vulnerability analysis, automated reverse engineering, and real-time forensics tools will enable designers to quantify the level of trust in various components of the infrastructure and to understand the risk these components pose to the execution of critical mission functions. Efforts to design and build secure hardware will provide a secure root-of-trust and enable a more intelligent mixing of government off-the-shelf and COTS components based on the systems' security requirements.

Cognitive Electronic Warfare

With the highly contested future EW environment, we have focused S&T efforts on creating the ability to rapidly respond to threats. This is accomplished by developing the analytic ability to understand a complex threat environment and determine the best combination of techniques across all available platforms. In addition, leveraging cognitive and autonomy concepts improves the cycle time between emergence of a threat and development of an effective response. This system-of-systems solution approach is implemented in a physics based interactive simulation capability to evaluate novel concepts. The Air Force is also developing technologies to enhance survivability and improve situational awareness in the electro-optical (EO)/infrared (IR) and radio frequency (RF) warning and countermeasures area. New electronic components (antennas, amplifiers, processors) will improve the ability to detect threats with emphasis on advanced processing and software to assess threats in a crowded RF environment. This includes solutions to detect and defeat infrared and optical threats. These will enable protection against autonomous seekers using multi-spectral tracking.

Space Situational Awareness/Space Control

The ability to counter threats, intentional or unintentional, in the increasingly congested and contested space domain begins with Space Situational Awareness (SSA). The SSA S&T investments needed to maintain our core Space Superiority and Command and Control missions in such an environment are substantial and include research in Assured Recognition and Persistent Tracking of Space Objects, Characterization of Space Objects and Events, Timely and Actionable Threat Warning and Assessment, and Effective Decision Support through Data Integration and Exploitation. The Air Force works across these areas in cooperation with the DOD, intelligence community, and industry.

To help build a holistic national SSA capability, the Air Force's S&T investment is designed to exploit our in-house expertise to innovate in areas with short-, mid-, and long-term impact that are not already being addressed by others. Examples include working with Federally Funded Research and Development Centers and academia to attack the deep space uncorrelated target association problem to improve custody of space objects and reduce the burden on the space surveillance network; better conjunction assessment and re-entry estimation algorithms to reduce collision probabilities and unnecessary maneuvers; and infrared star catalog improvement to ease observation calibrations. These products have recently transitioned to national SSA capabilities. Advanced component technologies developed with industry include visible focal plane arrays, deployable baffles and lenses to meet performance, and cost and weight requirements for future space-based surveillance systems.

As part of the Air Force Research Laboratory's long history of proving new technologies in relevant environments, the Automated Navigation and Guidance Experiment for Local Space (ANGELS) program examines techniques to provide a clearer picture of the environment around our vital space assets through safe, automated spacecraft operations above Geosynchronous Earth Orbit (GEO). Equipped with significant detection, tracking and characterization technology, ANGELS will launch in 2014. It will maneuver around its booster's upper stage and explore increased levels of automation in mission planning and execution, enabling more timely and complex operations with reduced footprint. Additional indications and warning work focuses on change detection and characterization technologies to provide key observables that improve response time and efficacy.

Satellite Resilience

Our Nation and our military are heavily dependent on space capabilities. With an operational space domain that is becoming increasingly congested, competitive and contested, the Air Force has seen the need for development of technologies to increase resilience of our space capabilities. The satellites upon which we rely so heavily must be able to avoid or survive threats, both man-made and natural, and to operate through and subsequently quickly recover should threat or environmental effects manifest. To this end, the Air Force S&T Program has increased technological investment in tactical sensing and threat warning, reactive satellite control, and hardening.

Satellites today are equipped with a wide range of sensors, that, if exploited in new ways and/or coupled with new hosted threat sensing technologies could yield significant increases to tactical sensing and threat warning. The Air Force pursues a range of internally-focused health and status sensing (e.g. structural integrity, thermal, cyber) and externally focused object or phenomena sensing (e.g. space environment, threat sensing, directed energy detection) technologies, and a range of data fusion approaches to maximize the timeliness and confidence of that warning. While tactical warning is vital, it is only immediately helpful when a satellite is able to tactically respond in some way to avoid a threat or minimize its effects. Any choice of a response requires some means of reconciling warning with viable courses of action available. The Air Force focuses on efforts specifically dedicated to tailoring satellite control based on tactical warning inputs. Finally, hardening technologies refers to a range of both passive and active capabilities that, when selected and executed, could result in threat avoidance, lessening their effects or recovering lost capability more quickly. For example, for particular types of threats, dynamic configuration changes, optical protection, cyber quarantine, dynamic thermal management or possibly maneuvers might achieve the desired protection.

Precision Navigation and Timing

Most U.S. weapon systems rely on the Global Positioning System (GPS) satellites to provide the required position navigation and timing (PNT) to function properly. This reliance has created a vulnerability which is being exploited by our adversaries through development of jammers to degrade access to the GPS signals. For success in the long term, Air Force S&T is improving the robustness of military GPS receivers and also developing several non-GPS based alternative capabilities including exploitation of other satellite navigation constellations, use of new signals of opportunity, and incorporation of additional sensors such as star trackers and terrain viewing optical systems. These receivers provide new navigation options with different accuracy depending on available sensors and computational power. Rapid progress is being made on advanced Inertial Measurement Units based on cold atom technologies. These units have the potential to provide accurate PNT for extended periods without any external update. Together, these approaches will provide future options to enable the Air Force mission to continue in contested and denied environments.

Assured Communications

Assured communications are critical to the warfighter in all aspects of the Air Force core missions. The Air Force S&T Program is developing technologies to counter threats to mission performance, such as spectrum congestion and jamming, and to maintain or increase available bandwidth through access to new portions of the radio frequency spectrum, alleviating pressure on DOD spectrum allocations. Future ability to use new spectrum will increase DOD communications architecture capacity and affordability, by requiring fewer expensive, high capacity gateways. Additional bandwidth will allow improved anti-jam communications performance and higher frequency communications, which will reduce scintillation losses for nuclear command and control (C2). The performance enhancements would directly improve the ability of remotely-piloted aircraft to transmit images and data (ISR) and improve command and control assurance.

Efforts in Assured Communications include the Future Space Communications effort which includes research to characterize and provide new spectrum for future military space communications through the W/V-band Space Communications Experiment (WSCE). WSCE will characterize and model the atmospheric effects of upper V-band and W-band (71–76 GHz and 81–86 GHz) signal transmission. Space-based data collection and atmospheric attenuation model development is necessary to provide the statistics necessary to design a future satellite communications architecture that will allow use of the currently empty V- and W-band spectrum.

Long-Range Sensing

For the past decade the Air Force has provided near persistent ISR for Combatant Commanders conducting operations in the uncontested air environments of Iraq and Afghanistan. We do not see the appetite for ISR waning in the future. However, the ability to perform effective sensing in anti-access/area denial and contested environments is threatened by many new and different challenges rarely seen during the past 10 years of permissive environment operations. In the past, airborne collection platforms conducted airborne ISR outside of the lethal range of air defense systems. Today, however, the modern and evolving foreign Integrated Air Defense Systems (IADS) of our adversaries have increased lethality and significantly improved engagement capabilities which will force ISR aircraft to fly at longer stand-off distances. The effectiveness of current precision weapons will be reduced with distance limiting the ability to accurately detect, identify and geo-locate targets.

The Air Force S&T Program is focused on significantly improving our sensing ability to adequately address the challenges of extended range ISR collection. The efforts include: (1) next generation RF sensing for contested spectrum environments in which long stand-off sensing is primarily focused on all-weather ISR using traditional active radar modes at ranges of greater than 100 miles; (2) passive RF Sensing in which signals of opportunity are exploited to detect, identify and locate targets through the use of passive multi-mode and distributed multi-static techniques; (3) laser radar sensing focused on enhancing target identification through the use of synthetic aperture laser radar and also addressing high resolution wide-area three dimensional imaging through advancements in direct detection ladar; and (4) passive EO/IR sensing to enhance capabilities to detect and track difficult targets, improve target identification at long standoff ranges and perform material identification through advancing hyperspectral and stand-off high resolution imaging technology.

Live, Virtual, and Constructive

The Air Force continues to develop and demonstrate technologies for Live, Virtual, and Constructive (LVC) operations to maintain combat readiness. The training need for LVC is real while training costs are increasing and threat environments are complex. In particular, realistic training for anti-access/area-denial environments is not available. During a recent demonstration of LVC capability for tactical forces at Shaw AFB, SC, AFRL LVC research capability was integrated in operations with an F–16 Unit Training Device (a virtual simulator) to simultaneously interoperate with a mix of live F–16 aircraft, other virtual simulations, and high fidelity computer-generated constructive players. This mix of players enabled the real time and realistic portrayal and interaction of other strike package assets and aggressor aircraft with a level of complexity that could not be achieved if limited to live assets, given the expense and availability of them to support the scenarios. LVC S&T has the capability to provide greater focused training for our warfighters across a range of operational domains such as tactical air, special operations, cyber, ISR, and C2. The Air Force is exploring a fifth generation LVC Proof of Concept set of demonstrations that would validate the requirements for a formal program of record for LVC.

Basic Research

The development of revolutionary capabilities requires the careful investment in foundational science to generate new knowledge. Our scientists discover the potential military utility of these new ideas and concepts, develop this understanding to change the art-of-the-possible and then transition the S&T for further use. Air Force basic research sits at the center of an innovation network that tracks the best S&T in the DOD, with our partners in the Army, the Navy, DARPA, and the Defense Threat Reduction Agency (DTRA), while monitoring the investments and breakthroughs of the NSF, NASA, NIST, and the Department of Energy. Air Force scientists and engineers watch and collaborate with the best universities and research centers from around the world in open, publishable research that cuts across multiple scientific disciplines aligned to military needs.

For example, Air Force basic research played a role in the Air Force's successful CHAMP technology demonstration discussed earlier. While the CHAMP demonstration required extensive applied research and advanced technology development, fundamental basic research investment in both supercomputers and computational mathematics provided a virtual prototyping capability called Improved Concurrent Electromagnetic Particle-In-Cell for directed energy concepts to Air Force researchers. This allowed new ideas to be studied effectively and affordably on the computer without costly manufacture for every iteration of the technology. Virtual prototyping was a critical enabling technology, and resulted from nearly two decades of steady,

targeted investments in fundamental algorithms that then transitioned to a capability driving technology development in Air Force laboratories and in industry.

Manufacturing Technologies

A key cross-cutting enabling technology area is in developing materials, processes, and advanced manufacturing technologies for all systems including aircraft, spacecraft, missiles, rockets, ground-based systems and their structural, electronic and optical components. The fiscal year 2015 Air Force S&T Program emphasizes materials work from improved design and manufacturing processes to risk reduction through assessing manufacturing readiness.

The Air Force's investment in additive manufacturing technologies offers new and innovative approaches to the design and manufacture of Air Force and DOD systems. Additive manufacturing, or the process of joining materials to make objects from 3D model data layer by layer, changes the conventional approach to design, enabling a more direct design to requirements. As opposed to subtractive processes like machining, additive manufacturing offers a whole new design realm in which geometric complexity is not a constraint and material properties can be specifically located where needed. As with the insertion of all advanced materials and processes, the Air Force strives to ensure appropriate application and proper qualification of additive manufacturing for warfighter safety and system performance.

Currently, the Air Force is invested in more than a dozen programs ranging from assisting in major high-Technology Readiness Level (TRL) qualification programs to mid-TRL process improvement programs, to low-TRL process modeling and simulation programs. Overall, we have established a strategic program to quantify risk for implementation and to advance the understanding of processing capabilities. We have identified multiple technical areas that require Air Force investment and are developing an initiative that integrates pervasive additive manufacturing technologies across Air Force sectors, spanning multiple material classes from structural, metallic applications to functional, electronic needs.

The Air Force leverages its additive manufacturing resources and interests with the administration's National Network for Manufacturing Innovation (NNMI) to support the acceleration of additive manufacturing technologies to the U.S. manufacturing sector to increase domestic competitiveness. In fiscal year 2013, the Air Force played a key role in supporting the NNMI National Additive Manufacturing Innovation Institute called "America Makes." The Air Force, on behalf of the Office of the Secretary of Defense, led an interagency effort , which included DOD, DOE, DOC/NIST, NASA, and NSF, to launch a $69 million public-private partnership in Additive Manufacturing.

Cooperatively working with the private partner team lead, the Air Force helped "America Makes" achieve significant accomplishments in its first year. After opening it headquarters in Youngstown, Ohio in September 2012, the "America Makes" consortium has grown to approximately 80 member organizations consisting of manufacturing companies, universities, community colleges, and non-profit organizations. A shared public-private leadership governance structure, organizational charter, and intellectual property strategy were implemented and two project calls were launched in Additive Manufacturing and 3D printing technology research, discovery, creation, and innovation. So far, more than 20 projects totaling approximately $29 million and involving more than 75 partners have been started covering a broad set of priorities including advances in materials, design and manufacturing processes, equipment, qualification and certification, and knowledge base development. "America Makes" serves as an example for future NNMI institutes and the Air Force has provided support to establish two additional DOD sponsored institutes of manufacturing innovation.

The Air Force Manufacturing Technology program continues to lead the way in developing methods and tools for Manufacturing Readiness Assessments and continues to lead assessments on new technology, components, processes, and subsystems to identify manufacturing maturity and associated risk. Increasing numbers of weapon system prime contractors and suppliers have integrated Manufacturing Readiness into their culture which aids in product and process transition and implementation, resulting in reduced cost, schedule and performance risk. Benefits from the advanced manufacturing propulsion initiative continue to accrue in the form of reduced turbine engine cost and weight through advanced manufacturing of light weight castings and ceramic composites and improved airfoil processing. Advanced next generation radar and coatings affordability projects continue to reduce cost and manufacturing risk to systems such as the F–22 and F–35 aircraft. The Air Force Manufacturing Technology investment continues to make a significant impact on the F–35 program in particular, driving down life cycle costs by over $3 billion, with

a number of ongoing projects that will benefit multiple F–35 program Integrated Product Teams.

The Air Force is also leveraging basic research efforts to improve sustainment of legacy systems. The "Digital Twin" concept combines the state-of-the-art in computational tools, advanced sensors, and novel algorithms to create a digital model of every platform in the fleet. Imagine a world where instead of using fleet averages for the maintenance and sustainment of an airframe, there is a computer model of each plane that records all the data from each flight, integrates the stress of the flights into the history of the actual materials on the platform, and continually checks the health of vital components. Thus, the computer model mimics all the missions of the physical asset, thereby allowing us to do maintenance exactly when required. This is the airplane equivalent of individualized medicine, making sure that each individual asset of the Air Force is set to operate at peak performance. Interdisciplinary basic research in material science, fundamental studies in new sensors and novel inquiry into new, transformational computer architecture enable the Digital Twin concepts. These foundational studies are tightly integrated with applied research, both in the Air Force Research Laboratory as well as efforts in NASA, to drive forward the S&T to permit breakthroughs in affordable sustainment.

RAPID INNOVATION PROGRAM AND SMALL BUSINESS INNOVATION RESEARCH

The Air Force recognizes small businesses are critical to our defense industrial base and essential to our Nation's economy. The U.S. relies heavily on innovation through research and development as the small businesses continue to be a major driver of high-technology innovation and economic growth in the United States. We continue to engage small businesses through the Rapid Innovation Program, and the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.

The Rapid Innovation Program has been an excellent means for the Air Force to communicate critical needs and solicit vendors to respond with innovative technology solutions. The program provides a vehicle for businesses, especially small businesses, to easily submit their innovative technologies where they feel it will best meet military needs. The Air Force benefits from the ability to evaluate proposed innovative technologies against critical needs, and selecting the most compelling for contract award. The response to the program has been overwhelming, and instrumental to the transition of capability by small businesses. Over the last 3 years, the Air Force has received over 2,200 white paper submissions from vendors offering solutions to critical Air Force needs. We have awarded over 60 projects directly to small businesses and anticipate awarding another 25 by the end of this fiscal year.

Projects from the fiscal year 2011 Rapid Innovation Program are now maturing and showing great promise. For example, one project developed a handheld instrument for quality assurance of surface preparation processes used in manufacturing of the F–35 aircraft. Current F–35 aircraft manufacturing processes require manual testing of 30,000 nut plates on each plane to ensure correct bonding of materials. The current failure rate is averaging 1 percent or 300 nut plates. Each failure requires individual re-preparation and re-bonding with supervisory oversight. The Rapid Innovation Program project handheld device will significantly reduce the failure rate of adhesively bonded nut plates. In turn, this will reduce rework and inspection costs, increase aircraft availability, assist Lockheed Martin in achieving its target production rate, and reduce repetitive injury claims from employees. Lockheed Martin has been very closely monitoring this technology and will be completing a return-on-investment review in the coming months following prototype evaluation.

The Air Force continues to collaborate with other Federal agencies and Air Force acquisition programs to streamline our SBIR and STTR processes. We are also collaborating with the Air Force's Small Business office (SAF/SB) to implement the provisions of the reauthorization and to assist in maximizing small business opportunities in government contracts while enhancing the impact and value of small businesses.

For example, to improve the effectiveness of SBIR investments, the Air Force Research Laboratory has started to strategically bundle, coordinate, and align Air Force SBIR topics against top Air Force priorities identified by Air Force Program Executive Officers (PEO). In the Fall of 2013, the Laboratory began a pilot effort with the Air Force Program Executive Officer for Space to focus the combined investments of approximately 45 SBIR Phase I awards and 15 Phase II SBIR awards on the identified, top priority challenge of transforming our military space-based PNT capabilities.

In conjunction with this strategic initiative, the Air Force is also energizing efforts to seek out and attract non-traditional participants, which are small businesses with skills, knowledge and abilities relevant to the bundled topics, in SBIR awards but who, for various reasons, do not routinely participate in the SBIR proposal process. This strategic concentration of small business innovation against top priorities will ultimately enhance the transitioning of small business innovation, raise the visibility and importance of those investments, and take advantage of the Nation's small business innovation. If proven successful, the Air Force will begin to institutionalize it as a model for organizing and aligning SBIR topics against other top priority issues.

One recent SBIR project developed innovative low profile and conformal antennas to allow air platforms, including small Remotely Piloted Aircraft (RPA), to operate more aerodynamically and ground vehicles to operate more covertly in areas where Improvised Explosive Devices (IEDs) are a threat. The wideband low profile antenna assembly for vehicle Counter Radio Controlled IED Electronic Warfare (CREW) systems operates efficiently from VHF to S-band, and at a height of less than 3 inches, greatly reduces visual signature. The wideband conformal antenna technologies developed for RPA systems operate from UHF through S-band and minimize the number of required antennas, significantly reducing weight and aerodynamic drag.

WORLD CLASS WORKFORCE

Maintaining our U.S. military's decisive technological edge requires an agile, capable workforce that leads cutting-edge research, explores emerging technology areas, and promotes innovation across government, industry and academia. Nurturing our current world class workforce and the next generations of science, technology, engineering, and mathematics (STEM) professionals is an Air Force, DOD and national concern. We must be able to recruit, retain and develop a capable STEM workforce in the face of worldwide competition for the same talent.

The Air Force continues to focus on developing technical experts and leaders who can provide the very best research and technical advice across the entire lifecycle of our systems, from acquisition, test, deployment and sustainment. After yielding success since 2011, the original Bright Horizons, the Air Force STEM Workforce Strategic Roadmap, is currently being updated with new goals and objectives to reflect the current environment. The Air Force has also developed a soon-to-be-released Engineering Enterprise Strategic Plan aimed at recruiting, developing and retaining the scientist and engineer talent to meet the future need of the Air Force.

The increased Laboratory hiring and personnel management authorities and flexibilities provided by Congress over the last several years have done much to improve our ability to attract the Nation's best talent. The Air Force is currently developing implementation plans for the authorities most recently provided in the National Defense Authorization Act for Fiscal Year 2014. The ability to manage Laboratory personnel levels according to budget will allow us to be more agile and targeted in hiring for new and emerging research areas. The Air Force Research Laboratory recruits up-and-coming, as well as seasoned, scientists and engineers, including continuing a vibrant relationship with Historically Black Colleges and Universities and Minority Serving Institutions (HBCU/MI), who conduct research projects, improve infrastructure, and intern with the Air Force Research Laboratory in support of the Air Force mission.

The Air Force also leverages the National Defense Education Program Science Mathematics and Research for Transformation (SMART) Program that supports U.S. undergraduate and graduate students pursuing degrees in 19 STEM disciplines. The Air Force provides advisors for the SMART scholars, summer internships, and post-graduation employment opportunities. The Air Force has sponsored 523 SMART scholars during the past 8 years, and of the 315 scholars that have completed the program, 88 percent are still working for the Air Force, 9 percent are getting advanced degrees, and 3 percent have left due to various reasons including furlough and government funding uncertainty. The Air Force identified 110 Key Technology Areas essential for current and future support to the war fighter, which we used for selecting academic specialties for SMART scholars. SMART scholars are an essential recruitment source of employees to enable key technology advances and future STEM leaders.

Sequestration and fiscal uncertainty in fiscal year 2013 caused the Air Force to significantly curtail travel expenses and severely limit conference attendance. It is essential for our scientists and engineers to be fully engaged within the national and international community so this curtailment disproportionately impacted the S&T community. We have worked with Air Force leadership to solve these issues and establish policies allowing greater flexibility for this mission imperative in 2014

and beyond. We can recover from the 1 year (2013) of non-participation in the greater S&T national and international community. However, severe travel restrictions over the long term could undermine the Air Force's ability retain top talent.

The Air Force has effectively used the authority provided by section 219 of the Duncan Hunter National Defense Authorization Act not only to increase the rate of innovation and accelerate the development and fielding of needed military capabilities but also to grow and develop the workforce and provide premier Laboratory infrastructure. For example, the Information Directorate of the Air Force Research Laboratory located in Rome, NY, used funding made available by section 219 to develop curriculum at Clarkson University. The curriculum is aligned to the Information Directorate's command, control, communications, cyber and intelligence (C^4I) technology mission and provides training and development programs to Laboratory personnel. To fully utilize the new section 219 authorities from the National Defense Authorization Act for Fiscal Year 2014, the Laboratory is now developing a targeted infrastructure plan to provide its scientist and engineer workforce premier laboratory facilities in its locations nationwide. Recent success in the infrastructure area includes the opening of two state-of-the-art fuze laboratories at Eglin AFB, FL, which are enabling enhanced research and development into hardened penetration and point burst fuzing.

CONCLUSION

The threats our Nation faces today and those forecast in the future leave the U.S. military with one imperative. We must maintain decisive technological advantage. We must take lessons from the last decade of conflict and creatively visualize the future strategic landscape. We must capitalize on the opportunities found within this space.

The focused and balanced investments of the Air Force fiscal year 2015 S&T program are hedges against the unpredictable future and provide pathways to this flexible, precise and lethal force at a relatively low cost in in relation to the return on investment. We recognize that fiscal challenges will not disappear tomorrow, and that is why we have continued to improve our processes to make better investment decisions and efficiently deliver capability to our warfighters.

Chairwoman Hagan, Ranking Member Fischer, members of the subcommittee, and staff, thank you again for the opportunity to testify today and thank you for your continuing support of the Air Force S&T Program.

Senator HAGAN. Thank you for joining us.

Dr. Prabhakar.

STATEMENT OF DR. ARATI PRABHAKAR, DIRECTOR, DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Dr. PRABHAKAR. Thank you, Madam Chairwoman and Senator Fischer. Thank you for the chance to be here with you today along with my colleagues.

DARPA is, of course, very much part of this DOD S&T community. We're also part of the larger national R&D ecosystem. But within these larger communities, DARPA has a particular role, and that role is to make the pivotal early investments that change what's possible so that we can take big steps forward in our national security capabilities. That mission has been unchanged over our 5½ decades, but, of course, the world in which we live has changed and continues to change today. Today, when you look at our portfolio, you'll see that we're pursuing the opportunities and challenges in the context of today's realities very much along the lines, Madam Chairwoman, of the things that you highlighted in your opening statement.

For example, today we look at the complexity of our military systems. We realize that classic approach is taking us in a place that is too costly and too inflexible to be effective for the kinds of challenges we're going to face in the future. A number of our programs are rethinking complex military systems, and we're coming up with

powerful, much more scaleable, flexible approaches to a next generation of radars, weapons, space systems, and navigation.

In a very different area, we also see this huge wave of change as information at massive scale starts creeping into every aspect of military operations. So in our portfolio you'll see significant investments to change the game in cyber and with big data tools.

Then, more broadly across a pretty wide range of research areas, we can see the seeds of technological surprise. One example is what is happening in research as biology intersects with engineering. In that area, for example, we're building new capabilities in areas like synthetic biology and neurotechnologies.

That's just a very quick glimpse of some of the things that we're working on today. I also want to talk a little bit about what it takes for us to do this kind of work and to deliver on our mission. You've helped us tremendously in that regard. First and most critically with people, you gave us a flexible hiring authority, the 1101 hiring authority, in 1999, and in the years since then we've become critically dependent on that hiring authority to get the kind of great people who have the potential to be wonderful DARPA program managers, but also to be able to do that at a pace that is consistent with the needs of our programs.

Just to give you a recent example, a few months ago one of our great program managers got a terrific job at a company. That's great. We love it when that happens. It's very much part of our model, where program managers come typically for 3 to 5 years. But when he left, as frequently happens, he left behind a big hole, in this case in the cyber programs that he was running.

The tempo of these changes is not something we control. Those changes happen at a pace that reflects private sector decision-making. But if we're going to keep our programs moving forward at that same pace of commercial technology, we need to be able to react quickly.

In this case we were able to. We found a wonderful candidate. Two weeks after we mutually agreed to take the plunge, we had him on board. The reason we moved so quickly in that particular case was because there was an upcoming Air Force exercise. We needed to have him on board to take our new cyber tools to that exercise. He was able to do that and, in fact, was able to be part of showing the Air Force these very interesting new capabilities.

That was possible only because of the 1101 authority. So, I think that is just a great example of the power of what you've given us.

We're currently under a cap that limits our use of 1101 hiring authority to 60. You've given us that number. It's been terrific. We've really appreciated it. But we have now used that allocation fully. I want to be clear that we're not growing in size as an agency. We don't want to grow. We actually love being a nice small size, we have been for many decades. It's just that we are using the 1101 authority now for a greater share of the hiring that we do for our technical workforce because of the kind of people it lets us get access to.

Let me turn briefly to the budget. The President's request for fiscal year 2015 is $2.9 billion for DARPA. The backdrop for that number is that between fiscal years 2009 and 2013 our budget declined by 20 percent in real terms. The fiscal year 2014 appropria-

tion turned that tide a little bit and that was very welcome relief. We can talk to any extent you'd like about the impact of that decline, but that very modest restoration in fiscal year 2014 also is now starting to make a real difference this year.

The President's request for fiscal year 2015 continues that gradual restoration. So again, I'll ask for your support for our critical work there.

Let me just end by saying that when I talk with our senior leaders in the Pentagon and here on Capitol Hill, I really feel that I can see the weight of our national security challenges bearing down on them and on you, all of us, because we all see that we live in a volatile world. We can see the growth and proliferation of threats. We're living in constrained budget times. Those are facts.

I also know that American innovation has turned the tide time and again, and I'm confident that our efforts today are going to do just that for the next generation.

I really want to thank you for your support. It's critical for the work that we're all doing. I'll be very happy to answer any questions along with my colleagues.

[The prepared statement of Dr. Prabhakar follows:]

PREPARED STATEMENT BY DR. ARATI PRABHAKAR

Chairwoman Hagan, Ranking Member Fischer and members of the subcommittee, thank you for the opportunity to testify before you today. I am Arati Prabhakar, Director of the Defense Advanced Research Projects Agency, DARPA. It is a pleasure to be here with my colleagues across the Department of Defense (DOD) Science and Technology (S&T) community. Our organizations work together every day to advance our Nation's defense technologies. DARPA plays a particular role in this community, and in the broader U.S. technology ecosystem. That role is to anticipate, create, and demonstrate breakthrough technologies that are outside and beyond conventional approaches—technologies that hold the potential for extraordinary advances in national security capability. This mission and our current work and plans are the focus of my testimony today.

DARPA'S MISSION AND THE DIVERSE THREATS FACING OUR NATION

In the fall of 1957, a polished metal sphere, 23 inches in diameter and launched from Soviet soil, began its orbit around the Earth, passing over American skies approximately every 96 minutes and initiating the space age, a space race, and a new era in the long struggle to maintain American military and technological superiority. Starting DARPA was one of the pivotal choices our Nation made in the wake of Sputnik. America today enjoys a hard-earned, privileged position, with tremendous military might, economic strength, and social and political freedom. Yet, as this Subcommittee knows well, risk is ever evolving in our complex and dynamic world. Regional instability, shifting military and economic positions, demographic and natural resource trends—these forces drive constant change in our national security environment. Today and in the years ahead, our potential adversaries will still include nation states, but also smaller, less well defined bad actors and an increasingly networked terror threat. National security challenges will continue to range from the acute to the chronic. This is the threat environment that shapes our technology investments today at DARPA.

Adding to the security challenges we face is the fact that technology and its accessibility have changed so significantly. Startlingly powerful technologies—semiconductors, information systems, and nuclear and biological technologies among them—are now globally available to a much wider swath of society, for good and for evil. While the cost of some technologies has dropped precipitously, other technology and non-technology related costs have risen steeply, leading DOD to difficult choices about our operational capabilities. That means our assumptions about the cost of military systems must change. I discussed these factors in some depth in last year's testimony, and they, too, continue to shape our investments at DARPA.

DARPA was designed and built for just this kind of shifting, challenging threat environment. Through more than 5 decades of tumultuous geopolitical and technological change, we have delivered outsized impact by focusing on our mission of

breakthrough technologies for national security. We imagine groundbreaking new technology advances with the potential for defense applications. We bring the best of those ideas to fruition by providing the right mix of research support, intellectual freedom, and responsible oversight to outstanding performers in industry, academia, and other government organizations. We facilitate the transition and operationalization of these new, paradigm-shifting capabilities.

HARNESSING COMPLEXITY TO CREATE EXCEPTIONAL NEW CAPABILITIES: DARPA'S PROGRAMS

Like most truly great problems that confront us, today's diverse threats can either be viewed as an imposing barrier or as an opportunity to overcome a difficult challenge. Either way, I believe our national security will depend upon how we deal with complexity. DARPA chooses to tackle complexity by harnessing it, and our programs reflect that approach of playing offense. We do that with game-changing new capabilities and with layered, adaptable, multi-technology systems. We do that by catalyzing major new national technology advances and by rapidly exploiting commercially available technologies. At a time when systems cost is the difference between building operational capability or just building PowerPoint, we do that by striving to invert the cost equation for our military.

DARPA has made important strides forward in delivering key breakthrough technologies since I last testified before this Subcommittee. In discussing how we are tackling various aspects of technological complexity, I will update you on several new programs that we have launched, results we have achieved, and transitions that have been accomplished or are in process.

Rethinking Complex Military Systems

Much of DARPA's work rethinks complex military systems, recasting today's approach with the intention of achieving far greater capabilities at lower cost. Today, our military relies upon the meshing of electronic, optical, software, and mechanical components to create satellites and the vehicles, aircraft, and ships that carry our Warfighters into battle. We also depend upon this integration of components in designing and producing the weapons these men and women must be prepared to use. That is not new. But today, these technology components are becoming ever more complex. Consider: radar systems have thousands of antenna elements, platforms run millions of lines of code, and integrated circuits are made of billions of transistors. These many components are also now interdependent and interacting to an unprecedented degree. Of course, these platforms and mission systems must operate in an environment that will be increasingly contested by others with access to ever-improving global technologies. All these factors contribute to the high cost, long development times, and inflexibility of today's most advanced systems. This demands that we rethink—sometimes in fundamental ways—how we approach the next generation of defense systems.

Let me give you a few examples of how DARPA is tackling this challenge from our portfolio of programs.

Robust Space

In times of conflict, our Nation's leaders count on our military to wage precise, overpowering war. This type of highly effective warfighting is critically dependent on space—for imaging and sensing, for communications, for navigation, even for keeping time. As never before, we require ready access to space and strategic control over our assets in space. But while space is becoming increasingly crowded and contested, DOD's ability to access and operate in space has become less nimble and more expensive over many years. DARPA has several programs underway to change that equation.

Rapid Launch: Experimental Space Plane (XS–1) and Airborne Launch Assisted Space Access (ALASA)

Imagine a world in which getting a satellite into orbit can be as quick and reliable as an aircraft takeoff. Our new Experimental Spaceplane is designed to take a 3,000- to 5,000-pound payload into orbit using an expendable upper stage, all for under $5 million; that is one-tenth the cost of a comparable launch today. Our ALASA program focuses on 100-pound payloads for less than $1 million. Even more striking is our goal of providing satellite launches for these payloads with just 24 hours' notice.

Avoiding Collisions in Space: Space Surveillance Telescope (SST)

In space, one major challenge is simply a lack of knowledge of what is around you. With satellite traffic and the risk of space collisions growing, space domain

awareness is a top priority. DARPA's SST enables much faster discovery and tracking of previously unseen, hard-to-find objects in geosynchronous orbits. We expect it to be ready for operations within 2 years in Australia as a result of a memorandum of understanding signed last November by Secretary of Defense Hagel with his counterpart. Once operational on the Northwest Cape of Australia, SST will provide detection and tracking of satellites and space debris at and near geosynchronous orbits within the Asia-Pacific region, information U.S. space operators can use to better protect critical U.S. and Allied space-based capabilities.

Lowering the Risk and Cost for Satellites

Communications satellites in geosynchronous orbit, approximately 36,000 kilometers above the Earth, provide vital communication capabilities to Warfighters and others. Today, when a satellite fails, we usually face the expensive prospect of having to launch a brand new replacement. Our Phoenix program strives to develop and demonstrate technology to robotically service, maintain, and construct satellites in the harsh environment of geosynchronous orbit. Phoenix is also exploring a paradigm change to satellite design that would enable ground and on-orbit assemble-able platforms to potentially lower the cost of next-generation space systems by a factor of 10 compared to what is possible today.

Winning in Contested Environments

Space is not the only environment that is growing more crowded and dangerous. We must always anticipate an actively contested environment as we look ahead to potential challenges from future adversaries. Today, we are dependent on centralized command and control, and the fragile lines of communications linking tactical assets to decisionmakers. While DARPA has multiple programs addressing these challenges for the air, ground, and sea, a common thread is the development of technologies to shift and distribute capability at the forward edge of the battle and to adapt quickly to a changing technology landscape.

Long-Range Anti-Ship Missile

Today's anti-ship missiles face challenges penetrating sophisticated air defense systems from long range. As a result, warfighters may require multiple missile launches and overhead targeting assets to engage specific enemy warships from beyond the reach of counter-fire systems. In important progress to overcome these challenges, the DARPA-Navy Long-Range Anti-Ship Missile (LRASM) program has had a series of successful flight tests on a precision-guided anti-ship standoff missile. That will reduce dependence on intelligence, surveillance, and reconnaissance platforms, network links, and Global Positioning System (GPS) navigation in electronic warfare environments. DARPA is collaborating with the Navy via a new joint program office, helping to move this leap-ahead capability to deployment very quickly.

Distributed Battle Management (DBM) and Communications in Contested Environments (C2E)

Under our Air Dominance Initiative, DARPA, the Air Force, and the Navy together have been exploring systems-of-systems concepts in which networks of manned and unmanned platforms, weapons, sensors, and electronic warfare systems interact to succeed in a contested battlespace. These approaches could offer flexible and powerful options to the Warfighter, but the complexity introduced by the increase in the number of employment alternatives—particularly in a dynamic situation—creates a battle management challenge. Further complicating matters, in future conflicts U.S. forces may face degradation or denial of critical communications capabilities essential for coordination and shared situational understanding.

We recently launched two programs that address these challenges. The Distributed Battle Management (DBM) program seeks to develop control algorithms and demonstrate robust decision-aid software for air battle management at the tactical edge. Our new Communications in Contested Environments (C2E) program is, at the same time, exploring the use of reference architectures to enable robust, scalable, and rapidly evolvable airborne communications networks.

Dominating the Electromagnetic Spectrum

The challenge of the threat environment extends to the airwaves as well, a reality that also is beginning to affect commercial and civil activity as demand continues to grow for access to the electromagnetic spectrum. The United States and our allies learned an important lesson in World War II, when we became the first to control and take advantage of one small part of the spectrum—the range occupied by radar. By many assessments, Allied dominance in radar technology was pivotal to our winning that crucial war. Today we can say that the next war may be won by the Na-

tion that controls the electromagnetic spectrum over the full range of wavelengths—a degree of control that can ensure dominance in communications and in the important linked domains of timing, location, and navigation. It also can ensure dominance in seeing what our adversaries are doing, and in controlling what they see of us—both our capacity to hide things from their sensors and our capacity to make "visible" an array of things that are not really there.

Spectrum Challenge

One approach to dominating the spectrum is simply to be more nimble, both in sensing and using whatever portions of the spectrum are available. Radios, for example, lack agility, despite the fact that they are used for the most mundane to the most critical of communications, from garage door openers to first responders to military operations. Wireless devices often inadvertently interfere with and disrupt radio communications, and, in battlefield environments, adversaries may intentionally jam friendly communications. To stimulate the development of radio techniques that can overcome these impediments, DARPA launched its Spectrum Challenge, a national competition to develop advanced radio technology capable of communicating in congested and contested electromagnetic environments without direct coordination or spectrum preplanning. We expect to see a massive increase in innovation when the teams return for the final part of the Challenge with promising results for future applications.

Moving to New Frequency Domains: Terahertz Electronics

Another way to control the spectrum is to move to new frequency domains, where hardware limitations currently prevent us from operating effectively. The submillimeter wave, or terahertz, part of the electromagnetic spectrum falls between the frequencies of 0.3 and 3 terahertz, between microwaves and infrared light. Unlocking this band's potential may benefit military applications such as high-data-rate communications, improved radar, and new methods of sensing. But access to these applications has been limited due to physics and our limited understanding.

Researchers under DARPA's Terahertz Electronics (THz) program have designed and demonstrated a 0.85 terahertz power amplifier using a micromachined vacuum tube; we believe it to be a world first. The vacuum tube power amplifier is one achievement of the broader THz program, which seeks to develop a variety of breakthrough component and integration technologies necessary to 1 day build complex terahertz circuits for communications and sensing.

Many more DARPA programs also rethink complex military systems. These include efforts to use the undersea environment to observe and access regions around the world, to rapidly bring advances in commercial technology to the battlefield; to develop hypersonic technologies for advanced speed, reach, and range; and to create new distributed architectures for the contested environments of the future.

INFORMATION AT SCALE

Let's consider a different aspect of complexity. As the information revolution continues, the sheer scale and variety of data seems immensely, and perhaps overwhelmingly, complex—but this challenge also presents major opportunities.

Insight to Enhance Analysts' Capabilities and Performance

Military intelligence analysts face the monumental and escalating task of analyzing massive volumes of complex data from multiple, diverse sources such as physical sensors, human contacts, and contextual databases. DARPA's Insight program addresses the need for new tools and automation to enhance analyst capabilities and performance. The program seeks to enable analysts to make sense of the huge volumes of intelligence-rich information available to them from existing sensors and data sources. Automated behavioral learning and prediction algorithms help analysts discover and identify potential threats, as well as make and confirm hypotheses about those threats' potential behavior. The goal is a comprehensive operating picture in which expedient delivery of fused actionable intelligence improves support of time-sensitive operations on the battlefield. We are working closely with the Army and the Air Force to transition operational capabilities to programs of record.

MEMEX: A Different Approach to Search

Despite the vast amounts of data available, today's web searches use a centralized, one-size-fits-all approach that searches the Internet with the same set of tools for all queries. While that model has been wildly successful commercially, it does not work well for many government use cases. Current search practices miss infor-

mation in the deep web—the parts of the web not indexed by standard commercial search engines—and ignore shared content across pages.

To help overcome these challenges, DARPA launched the Memory and Exploration of the Internet for Defense (MEMEX) program. This ambitious effort seeks to develop domain-specific search technologies and revolutionize the discovery, organization and presentation of the types of search results needed for national security concerns. MEMEX's initial focus will be human trafficking, which is a factor in many types of military, law enforcement and intelligence investigations and has a significant web presence to attract customers.

Mining and Understanding Software Enclaves (MUSE)

Information at scale includes not just data, but software code as well. Within the last few years, there has been a tremendous explosion in the number of open source projects and the size of codebases these projects contain. Software repositories today are estimated to contain more than 100 billion lines of code, and the number continues to grow. Open source software is widely used in mission-critical DOD systems as well as in the commercial world. DARPA's new Mining and Understanding Software Enclaves (MUSE) program aims to harness the scale and complexity of this array of software to instigate a fundamental shift in the way we conceive, design, implement, and maintain software. If successful, MUSE could lead to a new programming methodology, leading to automated mechanisms for improving resilience, reducing vulnerabilities, and simplifying the construction of software systems.

High-Assurance Cyber Military Systems (HACMS)

Embedded systems form a pervasive network that underlies much of modern technological society. Such systems range from large supervisory control and data acquisition (SCADA) systems that manage physical infrastructure to medical devices such as pacemakers and insulin pumps, to computer peripherals such as printers and routers, to communication devices such as cell phones and radios, to vehicles such as automobiles and airplanes. These devices have been networked for a variety of reasons, including the ability to conveniently access diagnostic information, perform software updates, provide innovative features, lower costs, and improve ease of use. But researchers and hackers have shown that these kinds of networked embedded systems are vulnerable to remote attack, and such attacks can cause physical damage while hiding the effects from monitors. DARPA launched the High-Assurance Cyber Military Systems (HACMS) program to create technology to construct high-assurance cyberphysical systems. Achieving this goal requires a fundamentally different approach from what the software community has taken to date. If successful, HACMS will produce a set of publicly available tools integrated into a high-assurance software workbench, which will be widely distributed for use in both the commercial and defense software sectors. For the defense sector, HACMS will enable high-assurance military systems ranging from unmanned vehicles to weapons systems, satellites, and command and control devices. In an early demonstration of the program, we are running first-of-its-kind provably correct software on a commercially available automobile.

These programs are examples from DARPA's broader portfolio in cyber and information at scale. Other efforts are developing new technologies to enable distributed computer systems to work through attacks; permit trustworthy Internet communications in untrusted environments; automate the discovery, identification, and characterization of new malware; provide DOD with military cyber capabilities; and automatically process text information to discover meanings and connections that might otherwise not be readily apparent to analysts.

Biology as Technology

A third area of complexity of growing interest and importance to DARPA—and among the most promising for future major capabilities—is the idea of biology as technology. Biology is nature's ultimate innovator, and any agency that hangs its hat on innovation would be foolish not to look to this master of networked complexity for inspiration and solutions.

Living Foundries

Synthetic biology—a hybrid discipline of biology and engineering—has already proven itself capable of using customized bacteria to produce medicines, and now it is heading toward even more interesting applications as we harness it to create entirely new chemistries. Our Living Foundries program seeks to develop the next-generation tools and technologies for engineering biological systems, compressing the biological design-build-test cycle in both time and cost. For example, the program has demonstrated the ability to generate a suite of novel bioproducts in weeks rather than years. The program is also producing new classes of materials with

novel properties that can enable a new generation of mechanical, optical, and electrical products.

Rapid Threat Assessment (RTA)

Even as we develop new materials and tools for engineering biological systems, we understand that we must also be prepared to react quickly to how our adversaries may seek to use similar capabilities. This concern is not new: novel chemical and biological weapons have historically been mass-produced within a year of discovery. Using current methods and technologies, researchers would require decades of study to gain a cellular-level understanding of how new threat agents affect humans. This gap between threat emergence, mechanistic understanding and potential treatment leaves U.S. forces and populations here and around the world vulnerable.

DARPA launched the Rapid Threat Assessment (RTA) program with an aggressive goal: develop methods and technologies that can, within 30 days of exposure to a human cell, map the complete molecular mechanism through which a threat agent alters cellular processes. This would give researchers the framework with which to develop medical countermeasures and mitigate threats. If successful, RTA could shift the cost-benefit trade space of using chemical or biological weapons against U.S. forces and could also apply to drug development to combat emerging diseases.

Brain Function Research

In an era when harnessing complexity will be the sine qua non of success, it should not be surprising that DARPA has a particular interest in tackling the brain. DARPA's interest starts with our desire to protect and assist our warfighters, whether it means preventing or treating traumatic brain injury, easing the effects of post-traumatic stress disorder, or learning to operate sophisticated prosthetic limbs with thoughts alone, as is now increasingly possible with our new and exciting technologies. These advances also open the door to a much deeper understanding of how humans interact with the world around them—new insights that may fuel the next revolution in how we work with complex technologies and systems. Over the past year, we launched several new brain function-related programs that are now getting underway. These efforts are part of the President's initiative in brain research. Recently, we have made unprecedented advances in developing advanced prosthetic arm systems and methods to restore near-natural movement and control.

DARPA's biology-related investments also include diagnostics and novel prophylaxes to outpace the spread of infectious disease and new methods to accelerate the testing of critical therapeutics.

New Frontiers

Consistent with our mission to prevent technological surprise by creating it, DARPA continues to invest across a wide range of fields where we see promising research that could lead to powerful technology capability. These investments are the seeds of what my successors, perhaps 5, 10, or 15 years from now, will be describing to you as technology revolutions.

I described earlier our work in developing new algorithms, software, and architectures that allow us to better mesh our electronic, optical and mechanical components together. What about those components themselves? We are pushing the frontiers of physics to make them dramatically smaller, or more capable, or both.

iPhod, COUGAR, and ORCHID

Consider the many ways we are developing to harness light, which will directly affect the size, weight, cost, and performance of military components ranging from small navigation sensors to phased array radars and communication antennas. One recently concluded program (iPhod) successfully miniaturized tools for creating delays in light transmission, while another (COUGAR) demonstrated unique designs in hollow core fibers, which guide light within a device much more efficiently than conventional optical fibers. Yet another (ORCHID) successfully demonstrated the "squeezing" of light, a concept in quantum optics that can ultimately lead to dramatic performance gains in microsystems. These programs challenge the assumption that highly-specialized, high-precision systems must be large and expensive.

Miniaturization with National Security Implications

Other advances in miniaturization include a recent demonstration by DARPA-funded researchers of the world's smallest vacuum pumps. This breakthrough technology may create new national security applications for electronics and sensors that require a vacuum: highly sensitive gas analyzers that can detect chemical or biological attack, for instance, or extremely accurate laser-cooled chip-scale atomic clocks and microscale vacuum tubes. As part of another program (QuASAR), one

which seeks to exploit the extreme precision and control of atomic physics for new sensor technology, researchers have developed methods for measuring magnetic fields at scales smaller than the size of a single cell. Applications include critical advances in position, timing, and navigation—all critical to military situational awareness and operations.

Ground Robotics

Some advances seem at our doorstep—thanks to science fiction and the amazing special effects of creative individuals and teams who lead our entertainment industry. At the DARPA Robotics Challenge trials a few months ago, we drove robotics technology forward by engaging teams of creative specialists at companies, universities, and other government agencies. These world-leading experts were charged with advancing the capabilities of robots to perform basic skills that would be required in carrying out humanitarian and disaster relief missions. The Robotics Challenge—which is still underway—is showing how robotics capabilities can advance. It is also demonstrating just how far these kinds of robots are from serious battlefield application. That, too, is part of DARPA's mission: push the research frontiers of what is possible and inform our military decisionmakers where those limits are and the prospects for the future.

Algorithms Opening New Horizons

Research in mathematical algorithms is also creating important new technological opportunities. Clustering algorithms can detect common activity patterns across a vast data set. A combination of vector mathematics, time integration, and power law distributions enables the analysis of ensemble behaviors—patterns that only become visible when correlated across large numbers of points. Time series analysis can find previously unknown outliers in a data set for anomaly detection. Our programs apply these mathematical techniques to immense data sets with hundreds of millions or even many billions of elements. Individually or in combination, these new algorithmic approaches enable rapid analysis of data volumes that finally begins to scale with the complexity of the national security challenges that we face today.

PEOPLE, PROCESS, AND BUDGETS

I have cited several examples of DARPA technologies that made significant progress in the last year. There are many more in that same category. Additional examples of successes in the making are attached to my testimony.

What does it take for DARPA to do these transformative things? It takes the right people, process, and funding. The support of this subcommittee has been essential for each of these.

People

For DARPA to remain as creative and effective as it has been through its history, first and foremost we depend upon stellar program managers. They come to DARPA with inspirations about achieving breakthroughs in technologies that stand conventional wisdom on its head, mindful of the rare opportunity to bring about rock-the-boat changes that will contribute to our national security. We keep these program managers onboard typically for 3 to 5 years; that helps to infuse new people with fresh views into the Agency continuously. That means we need to quickly identify and bring in experts who frequently are widely sought after by the private sector, academia, and other government agencies.

The 1101 hiring authority Congress has provided to DARPA is key to our continuing success and makes a very concrete, positive difference in our ability to recruit incomparable program managers. I thank the subcommittee for its continued support and extension of this special authority over a lengthy period.

Processes

Likewise, the authority to conduct challenges is a very effective part of our toolbox of innovative management approaches. It complements the variety of other means we have for working with the technical community, including more traditional awards to performers and collaborative undertakings. Our challenges reach a broad range of performers by offering prizes to those who accomplish previously unattainable goals. They have proven to be an extraordinarily effective way to tap the creative ideas of an ever-wider community to help DARPA push the frontiers of technology forward. Last year, Congress extended the Challenge authority until September 30, 2018. Thank you for continuing this important authority. In fiscal year 2014 alone, we are in the midst of the DARPA Robotics Challenge, the Cyber Grand Challenge, and the Spectrum Challenge.

Budget

The President's fiscal year 2015 budget request for DARPA is $2.915 billion. This compares with $2.779 billion appropriated for fiscal year 2014, an increase of $136 million. Before describing our fiscal year 2015 plan, let me put this number in context.

From fiscal year 2009 to fiscal year 2013, DARPA's budget declined through a series of small reductions followed by the 8 percent across-the-board sequestration cut in fiscal year 2013. The total reduction to DARPA's budget from fiscal year 2009 to fiscal year 2013 was 20 percent in real terms.

This pernicious trend turned around last year. I thank this Subcommittee, and Congress more broadly, for your support in helping us to begin to address this issue in fiscal year 2014 by restoring an initial $199 million. The President's fiscal year 2015 request continues restoration, almost returning the Agency's budget to its pre-sequestration level in real terms.

Let me outline what these budget changes mean in terms of our ability to execute DARPA's vital mission. As budgets eroded over the last few years, one effect was a reduction in our major demonstration programs. In some cases, we have been unable to advance our work to the point of actually demonstrating that a totally new approach is workable. In other cases, we had to rely on a single approach to solving a particularly challenging problem because we could fund only one performing organization. That is especially problematic since we are trying to do something that has never been achieved before. Reduced funds also meant fewer early-stage investments to explore new research frontiers. Sequestration further affected our programs, with many being delayed or reduced.

In the current fiscal year, the partial restoration of funds is making a real difference in DARPA's ability to attack the thorny problems the Nation faces in today's military and national security environment. As a projects agency, DARPA is always beginning new programs as old ones end. But the new efforts in fiscal year 2014 are stronger because of the healthier budget level. In some areas, we are now able to plan for the real-world prototyping and field testing needed for new concepts to be fully evaluated. Our new programs include the important exploratory projects that will expand future national security opportunities. The fiscal year 2015 request before you today will allow us to continue to restore and strengthen our portfolio of investments. With this funding level, we will be on the right track.

Let me close by saying that I am mindful of the challenges that our Nation faces and the increasingly difficult environment in which we work, including severe constraints on resources. But I also am excited about what lies ahead and confident that—with your support for the President's fiscal year 2015 budget request—DARPA will continue to make a real and outsized difference in redefining the national security landscape and our Nation's security.

Again, thank you for your support—past, present, and future. I look forward to working with you, and will be pleased to respond to your questions.

Addendum

DARPA Transitions

Many technologies from earlier DARPA investments are now moving forward with a wide variety of our partners and customers. These summaries provide snapshots of progress for some programs from recent years.

Leap Ahead in Surface Warfare Capabilities by Reducing Dependence on ISR Platforms, Network Links, and GPS: Long Range Anti-Ship Missile (LRASM)

Technology Description and Program Goal

- Our current anti-ship missiles must penetrate sophisticated enemy air defense systems from long range. As a result, Warfighters may require multiple missile launches and overhead targeting assets to engage specific enemy warships from beyond the reach of counter-fire systems. To overcome these challenges, the DARPA-Navy Long Range Anti-Ship Missile (LRASM) program is investing in advanced technologies to provide a leap ahead in U.S. surface warfare capability.
- LRASM aims to reduce dependence on intelligence, surveillance and reconnaissance (ISR) platforms, network links, and GPS navigation in electronic warfare environments. Autonomous guidance algorithms should allow LRASM to use less-precise target cueing data to pinpoint specific targets in the contested domain. The program also focuses on innovative terminal survivability approaches and precision lethality in the face of advanced countermeasures.
- LRASM began in 2009. Now in its final DARPA phase, this program leverages the state-of-the-art Joint Air to Surface Standoff Missile Extended Range (JASSM-ER) airframe and incorporates additional sensors and systems to achieve a stealthy and survivable subsonic cruise missile.
- ***In 2013, DARPA conducted two flight demonstrations, each with resounding success.*** The LRASM was dropped from an Air Force B-1, successfully separated from the aircraft, navigated through a series of preplanned waypoints, and then transitioned to an autonomous mode while seeking the target it had been instructed to attack. ***The missile detected, identified, and tracked the mobile ship target at extended range; transitioned to guidance on the terminal sensor; and impacted the target*** with a miss distance well within acceptable error probabilities. Other flight achievements include weapon data link updates, transmission of weapon in-flight tracks, and increased flight range.

Transition Plan and Status

- The program is on track to deliver an advanced prototype weapon to the Navy and Air Force with capability for challenging future operational environments, while being sufficiently mature to transition rapidly to an acquisition program to address near-term operational challenges.
- DARPA is engaged with the U.S. Navy NAVAIR's Program Executive Office for Unmanned Aviation and Strike Weapons (PEO U&W) to provide an innovative management approach for rapid acquisition of LRASM for Air Force and Navy air launch platforms to meet offensive anti-surface warfare missions. This approach leverages DARPA investment, program security, contracts, and infrastructure. Ultimately, it will leverage DARPA's technology development and risk reduction efforts to expeditiously field LRASM. In FY 2014, DARPA and Navy efforts

include continued technology development, integration risk reduction, and pre-Milestone B activities.

- ***DARPA has transitioned the technology to a new DARPA/Navy/Air Force co-staffed office chartered by USD(AT&L) to rapidly deploy this dramatically enhanced new capability.***

Reducing Drag and Fuel Usage: Formation Flight for Aerodynamic Benefit

Technology Description and Program Goal

- With the Air Force consuming more than 2.5 billion gallons of aviation fuel in 2010, DARPA launched the Formation Flight for Aerodynamic Benefit program to seek creative ways to reduce drag and fuel usage in the C-17 fleet.
- C-17s are the largest single user of aviation fuel, consuming 650 million gallons (26 percent) in 2010. DARPA's goal was to achieve a 10 percent reduction in fuel flow.
- The approach taken was motivated by large flocks of migratory birds that fly in a "V" formation.
- All aircraft produce wingtip vortices when flying, which are a drag byproduct of producing aerodynamic lift. After analyzing C-17 wingtip vortices, DARPA predicted optimum formation positions.
- The DARPA program created new software that innovatively enabled precise autopilot and auto-throttle formation flight operations with existing C-17 hardware.
- DARPA simulation, modeling, and lab testing projected success in reaching the target reduction in fuel flow using this software modification.

Transition Plan and Status

- DARPA transitioned the software to the Air Force Research Laboratory (AFRL) in July 2012 as the Surfing Aircraft Vortices for Energy ($AVE) program.
- AFRL conducted 30 hours of flight testing in C-17 formation flight, including 12 hours on operational flight routes over the Pacific in 2013.
- ***That testing validated a 10 percent fuel flow reduction with the DARPA software modification. Moreover, the changes were safe, aircrew friendly, and aircraft friendly – and made business sense.***
- The Applied Technology Council approved funding for an Advanced Technology Demonstration (ATD) of the DARPA C-17 software-only modification. The ATD will enable the Air Mobility Command to develop CONOPS for rapid fielding this DARPA energy efficiency advancement.
- ***AFRL is examining use of this technology to obtain fuel savings on C-130s and other DoD platforms.***
- Commercial carriers, the Federal Aviation Administration, and the National Aeronautics and Space Administration (NASA) expressed interest in civilian applications of this DARPA technology.
- This DARPA program success reflects significant contributions from the Air Mobility Command, AFRL, 412th Test Wing, Air Force Life Cycle Management Center, Boeing Company, and NASA Neil A. Armstrong Flight Research Center.

New Approaches to Tackling DoD's Language Challenges: BOLT, RATS, and MADCAT

Technology Description & Program Goal

- DARPA has invested in solutions for DoD to recognize, classify, and help digest written and spoken foreign languages.
- Technology from the Broad Operational Language Translation (BOLT) program provides automated translation and linguistic analysis that can be applied to informal genres of text and speech as well as multilingual search capability and unrestricted multi-turn bilingual conversation.
- The Robust Automatic Transcription of Speech (RATS) program creates algorithms and software to perform the following tasks on potentially speech-containing signals received over channels that are extremely noisy and/or highly distorted: speech activity detection, language identification, speaker identification, and keyword spotting in foreign languages.
- The Multilingual Automatic Document Classification Analysis and Translation (MADCAT) program automatically converts foreign language text images into English transcripts, eliminating the need for linguists and analysts while automatically providing relevant, distilled actionable information to military command and personnel in a timely fashion.

BOLT Transition Plan and Status

- The Combating Terrorism Technical Support Office (CTTSO), under the Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict, ***successfully transitioned to military users a tool for translation of and topic spotting and data exploitation in social media***. Initial implementation is with a military user with plans to extend use to multiple government, military, and academic media monitoring system users.

RATS Transition Plan and Status

- The Air Force has provided lab facilities to test RATS capability using operational data. ***Initial evaluations show RATS technology superior to any other system***, and plans are underway for integrating the speech activity detection portion of the RATS technology into systems that provide noisy speech signal processing capabilities. Other interested DoD elements are awaiting the results of operational field trials before pursuing acquisition.

MADCAT Transition Plan and Status

- MADCAT optical character recognition has been coupled with machine translation and deployed in 11 languages to enable English-speaking government and military personnel to read hardcopy foreign language documents. A project also is underway to further develop Korean optical character recognition and machine translation to support user requirements.
- MADCAT offline handwriting recognition system was delivered to a government user in 2011 and is in ***operational use. The CTTSO is supporting the MADCAT transition to various other DoD and intelligence community users.***

Achieving Dramatically Faster Mapping: High-Altitude LIDAR Operations Experiment (HALOE)

Technology Description and Program Goal

- Leveraging past DARPA developments in Light Detection and Ranging (LIDAR) systems, a sensor pod for rapid collect, wide area, long range, high-resolution 3D datasets was developed for the HALOE system. In 2010 and 2011, DARPA invested funds to harden the sensor system in preparation for a prolonged operational trial in Afghanistan.
- ***HALOE provided forces in Afghanistan with unprecedented access to high-resolution 3D data, and it collected orders of magnitude faster and from much longer ranges than conventional methods.*** At full operational capacity, HALOE could enable mapping of 50 percent of Afghanistan in 90 days. State-of-the-art deployed systems would have required 3 years to accomplish that task, and more conventional systems would have required 30 years.
- This increased performance is enabled by advances in shortwave infrared sensitive material properties that permitted photon-counting detector arrays so sensitive that it is now possible to make range measurements with fewer than 10 photons received, versus tens of thousands of photons. As is true with any camera, increased sensitivity means an image can be captured more quickly since the shutter has to be open for less time – and less light is required to capture an image. Less time and less power translate to higher collection rates at greater standoff. HALOE can collect data at a rate more than 10 times faster than state-of-the-art systems or 100 times faster than conventional systems.
- HALOE was one of several DARPA advances directly supporting the Warfighter that earned the agency the Joint Meritorious Unit Award from the Secretary of Defense late in 2012.

Transition Plan and Status

- The HALOE sensor pod was initially integrated onto a WB-57 aircraft and deployed to Afghanistan from November 2010 through August 2011 in a ***joint effort with the Army Geospatial Center (AGC).*** During this time, over 70,000 square kilometers of terrain data (about 10 percent of Afghanistan) were collected, reflecting the priorities of operational units.
- In March 2012, **with AGC funding**, the HALOE sensor pod was integrated onto a BD700 aircraft, a highly customized, longer-range flight platform.
- In July 2013 the HALOE system was deployed to the AFRICOM Area Of Responsibility (AOR). The system collected data in Africa during eight flight sorties through August.
- In September 2013, HALOE was transferred to Afghanistan in September 2013.
- ***HALOE performed exceedingly well in its several deployments in Afghanistan,*** collecting more than 83 percent of all tasked regions with a cumulative mission area of greater than 74,000 square kilometers. The collected data have been in response to multiple RFIs in support of operational units. The HALOE system has transitioned out of theater, with the last sortie flown in December 2013.
- Plans call for a 6-month period in CONUS for maintenance and training followed by ***redeployment in June 2014*** for the remainder of FY 2014. Potential locations include AOR of USCENTCOM (not Afghanistan), USAFRICOM, and USPACOM.

Blast Monitoring Tool Also Will Improve Future Understanding of Injuries: Blast Gauge

Technology Description and Program Goal

- Blast Gauge is a low-cost, disposable, individually wearable sensor system that records the environment during an explosive event – for example, an attack from an improvised explosive

device (IED) or a rocket-propelled grenade (RPG), or the firing of a missile or rocket during training.

- ***The goal was to rapidly develop and field a system to quantify blast exposure, assist commanders in finding injured Service Members who would otherwise not report, and record data to understand blast injuries, including traumatic brain injury (TBI).***
- DARPA recognized that blast overpressure and linear acceleration must be recorded – and at multiple points on the body– to understand blast-related injuries and that the needed technology could be built completely out of common commercial components.
- The device was developed in just 11 months; Special Operations Forces (SOF) fielded Blast Gauge in Afghanistan in July 2011 and Rochester Institute of Technology researchers who developed the dosimeter quickly formed a small business to commercialize and manufacture the gauges.
- ***Costing less than $50 per device,*** the gauge includes a simple three-light system (red, yellow, green) to indicate condition and magnitude immediately following a blast. Service Members wear three gauges: on the back of the helmet, shoulder, and chest. This allows a blast to be captured regardless of its relative location.
- Information is transmitted to medical staff and researchers; doctors and medics report that the lights are a valuable feature for augmenting triage following a blast.
- DARPA also developed a system to capture the data, contributing to better understanding of the effects of blasts on the brain.

Transition Plan and Status

- DARPA completed development with release of the latest generation gauge in June 2013. It can be purchased directly from the manufacturer or from Defense Logistics Agency stock.
- DARPA initially provided field support to train Soldiers on the gauges and to distribute gauges and collect exposure data. More than 150,000 gauges (50,000 sets) have been distributed to all Services.
- ***As a result of the DARPA-funded field trials, Blast Gauge technology has been adopted by SOF and the Army:***
    - The Combined Joint Special Operations Task Force Afghanistan (CJSOTF-A) mandated that all special operators in its task forces use blast gauges. They are purchasing 60,000 gauges for deployed forces and stateside training.
    - Other SOF units are purchasing and using gauges throughout training and operations. In these cases, Blast Gauge has become a key component of their strategy for managing TBI.
    - The Army has selected Blast Gauge as one of three components of its Integrated Soldier Sensor System (ISSS) requirement. DARPA is supporting the Army in designing and evaluating the ISSS.
    - While the Army is developing its objective solution (ISSS), it selected the Blast Gauge to be fielded to 18,000 Soldiers in OEF.
- Other services (including the Marine Corps Warfighting Laboratory), NATO partners, and Australia have independently evaluated the gauges and are deciding on next steps.
- Blast Gauge was cited as a DARPA advance directly supporting the Warfighter that contributed to the agency being awarded the Joint Meritorious Unit Award from the Secretary of Defense in 2012.
- Military officials have shown interest in examining the data and post-event analyses to ***gain insights into potential issues with brain injuries resulting from improper techniques and procedures for using equipment, including during training when most exposures occur.***

Revolutionizing Prosthetics (RP): Restoring Near-Natural Movement and Control of Upper Limbs

Technology Description and Program Goal

- When DARPA launched the Revolutionizing Prosthetics (RP) program in 2006, the state of upper-limb prosthetic technology was far behind lower-limb technology and was judged to be a more difficult medical and engineering challenge.
- The concept of a new system design may open the option for Service Members and others with upper-limb loss the chance to return to more fully active lives.
- The two research teams selected for the program, DEKA Integrated Solutions Corporation and the Johns Hopkins University Applied Physics Lab (APL), were tasked to:
    - Design and build anthropomorphic electromechanical upper extremity prostheses that mimic the capabilities of a natural arm for people with loss of an upper-limb.
    - Develop near-natural control modalities including exploration of direct neural control from peripheral nerves or the brain.
    - Investigate the ability to provide sensory feedback from sensors on the prosthesis through peripheral nerves or directly to the brain.
- Collaboration with Veterans Affairs, National Institutes of Health, Army Medical Research and Materiel Command, and Walter Reed National Military Medical Center has given more than75 users (amputees and tetraplegics) an opportunity to provide input to the design of both arm systems and supported regulatory submissions. In addition, Revolutionizing Prosthetics became the pilot program of the Food and Drug Administration's *Innovation Initiative* in 2011, providing a new pathway for novel medical technologies.

Transition Plan and Status

- Since February 2012, the University of Pittsburgh Medical Center, a subcontractor to the Applied Physics Lab (APL), has conducted a ***successful clinical study*** in which research participants living with tetraplegia were able to use neural signals from their brain to directly control the Modular Prosthetic Limb (MPL). ***This work has demonstrated that advanced prosthetics and direct neural interfaces can enable restoration of near-natural arm control to improve the quality of life for military personnel and civilians living with amputation or paralysis.***
- Veterans Affairs is conducting an independent 3-year home study of the DEKA Arm System. Upon Food and Drug Administration approval, the DEKA Arm System will be readied for commercialization. This transition plan includes development of advanced manufacturing and distribution to medical practitioners.
- The APL's MPL serves as a research platform and some MPL ***technology has transitioned to small robotic systems used in manipulating unexploded ordnance and suspicious objects.***

Smartphone Apps for the Dismounted Warfighter: Transformative Apps (TransApps)

Technology Description and Program Goal

- Today's Warfighters perform increasingly complex tasks but are still using outdated tools to access and share information on the battlefield. From a ground Soldier's perspective, little has changed in the last 20 years. They rely on inferior paper maps, written notes and reference materials, and voice radio transmissions to carry out their missions. Many technology advances that consumers take for granted have not made their way to the battlefield for a variety of reasons, especially security concerns and lack of robust high-bandwidth networks.

- With the TransApps program, DARPA aims ***to put today's commercial smartphone-grade capabilities in the hands of the Soldiers who most need them*** – those on daily patrols in theater – making their work much more effective and their lives easier and safer. In the field, the devices are providing Soldiers with an integrated ecosystem for situational awareness.
- Soldiers on patrol can keep up with fast-paced missions and changing environments by sharing and managing information in real time. That allows Warfighters and decision makers up and down the ranks and in various functions to share a common operating picture.
- They do this by using features and apps designed for their unique requirements: for example taking note of changes in the field – such as new bridges, structures, or civilians in an area – and sharing that information immediately with others who will direct and carry out future operations in that area.
- TransApps created a new agile development process, integration framework, and customized test cycles to allow rapid development of new applications, with new features and enhancements deployed quickly based on Soldiers' evolving requirements. ***When Soldiers need new apps, they can get them quickly – sometimes the very next day. This is a radical departure from how they have been operating.*** The TransApps ecosystem bridges old and new, allowing future technologies to work seamlessly with legacy radios and information systems. By endowing commercial off-the-shelf (COTS) smartphones with custom multilayered security and agile development processes modified for the tactical community, TransApps is creating a scalable and sustainable infrastructure template.

Transition Plan and Status

- A 4-year program that concludes in FY 2014, ***TransApps was first fielded to Afghanistan in 2011; within 18 months, more than 3,000 systems were deployed to the battlefield, supporting all Army maneuver operations theater-wide.***
- In FY 2014, DARPA is working with the Army Nett Warrior Program to fully transition TransApps capabilities into the enduring Program of Record, as part of the Army's efforts to get new technologies into the hands of the Soldier.
- Other organizations and agencies are preparing to transition program components. These include the Application Testing Portal for streamlined security and performance analysis of mobile applications, as well as TransApps' custom imagery processing and configuration tools, which empower Soldiers to manage their own maps based on mission requirements.

Persistent Close Air Support: Faster and There When Troops Need It

Technology Description and Program Goal

- To maintain a decisive tactical advantage in 21st-century combat, Warfighters need to safely, rapidly, and collaboratively deploy ordnance against elusive mobile targets. Unfortunately, air-ground fire coordination, referred to as Close Air Support, or CAS, has changed little since World War I.
- Pilots and dismounted ground agents can focus on only one target at a time and often must ensure they hit it using just voice directions and a paper map. In complex environments, it can take up to an hour to confer, get in position and strike – time in which targets can attack first or move out of reach.
- DARPA created the Persistent Close Air Support (PCAS) program to enable dismounted ground agents and combat aircrews to share real-time situational awareness and weapons systems data.
- The system DARPA developed and tested ***enables ground agents to quickly and positively identify multiple targets simultaneously.*** Ground and air forces would jointly select precision-guided ordnance that best fits each target and minimizes collateral damage and friendly fire.

Finally, both parties would authorize weapons deployment.

- Benefits would include reduction in time from calling in a strike to target hits reduced from as much as 60 minutes to just 6 minutes; direct coordination of airstrikes by a ground agent from manned or unmanned air vehicles; improved speed and survivability of ground forces engaged with enemy forces; and use of smaller, more precise munitions against smaller and moving targets in degraded visual environments. Another benefit is graceful degradation; if one piece of the system fails, Warfighters still retain capability of more basic functionality.

Transition Plan and Status

- In early 2013, DARPA deployed 500 Android tablets equipped with PCAS-Ground situational awareness software to units stationed in Afghanistan. An operator on the ground – with a tablet and voice radio – communicated with a pilot who had a tablet in the cockpit about imagery they both share on their tablets. (The program also developed a networked solution that allows even more rapid information sharing.)
- ***Field reports show that PCAS-Ground replaced those units' legacy paper maps, dramatically improving ground forces' ability to quickly and safely coordinate air engagements.***
- The program, which began in FY 2010 and concludes in early 2015, is in the flight-testing phase, which concludes with live fire demonstrations.
- Elements of PCAS, particularly the JTAC ground software, are seeing traction among various JTAC-related programs of record across the Services.

Senator HAGAN. Thanks to all of you for your opening statements. We will have 7-minute rounds for questions. I'll go ahead and start.

Mr. Shaffer, I noted in my opening statement, and you discussed it, too, that the overall funding for the S&T programs in this budget request has been reduced by $500 million compared to last year. I understand that basic research programs have been reduced in funding as well. Can you describe and give us some concrete examples and impacts that these reductions will have on the S&T programs in 2015 and beyond?

Mr. SHAFFER. Yes, ma'am. This will, of course, be fairly broad. As you said, we did reduce basic research by $200 million. That was about a 10 percent reduction. We did that for a very conscious reason, not that we don't like university research. We love university research. Given the constraints that we had in making our budget, we wanted to push more money into the advanced technology development portion of the budget, because as we look at the earlier acquisition engineering programs, they've fallen as much as 45 percent in the last 5 or 6 years.

We have to continue to exercise design teams, engineering design teams. So we made the decision to pick up some of the slack in the S&T program for that.

Now, you ask what is the cost of that particular decline to our universities. We figure that it's somewhere in the order of 1,500 to 2,000 grants. That's a lot of university grants that are coming out.

Senator HAGAN. You're saying a cut?

Mr. SHAFFER. $200 million will cut about 1,500 grants nationwide, give or take.

That's just using straight math at $100,000 roughly per university grant. We also see, we took about $150 million out of the Missile Defense Agency S&T. The reason we did that is it's maturing. We're picking up some of the technologies that are being very successful in other parts of DOD.

The rest of the reduction was pretty much spread between the three Services and in lower priority projects. So, I think the way

I would characterize our budget, we took more risk in basic research, which we didn't like doing. We put more money into category 6.3 advanced technology development and prototyping activities and demonstrations, because we have to continue to develop capabilities and we have to exercise design teams. The final reason is under the Budget Control Act, even with some of the relief we got from the Bipartisan Budget Act, we still had a budget that came down, we still have forces deployed in war. We couldn't take money out of force structure right now, we can't take money out of that quickly. Modernization and readiness was going to pay a large portion of the bill in fiscal year 2015, probably 2016, 2017, and maybe 2018 also. That's just where we are until the force size comes down.

Senator HAGAN. It seems like as we reduce basic research, though, we're really hurting ourselves in the long-term, because we're missing that opportunity. We're missing opportunities with the people that would be doing that research during that period of time. I think on a long-term basis that's going to come back to hurt us.

Mr. SHAFFER. Very painful, ma'am. It really came down to, do we shift our emphasis to maintain contact with the engineering and design teams in industry? I had one company that came in to see my Under Secretary and myself yesterday. They're losing about a quarter of their design team in two very critical areas that no one else knows, that no other people do. So we're starting to see industry lose engineering design teams. That is also a concern, not necessarily for S&T, but we have to have people who catch what we develop.

Senator HAGAN. Let me move to science, technology, engineering, and mathematics (STEM) education. If you've been around me any period of time, you understand how important I take STEM from the standpoint of teaching and training our young people. I want to really look at how we can use STEM activities in education for our military children. I know the National Science Foundation and the Department of Education can and should play a big role in Federal STEM programs, but I believe DOD has a unique responsibility for supporting military children.

These children are faced with dealing with the additional stress of deployments of their parents. They also face the stress and the challenges of moving multiple times, multiple schools, over the course of their childhood, with different and inconsistent educational practices and course work as they move from area to area. I think we owe it to the children, we owe it to their parents, to provide the best STEM opportunities possible.

Some of this is through better access, through advanced course work, internships at labs, through other programs. It's important that these efforts are, obviously, based on sound educational practices and produce measurable results. This isn't something that we'll go in and say, we have three engineers to come talk to a class, without being able to measure what the practical ramifications and results are. So it needs to be much more in depth than that first example.

Mr. Shaffer, I know that the Office of Management and Budget (OMB) has previously told DOD to terminate the K through 12 programs, so there's no funding in fiscal year 2015 for these efforts.

Mr. SHAFFER. Correct.

Senator HAGAN. I'd like you to address that and then tell me what you can see as a possibility, how we, everybody in this room, can work together to have a focus on our military children in school, so that we can really have an impact on their education.

Mr. SHAFFER. Yes, ma'am. First, OMB and the White House did try to focus K through 12 Department of Education efforts, the thing that hurts us most as a mission area provider. I think everybody at this table would like to be involved in K through 12.

The second thing, you mentioned that the program working with the children of our deployed service men and women. Ma'am, I was a serviceman. I moved 13 times in 24 years on Active Duty. I support anything we can do to help our dependents. I recognize that it's part of our responsibility. The program that you're alluding to is in our Under Secretary for Personnel and Readiness, our personnel and readiness portfolio. We're working with the Secretary, Ms. Jessica L. Wright, to try to figure out how to enact an improvement supporting our military dependents.

Senator HAGAN. On page 6 of your testimony you talk about the STEM executive board.

Mr. SHAFFER. Yes, ma'am.

Senator HAGAN. The DOD STEM strategic plan is aligned with the Federal plan to achieve Federal and DOD STEM education goals. I don't know what those mean. I guess my question is, how can we make an impact and what is their assignment and what can we do as soon as possible to be sure that we have a concrete mission in this area?

Mr. SHAFFER. I will let other people comment. I would welcome any and all authorities for us to continue to interact with kids in STEM.

Senator HAGAN. Any concrete suggestions?

Mr. SHAFFER. I'll take that for the record.

Senator HAGAN. Okay.

[The information referred to follows:]

We do not generally have authority to fund K–12 programs with a limited exception. We can, for example, through the Office of the Secretary of Defense, the Military Departments, and the Defense Agencies, support certain K–12 events. For instance, in April this year, the Department of Defense sponsored the first day of the USA Science and Engineering Festival in Washington, DC. This was a great success and was well-attended.

Ms. MILLER. Ma'am, the Army did not lose our funding for K through 12 educational outreach. Our Army educational outreach program is still funded. We're grateful for that. It's on the order of between $10 and $12 million a year. We do outreach all the way K through 12 and then into——

Senator HAGAN. Do you have metrics, measures of your results?

Ms. MILLER. We do have metrics and measures. We have the University of Virginia that actually comes in and does an independent assessment of performance. We like to think that's one of the reasons we got to keep our resources here, but we frankly think we have a very good program. We have done deliberate outreach

to the schools that are at the location of all of the laboratories, because part of our extended outreach is we try to bring the young kids into our laboratories to interact, not only with our researchers, but in a real research environment, to help inspire them. We have done that outreach with other schools as well.

Senator HAGAN. I would like to hear back from each of you if you come up with some concrete ideas on what we can do.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chairwoman.

Mr. Shaffer, last year we discussed duplication and focusing research on warfighting needs. You mentioned the Reliance 21 process and how Senior Executive Service members were reviewing their portfolios. When I look at this budget, I see that the Navy and the Air Force are developing generator technology that seems to be very similar to what the Army already has fielded.

In addition, and there might be a good reason for this, the Navy is requesting money to study kidney stones in dolphins. While these may be somewhat small expenditures, I think we need to make sure that every dollar we have is spent in a responsible and appropriate way, considering, especially considering, the times that we're in.

Can you elaborate on what's being done to prevent or reduce the non-warfighter-related spending in all of the Services?

Mr. SHAFFER. Yes, ma'am. I won't talk or I won't try to address kidney stones in dolphins. That one got by me. I will let Ms. Lacey deal with that or I'll turn to that one later.

Let me talk about the generator technology. One of our most mature and active communities of interest is power and energy. We have a senior executive from each of the three Services on power and energy, and we also have some DARPA input, who come in and compare and look at each other's programs.

I stand comfortable and confident that the knowledge and the information and development that's been led by the Army is being leveraged by the Air Force and the Navy for their particular applications. I don't have the specifics. I'll be happy to take it for the record, come back to you with a full written explanation. I stand before you very confident that this Reliance 21 process we have and the road maps that are being put in place to address our highest priority needs and drive out unintended duplication is, in fact, working very well. I'm seeing evidence of it as our people interact.

I'd offer my colleagues to say the same or back me up or refute that.

[The information referred to follows:]

The Department of Defense (DOD) Energy and Power Community of Interest (EPCOI) coordinates the core science and technology efforts that go into development of these power generation systems. Power Generation/Energy Conversion is one of the five major EPCOI technology taxonomy areas. These core technologies work to minimize size/weight while maximizing efficiency for energy savings. Through the EPCOI, the different DOD Services tailor those core technologies to unique service electrical power needs.

Each of the Military Departments generator needs is uniquely different. The Army's power generation need for ground vehicles and forward operating base micro-grid power sources are rated 10s to 100s kilowatts at voltages that span compatibility with consumer electronics and specialized military equipment. Air Force generators for modern and next generation aircraft are 270 volt direct current to meet aircraft utilization equipment standards and rated at 100s to upwards of 1,000

kilowatts. Navy ship power generation is very high voltage, very high power kilovolts/megawatts required to provide electrical power for very large shipboard power systems. While each power generation application is unique, there are many instances of common component technology development across the Military Departments in which collaboration and coordination allow for leveraging and acceleration for ultimate implementation. The EPCOI identifies common technologies and makes the information available to all Military Departments. It is at the application level that variations occur.

Ms. FISCHER. Ms. Miller, you get to back him up.

I appreciate it. Thank you, Mr. Shaffer.

Ms. MILLER. I'll give you an example where sometimes the words that we put in our budget documents often sound the same and it seems duplicative, but it's not. I'll talk directed energy, because actually, if you look, you'll see that all Services have an investment in solid-state lasers. We did the fundamental solid-state laser development collaboratively through the Joint Technology Office (JTO), the HEL–JTO.

We got to a point where we could get high-power energy out of solid-state lasers. Then every one of the Services has taken that capability and demonstrated it in our own respective mission environments. Why? Because our Services have to understand the effectiveness and capabilities of that same HEL construct in their respective mission space. So it's not the same.

The Army and the Navy are testing together down at Eglin—we're there now and we're starting our testing—to do high power, solid-state laser testing from a ground perspective, but in an environment that is not the desert. A lot of the Army testing has been done out at Wisner at our HEL S&T Facility out there. But that's not where the Army's going to be. We're going to be a lot of places.

Our solid-state laser program is aligned to a program of record and we should see it show up in about the 2020, 2022 timeframe, and we have progress along the way. The Navy's already going out on a ship and Mary Lacey will tell you about when we're going to deploy on a ship. The Air Force is also looking at how they can use solid-state lasers.

Then there's DARPA, which always brings in another alternative way to do HEL, perhaps in a different construct, but as effectively and efficiently. If we can get the technology to prove out, we can insert it.

Sometimes we all sound the same, but we're different.

Senator FISCHER. I appreciate you clarifying that, because I think it's important for us to be able to understand that. But I think that openness is also important for the public to understand as well, because, as you can imagine, we all hear, and you hear it too, I'm sure, from your friends and neighbors that cuts can be made, we can find cuts, we can look for duplication. I believe we can.

I think it's important that in the future maybe you can distinguish it somehow better, that these may be similar programs, but they're building on each other and they are addressing different needs.

Ms. Lacey, could you give me just a short answer. Please tell me about those kidney stones?

Ms. LACEY. On the kidney stones, as you probably know, we have a marine mammal program for special operations underwater, and

we have many dolphins that are involved in that program. When you have them in captivity and you limit the diet, it does bad things to them, just like it does to people, and this research is affiliated with that.

I will get you a complete answer on exactly what they're doing.

Senator FISCHER. So diet and age?

Ms. LACEY. Yes, ma'am. When they join the Navy they join for life.

Senator FISCHER. They have a pretty good life, I think, as well.

Ms. LACEY. They do.

Senator FISCHER. Yes, the dolphins. Thank you.

[The information referred to follows:]

The U.S. Navy has five Marine Mammal Systems, consisting of humans and dolphins and/or sea lions, that conduct three missions for the Navy: (1) Protection of harbors and Navy assets from swimmer attack (including waterfront security at the Trident submarine bases in Kings Bay, GA, and Bangor, WA); (2) Underwater Mine Counter Measures (detection and neutralization of tethered, bottom, and buried sea mines); and (3) Location and recovery of underwater objects (expensive exercise and training targets). The Navy has 83 bottlenose dolphins and 53 sea lions, two thirds of which actively participate in the Fleet Marine Mammal Systems and all support the Program objectives. It takes 3 to 5 years to train and certify a mine hunting dolphin, at a cost of approximately $1 million. We plan for a 25-year service life of the animals in fleet systems and Navy dolphins typically live to be over 30 years old, compared to late teens in the wild.

The Secretary of the Navy Instruction 3900.41G sets policy for the treatment of the Navy's marine mammals, stating: "marine mammals will be provided the highest quality of humane care and treatment." Over the last 2 decades, we have detected the presence of kidney stones in our dolphins. Since 2010, there have been three life-threatening cases of renal disease due to kidney stones. The research funded by the Office of Naval Research (ONR) enabled the Navy to save the dolphin in the most recent case and is expected to result in preventative measures for the future. The ONR investments in the health of our marine mammals not only ensures compliance with policy on their humane treatment, but also enables the operational readiness of this unequalled underwater detection capability. The fiscal year 2015 increment for the kidney stone project will be $124,629. Investment in this marine mammal health research totaled about $1 million over the 4-year duration of the project and will be complete in March 2015. The Navy has contributed more to the body of knowledge on marine mammals than all other institutions and researchers combined, with over 1,000 peer-reviewed publications.

Senator FISCHER. Mr. Shaffer, have you changed any processes since the sequestration hit last year with regards to Reliance 21, the process that you use? Have you changed anything in addressing the budget needs?

Mr. SHAFFER. I think if anything, ma'am, we've accelerated and put our foot on the gas for Reliance 21 after the sequester. We recognize that budgets are going to be hard, they're going to be tough. I want to drive every dollar out that we don't need to spend, because I have more places, we have more places to spend in support of our warfighters than we have money to spend. Every dollar I can drive out that is duplicative or not on our critical path I can put on some other really critical need.

Senator FISCHER. Are you reviewing programs differently than you were before sequester?

Mr. SHAFFER. We're reviewing them, I think, in more depth and in a more integrated fashion. So for instance—I'm going to get the dates wrong, but I think 28 and 29 May the S&T executives at this table are sitting down for 2 full days to review just six areas. If you do the math, that's about 3 hours per area for all of the major programs in things like power and energy, weapons, autonomy.

That's a pretty extensive use of executive time, to spend that amount of time.

We're going to go through it and figure out what DOD has to do, how industry can help us with our independent R&D, how our international partners can help us, and how DARPA can develop things that might take some of the things that are currently on our critical path and obliterate them. I want DARPA to disrupt our critical path. I want them to develop capabilities so we can go other places.

I think we've put our foot on the gas, ma'am.

Senator FISCHER. Thank you, Madam Chairwoman.

Senator HAGAN. Thank you, Senator Fischer.

Dr. Prabhakar, I wanted to ask about DARPA. We have discussed in this and other hearings that DOD is faced with the challenge of an ever expanding and complex system of threats in space, cyber space, WMD, and other areas. At the same time, we know that we're faced with defense budgets that are flat, operational costs are growing, and research budgets are declining.

It seems like a problematic strategy for the future. What are some examples of programs and technological areas DARPA is investing in that can help break some of these trends? For example, I worry that we will tend to be risk-averse with our research funding dollars, and as Mr. Shaffer just said, he wants DARPA to be disruptive in these areas.

I want to be sure we're not risk-averse as these dollars get tight. So how does DARPA strike the balance between risk and payoff in the development of your research portfolio?

Dr. PRABHAKAR. Thank you for the excellent question. It's very much on my mind all the time that we maintain our focus on high impact and be willing to take the risk that it takes to get there.

Just for context, one thing that has really struck me: I've been on board here for about a year and a half and, given the situation that we're in that you described with budget pressures and a lot of pressure on DOD right now, it was my expectation that DARPA would be getting pushed to be more incremental. I've found, somewhat to my surprise, that, in fact, I think it's the opposite. I think the appetite for fundamental change is very significant. I think it's a consequence of how severe the situation is, exactly as you described: significant threats, but cost pressures, and the cost of our operational systems don't compute when you put them all together and you project out into the future.

Some of the things that we are doing to tackle that have to do with trying to break an approach to complex military systems that has typically started by saying: Let's build this monolithic platform. It's the school bus that we're going to launch to geosynchronous orbit, or it's the huge aircraft that's going to be how we think about the next generation of air dominance. It's a model that we have developed in many different domains, all for good reasons, because that's how you build complex, very powerful systems. That's how we know how to do business.

When the working model is that we have the deepest pockets on the planet and therefore we can just outspend everyone else and that that's one of our competitive advantages, that actually has worked great for us. That's why we have the overwhelming capa-

bilities that we have today. Of course, that same strategy is now what's killing us.

Finding the way to break that is the core of a lot of our programs. In the space domain, just to pick one example, to get to a different model is going to require a variety of different components. One I think we touched on during the opening statements, has to do with moving from space catalogue maintenance to understand what's on orbit, moving from that to space domain awareness in real time—a very different environment than we operate in today, number one.

Number two, we have to change the cost of launch and change the flexibility of launch. Today, it's 24 months typically from the time you know you want to launch a satellite to the time that you can get it on orbit. We want to take that to 24 hours.

Then with that, we also want to change the economics of satellites themselves. One of our programs, Phoenix, is coming up with some radical new approaches using space robotics to change the economics of geosynchronous satellites. Those efforts taken together give us a way to fundamentally change that rigid model that we currently have for space.

Senator HAGAN. Thank you.

Mr. Shaffer, on your page 11 you talked about how China has a planned launch of 100 satellites through 2015.

Mr. SHAFFER. Yes, ma'am. I was over here with Mr. Kendall when he came to see you. The modernization of China and, in fact, other countries, to include Russia, as we step back and look at it has been very focused and will create tremendous challenges for us. So Dr. Prabhakar said that DOD is interested in not incremental, but really blowing things up. We really are at a strategic crossroads, and Secretary Hagel did say it very well. We are in danger of losing our dominance in every domain. Those call for really radical, radical ideas, and I welcome them.

Senator HAGAN. Dr. Prabhakar, I want on this subcommittee to do everything we can to support DARPA's efforts at investing in those high-risk, high payoffs. If you have suggestions for us—and I take your suggestion on the section 1101 process, where you said you have 60 positions and those are filled, 60 out of how many, and what would you like that number to be or do you have a recommendation on that?

Dr. PRABHAKAR. Thank you very much for the support on that, because it is so critical to getting the people that we need.

DOD sets a cap for our agency for the number of civil service positions that we have. That number is either 182 or 183 right now, and it's been very consistent for a very long time. The 60 for the 1101s is legislative, very different from DOD's cap. It's just a number that's legislated separately within that. I don't know; I'd probably need to get back to you on what would make sense there.

I think the fundamental thing that we have seen shifting is, of the ways that we have to hire people, others are getting harder and harder, and that's why the 1101 is an increasing percentage of what we're actually doing.

Senator HAGAN. I have about 1 minute before I'm going to switch it back to Senator Fischer. Another thing, when we were talking about staffing, once again, Mr. Shaffer, you were talking about the

average age of the scientists and that some of the younger employees were leaving. They consistently cited travel and conference restrictions, as well as perceived instability of long-term career, as a motivating factor for their departure. I see shaking heads.

What can we do about that and what are your suggestions about that?

Mr. SHAFFER. Ma'am, I think we've taken care of some of that, in the fact that I drafted for Mr. Kendall, he signed out, a very strong letter saying that going to technical conferences is part of the workforce development of our force.

Senator HAGAN. Which seems a given to me.

Mr. SHAFFER. It seems a given, but it is very difficult because every community in DOD and the military think that they are special. I think the scientists and engineers are special, but the logisticians will tell you they are special. It becomes very hard. I'm very sympathetic to personnel and readiness folks.

Let me take for the record what you can do for us. But any flexibility in hiring. We're working through the section 1101 hiring authorities from last year and trying to get consistencies across DOD. Our laboratories have it better than we have it in headquarters, and that's good because that's where the work has to get done.

I am concerned about the age of our workforce. A workforce that's getting older each year is not healthy. We're monitoring that, ma'am.

[The information referred to follows:]

Section 1107 of the National Defense Authorization Act for Fiscal Year 2014, provides additional hiring authorities and flexibilities to our lab directors. I don't believe any further authorities are required at this time. We will need 1 to 2 years to assess the impact of section 1107.

We welcome Congress' support in strengthening our laboratory workforce. Due to the budget pressures of the last several years, our government laboratory workforce has been under increasing duress from furloughs, shutdowns, and perceived lack of support of our laboratory workforce. Positive messages from Congress on the value of our labs and scientists and engineers would be of high value.

For a longer-term impact, we are exploring options for new funding mechanisms, using existing funds, to recapitalize our lab infrastructure and equipment.

Senator HAGAN. Thank you.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chairwoman.

Dr. Prabhakar, I know that DARPA has a bit of a different focus when it comes to technology development. We heard Mr. Shaffer talk about the Reliance 21 process. I'm curious to know what processes do you use to ensure the greatest return on investment for our warfighters.

Dr. PRABHAKAR. That's the question I ask myself every day, so that's perfect from my point of view. Our starting point at DARPA is to understand the context for our work, and today we focus on three major factors that shape the way we put together our investment portfolio. The first has to do with the breadth and the diversity of threats that our country faces, some from nation states, but also we continue to deal with the terror threat, the increasingly networked and shape-shifting terror threat, very different kinds of threats; just understanding that there is not a single kind of problem that, once solved, we're safe forever. That's number one.

Number two is, simply the cost of our operational military systems we think now is a threat as well and something that I believe will require radical innovation. We think it's not someone else's problem. It's our community's problem.

Then third, the technology world in which we live is one where very powerful technology is globally available and moves at a very fast pace. The United States does not have a monopoly really on any technology field any more.

Those are the factors that shape our portfolio. We then very much look to our program managers to go out and to find, by being in direct contact with the technical community, with the Services, the operational community, with all of their partners in their fields of interest across DOD S&T and the Services that are represented here. Those program managers are the people that we look to to craft the programs that can deliver DARPA-scale impact against the problems of the day.

Then our management role is to knit all of that into a portfolio that is addressing an appropriate range of challenges and opportunities, that is balanced, so that we don't take all our risks in one particular area, but we hedge our bets and make sure that we're covering the landscape that we think is the most effective over time.

Senator FISCHER. How do you weigh the risk versus reward? How do you look at emerging threats? How do you look at surprises that will happen? Do you use that team effort there, that team effect with your managers? With the shortage of money then, how are you going to do that?

Dr. PRABHAKAR. Yes. I think that's a question that's hard to answer for the entirety of what national security threats we face. Maybe I could describe for you some of the work that's going on in a particular area, an air dominance project. An initiative, the Air Dominance Initiative, was kicked off by Under Secretary Frank Kendall about a year and a half ago. In that he asked us specifically to work with the Air Force and the Navy on concepts and potentially down the road prototypes that could help change the face of air dominance for the next generation.

His request was rooted in an understanding that our systems today are not going to be effective against a sophisticated adversary when we're fighting far from home. In the years to come we know that we're going to have to up our game. I don't think it's yet completely clear how we need to do that.

What came out of that was a terrific effort where DARPA, Air Force, and Navy folks in that case have been working together under a security umbrella, first to understand all the excellent work that's already going on, then to develop a shared view of threats and new capabilities that could emerge, and then there's been this marvelous interplay between technology programs and military operators thinking about how they would use these new technologies. As they develop new concepts of employment, those then feed back into how we shape our technology programs.

In that case, that has led for DARPA to some specific program investments where, for example, we're investing in distributed jamming and distributed radar and new approaches to do collaborative autonomy among missiles. Those are programs that are rooted in

an understanding of the threat and the opportunities because of this deep engagement that we've had.

Area by area you'll find that there's that kind of background work, and then the program manager again is on the hot seat to put together a program that will really deliver results.

Senator FISCHER. Thank you.

Mr. Shaffer, Dr. Prabhakar mentioned Secretary Kendall, and earlier you had also mentioned that you had a meeting with him. If you could let us know, I guess be able to provide to us, what your efforts are in dealing with threats, how do you stay ahead of the game, that would be good.

Mr. SHAFFER. Yes, ma'am. Let me just do a very short answer and then we'll follow up for the record. We've done a couple of things in my immediate office. First, I have stood up an office that reports directly to me for technical intelligence. I actually have an intelligence analyst on our staff with some of our S&T people. Their job is every day to look at what the rest of the world is doing.

The second thing that we have done, over the last dozen years or so, we have lost some capacity in doing real operations research campaign analysis. I have a small effort that I've stood up in our office. We get help from the Services to actually do analysis and try to get at some of these cost-capability trades that you're talking about.

Getting support for doing more hard analysis upfront, where we really run through what will this mean to a campaign phase, I think will get us a better payoff in the long term. That's a new effort in 2015. I'm paying for some things this year out of below-threshold reprogramming, but helping us get back to a real strong analytic basis, ma'am, is something that I could use your help with.

Senator FISCHER. You said you had one new person employed in that area?

Mr. SHAFFER. It's a new program line. I think it's approximately $15 million, $12 to $15 million in 2015, and scales up after that. I have a person who actually has outreach to each of the components, plus Lincoln Laboratory, Georgia Tech Research Institute, and Johns Hopkins Applied Physics Laboratory are federally funded R&D centers and university-affiliated research centers to start to really develop, redevelop, our analytic capability.

Senator FISCHER. Thank you very much.

Mr. SHAFFER. Yes, ma'am.

[The information referred to follows:]

We have done several things to develop capabilities to deal with both the current threats and to address evolving threats. Within the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L), we have established or enhanced several entities to respond to the rapid military modernization efforts of potential adversaries; we have established the Research, Development, and Acquisition Task Force (RDA TF), the Strategic Capabilities Office (SCO), and an Analysis Team, while also enhancing the capabilities of the Office of Technical Intelligence to improve information flow between the research and acquisition community and the Intelligence Community (IC). Additionally, these organizations have built close ties with the primary combatant commander organizations in the relevant areas of responsibility to help understand the warfighter's ability and requirements to execute their missions in the face of evolving and modernizing threat capabilities.

The RDA TF was established to identify near-, mid-, and far-term technology-based capability vulnerabilities the United States may be faced with from near peer competitors in an anti-access/area denial (A2/AD) environment, and to develop rec-

ommendations for capability improvement/development to mitigate those vulnerabilities. The RDA TF works closely with the IC, the acquisition community, and the research community to develop a broad range of system-of-system assessments (looking at current and future red and blue system interactions in an operational context across a 20-year timeframe) to identify potential vulnerabilities and then coordinate with analytic and/or developmental efforts across DOD to build recommendations for capability development efforts to mitigate the vulnerabilities.

The SCO is spearheading efforts to cultivate cutting-edge concepts that could give U.S. Forces new advantages against sophisticated military adversaries. The SCO was established by AT&L in 2012 to conduct analysis in support of ongoing efforts to shape and counter emerging threats with emphasis on innovative and architecture-level, cross-service and cross-defense/intelligence concepts. The SCO's mission is to develop capabilities to shape, deter, or dissuade an adversary in pre-conflict operations and therefore focuses on impacts in the crisis phase and early conflict phase of an operation, whereas the RDA TF focuses on developing capabilities needed in the conflict phase of operations.

Recently, the ASD(R&E) stood up an analytic cell to rapidly conduct analysis, from the physics and engineering level to the campaign level, which supports AT&L's efforts to develop capabilities to mitigate or defeat those current and emerging threats. The specific analytic efforts are identified and prioritized by the kill chain analysis work that is informed by the IC and emerging threats. The analytic cell then coordinates with the Military Departments and works with Federally Funded Research and Development Centers and University Affiliated Research Centers to carry out the analysis. The analysis, which is further informed by the IC and appropriate program offices, provides the objective basis for resourcing and cost/capability trade decisions.

Although the Office of Technical Intelligence (OTI) has been established since before we began the efforts to address near peer military modernization efforts, we have reorganized it to improve our integration with the IC by bringing on a full time liaison officer from an intelligence agency that helps with the coordination and deconfliction with translating requirements between intelligence analysts and scientists and engineers, as well as keeping the capability developers informed of the latest military modernization efforts around the world. Additionally, OTI has an horizon scanning effort that identifies technologies that may lead to disruptive capability developments with the intent of developing means of exploiting those technologies either for development of a capability or to mitigate an adversary's use of those technologies.

Throughout these organizations, the research and acquisition communities remain closely linked with the IC. This provides a two-way communication path for exchange of information and ideas that provide the capability developers with a more informed awareness of the technical capabilities a potential adversary is developing while providing the IC with a better understanding of the impact of technology on military capabilities.

Senator HAGAN. One of the things about this hearing that is exceptional is the fact that before us we have three highly qualified and distinguished women leading large and important technical organizations on behalf of the Nation. So, thank you.

I worry that we're not doing enough to foster diversity within the overall DOD STEM workforce. A recent study by RAND estimated that the DOD STEM workforce was 76 percent white, 5 percent Hispanic, and 72 percent male. For all the witnesses: Are there specific advantages to innovative organizations, like yours clearly are, to have a more diverse workforce, and what steps are you taking to increase the diversity of your STEM workforces?

In the RAND study, I didn't see the division of the African Americans that were in the workforce.

So Mr. Shaffer, do you want to start or the three women?

Mr. SHAFFER. First off, I think that report has it exactly right. I don't think that we are as successful as we need to be to bringing all aspects of American life into our laboratories. It takes time. This is one of the reasons I worry.

Senator HAGAN. It is 2014.

Mr. SHAFFER. I understand that. But that's one of the reasons I'm most worried about K through 12, because we can reach out and excite young boys and girls of all colors, all ethnic backgrounds, into science if they can do hands-on touching of it.

I tend to agree. I'll let the ladies and Kevin talk, but I think we need to do more in making our workforce as diverse as possible, as representative of America as possible.

Senator HAGAN. Ms. Miller?

Ms. MILLER. In our outreach program we are looking at diversity, but in the broadest context, not just on ethnic backgrounds, but also on economic backgrounds as well, and bringing in this diverse school of thought. We are looking at how we then encourage. The statistics are that women tend to drop out in S&T. I don't understand that personally, but they do tend to drop off later in their education.

One of the things that we try to do is to get them paired up with somebody that can help encourage them to stay in this kind of line-of-technology development. That is something I think is worthwhile to the enterprise itself, to help facilitate this.

Senator HAGAN. I'm going to interject here, that it would be, I think, very beneficial for DOD to have a strong focus on our military dependents, where they are, because it seems like that's a wonderful talent pool that we need to be bringing on board. We do lose young women in middle school.

Ms. Lacey?

Ms. LACEY. Ma'am, if I could? The Navy only has two DOD Education Activity schools that are located where our Navy laboratories are, and we go out of our way to reach out to them very strongly. One, of course, is at Dahlgren and the other one is at Quantico. We do enjoy those special relationships with the DOD schools.

On the diversity writ large, let me just speak to the Navy laboratories. They tend to reach out locally in their community, and some of them are located in quite diverse communities. We have a tremendous outreach effort to the Hispanic community in southern California, and we have been very successful there in stimulating the population to consider the U.S. Navy as a career option.

I agree with you, you can never do enough. It's important to note that the workforce of today was raised in the 1970s and 1980s. If we want to influence the workforce 15 to 20 years from now, as Mr. Shaffer says, we really need to have that outreach in our K through 12 programs.

Senator HAGAN. Mr. Gooder?

Mr. GOODER. Yes. Diversity is extremely important to the Air Force. We have a very vibrant minority leaders program.

Senator HAGAN. How about in the S&T area?

Mr. GOODER. In the S&T area, we use the section 219 for a lot of workforce development activities, and we're looking at a current program with Reserve Officers' Training Corps that we're looking to get out. It's a specific program for electronic warfare cyber, to try to pull those folks into the pipeline so that we have diversity in that area. That looks very promising right now.

We're also working with Mr. Shaffer's office on the STEM diversity campaign that Dr. Reginald Brothers, the Deputy Assistant

Secretary of Defense for Research, is leading. In that area, we're looking to continue some of the materials camps, teachers materials camps that we're doing. One of those is at Howard University here in Washington, DC, that we're looking to host this summer. We think that that activity is going to be beneficial.

Senator HAGAN. Dr. Prabakhar?

Dr. PRABHAKAR. I'd like to actually broaden this topic a little bit. In my venture capital life in Silicon Valley when I served on the boards of startup companies, a very typical board meeting looked like a junior United Nations because of the nations of origin that would be represented around the table. When I came back into the national security world, I knew it was going to look different, but it was really different.

That actually caused me to go look recently to see what the percentage of our S&T workforce in the United States is that's foreign-born. I knew the numbers would be interesting, but even I was surprised. Over half of the Ph.D. engineers working in the United States were not born in the United States. About a third of master's degree engineers in the United States were not born in the United States.

To me, that says two things. One is exactly the conversation we've been having, which is how do we get from across all of American society, how do we get more people to pursue these opportunities, which we all have just had the great pleasure of having these fulfilling careers in technical areas? I think that continues to be an important calling.

At the same time, our country is so fortunate to get these amazing talents from around the world. It turns out I'm actually part of that foreign-born Ph.D. contingent. I came here when I was 3 years old, so it was my parents who made the immigrant decision, not me. Those people that made that choice to come to the United States to get an education, so many of them have stayed and have contributed in amazing ways, often only, though, to our economy, not as much to our national security.

I think there are obviously valid reasons; that you have to think through security issues and figure out how you manage that. That is another place where I think DOD is not as fully tapping a very broad community that offers a great deal.

Our university programs are one place where we have an important touchpoint with that much broader community.

Senator HAGAN. Where we've just cut $200 million.

Dr. PRABHAKAR. That's a continuing issue. As I think you know, my understanding is that $6.1 actually had been in a somewhat more protected position in prior years. In a little bit broader context, I think it's still a vital and important part of what we do.

My point is just that it's a two-way street, and when someone who's here working in a lab in a U.S. university, may have come from another part of the world, when they know about our country through the kind of work we can engage them in, that's something that actually can have very long-term national security implications. I think it strengthens us and it's another part of this conversation.

Senator HAGAN. I agree.

I want to follow up, Mr. Shaffer. Since fiscal year 2010, the Historically Black Colleges and Universities (HBCU) program has been cut from $67 million down to $36 million. That's just from 2010. In your fiscal year 2015 budget the program is further reduced to $24 million. In 2010 it was $67 million, you're now proposing $24 million.

Given our diversity and technical hiring challenges, this is disturbing. Given that the HBCUs educate roughly 20 percent of black science and engineering students, undergraduate students, why does this program have such a low priority and what steps can we take to strengthen the ties between DOD and our HBCUs?

Mr. SHAFFER. Regardless of what the numbers say, ma'am—and I want to take one thing for the record and get back to you—I don't think it has a low priority. I believe in fiscal year 2010 there had been a previous decision. I think it was the Rothe decision, that didn't let us spend any money for 1 year in HBCUs.

Senator HAGAN. The Rothe decision?

Mr. SHAFFER. Yes, there was a protest on using Federal money to set aside for specific groups of people, for minorities, so we could not spend for a year.

The appropriators then doubled our investment for 1 year so we'd have a steady stream. Traditionally, we've been at about $25 million to $35 million. Coming down to $25 million, hated doing it this year. We did it because we had across-the-board cuts.

We've done something to focus the program this year. In fact, we're starting two Centers of Excellence. We've heard the people here at this table talk about how do we better use some of the levers. I want to help use the HBCU program to help universities graduate.

Delaware State has graduated in mathematics. They have a Center of Excellence where now Delaware State Mathematics Department is as good as any in the country, maybe with the exception of Massachusetts Institute of Technology, but they're certainly as good as University of Vermont where I went. We're looking and we've gone out competitively for two more Centers of Excellence, where we're going to put $5 million into an HBCU to build a corpus of strength and see if that can start to have some schools graduate where they're competing across the entire Federal landscape.

I wish I could tell you that we funded everything where we wanted to fund it, ma'am. There were very hard choices. HBCUs was one of the hard choices. Frankly, one of the things that led us there was that program was very late in obligating and executing money.

[The information referred to follows:]

The Historically Black Colleges and Universities and Minority Serving Institutions (HBCU/MI) program plays a pivotal role to strengthen research and educational opportunities at HBCU/MIs and increase number of minority graduates in science, technology, engineering, and mathematics disciplines critical to national defense. The program also allows the Department of Defense (DOD) to build a more diverse pool of scientists and engineers to meet future needs of defense-related programs.

DOD has sponsored well-attended outreach activities for HBCU/MI universities. These include:

- An HBCU/MI National Conference on March 20 to 22, 2011, to discuss the state of HBCU/MI participation in DOD programs, describe areas of research interest, describe DOD funding and laboratory research opportunities, provide networking opportunities, and showcase HBCU/MI accomplish-

ments. DOD had over 295 participants (included HBCUs, MIs, Federal Government, and industry).

- DOD sponsored a DOD–HBCU Workshop on May 20, 2012, to bring together DOD Technical Officers and HBCU investigators to discuss specified areas of research interest, including breakout and one-on-one sessions, and the DOD process for submission of white papers and proposals. The workshop included 40 participants from HBCUs and 7 DOD agencies.
- An HBCU/MI Webinar was conducted on August 28, 2013 for the purpose of the Department to describe areas of DOD research interest, provide information on how to locate DOD funding opportunities, and explain the DOD contracts, grants, and agreements business process. We had 310 participants from HBCUs/MIs universities.

Future outreach activities include:

- An HBCU/MI Webinar scheduled for May 28, 2014. The purpose of the webinar is to discuss areas of DOD research interest, particularly Centers of Excellence topics, to answer questions and provide information about other funding opportunities.
- An HBCU/MI Workshop is being organized for the fall of 2014 for the purpose of bringing together DOD Technical Officers and HBCU/MI investigators to discuss areas of research interest and encourage participation in DOD research opportunities.

From a funding perspective, the President's budget requests for HBCU/MIs have been relatively flat from fiscal years 2009 to 2014. Increases to HBCU/MI program were a result of congressional action except in fiscal year 2014, where the Department increased HBCU/MI core program to fund three Centers of Excellence. See following table.

DOD Historically Black Colleges and Universities/Minority-Serving Institutions (HBCU/MI) Funding Profile – FY 2009-FY 2015				
Fiscal Year	President's Budget Request (in thousands)	Congressional Action	Appropriated Amount (in thousands)	Impacts on DoD Spending
Rothe Era				
2009	$15,156	Increased funding level	$41,556	*Rothe* decision resulted in hold on program execution
2010	$15,164	Enacted 10 U.S.C. 2362 and re-appropriated FY 2009 funds to overcome effect of *Rothe* decision	$67,097	Delegations for 10 U.S.C. 2362 signed on March 29, 2010—halfway through fiscal year
Devolvement				
2011	$15,543	Increased funding level	$23,067	Decision by SecDef to devolve program to the Army beginning in FY 2012
2012	OSD = $0 Army = $15,245	Required reprogramming from Army line to OSD and increased funding level	$35,245	Devolvement issues delayed program execution; funds not restored to OSD until May 2012
2013	OSD = $0 Army = $15,599	Transferred amount requested from Army line to OSD and increased funding level	$35,599	Sequestration resulted in a program reduction
Program Returned to OSD				
2014	$30,895	Increased funding level	$35,895	Additional $15M requested by DoD targeted to establishment of three Centers of Excellence
2015	$24,412			

Senator HAGAN. Why?

Mr. SHAFFER. We're going through a root cause analysis right now, but we get billed very late. We've had some program management that may not be where I want it to be. Any number of reasons.

Senator HAGAN. It seems like we shouldn't be penalizing the students who attend these universities. I think maybe better oversight from DOD could make a big difference.

When we're cutting at HBCUs in this time, when you look around this room, the need for diversity, we should be doubling those funds instead of cutting them. I think diversity brings so much to the table when we're talking about all areas.

Mr. SHAFFER. Yes, ma'am.

Senator HAGAN. I would like to see what steps we can take to strengthen the tie between DOD and HBCUs. I have a number of HBCUs in North Carolina, 10 of them.

Mr. SHAFFER. You have very good ones.

Senator HAGAN. I know we do. I remember one time when I was talking to one of the generals and asked where they recruited for

S&T. They did not recruit at North Carolina A&T. I asked him to specifically go there. I think things like that, where you actually go and recruit at HBCUs and be a face and actually, obviously, support from a financial perspective, too, will help.

Mr. SHAFFER. Yes, ma'am.

Senator HAGAN. Let me ask about the S&T support missions at some of our bases. As we try to advocate for these research efforts, it's always helpful to note specific examples of our S&T accomplishments and how real capabilities have been delivered to operational units. We have two very large military installations in my State, Camp Lejeune and Fort Bragg. Our 82nd Airborne Division and the Second Marine Expeditionary Forces have challenging and technologically-rich missions. I'm interested in how the S&T enterprise supports these missions.

Ms. Lacey, I understand you have the oversight over the Marine Corps S&T programs. Can you give me some of the specific R&D efforts that you're undertaking for supporting the mission of our marines?

Ms. LACEY. Ma'am, yes, the Navy does oversee and make investments for the Marine Corps in S&T. Let me give you a recent example. Paint is a big problem for the Marine Corps, not just the corrosion problem, but we paint everything. If it doesn't move, we paint it, right. If it does move, we paint it.

Paint scratches, things rust, they deteriorate, and the equipment is no longer protected. We've recently developed a self-healing paint. I'll be honest with you, I wish I had it on my car. It's a self-healing paint, so that if it scratches it reassembles itself, the molecules in the paint, so it heals the scratch until we can get it to a more permanent repair.

We've been working on that in the S&T world for a while. We've taken it out, we've demonstrated it, and we're getting ready to transition it next year into the Marine Corps Joint Light Tactical Vehicles. We're pretty excited about that sort of thing.

Senator HAGAN. Explain to me the importance and significance of that.

Ms. LACEY. It reduces the amount of work that the Marine Corps has to do to maintain their equipment. We've reduced the corrosion. They don't need to bring those vehicles back in, totally take them apart, strip the paint off, repaint them to get a complete coating on them. It's a big money-saver.

If we put it on all of our Marine Corps vehicles, we expect that we could save upwards of several hundred million dollars a year.

Senator HAGAN. That would be great going to our HBCUs.

Ms. LACEY. Yes, ma'am.

Senator HAGAN. Thank you.

Ms. Miller.

Ms. MILLER. We have a couple of near-term examples that we've been using. One of the things that the Army does in support of our airborne expeditionary missions is we're looking at how we get better and less weighty soldier power solutions. We've done a lot of the base development of technology at the Army Research Laboratory, at our Communications-Electronics Research, Development, and Engineering Center, and then at our Soldier Research, Development, and Engineering Center, coupled with the PEO soldier, who

actually has been able to field our technology, which has been very effective. We did a lot of this in Afghanistan.

You'll hear about things that we did in fielding conformable, wearable batteries that have been 2.3 pounds, but ergonomic to fit to the soldier himself, make it much easier for him to do his mission, and not be constrained by all these boxes that we hung around his waist.

We have done a universal battery charter that you'll see PEO soldier has made into a program of record. That allows us to take any kind of battery and charge out of one capability. We can plug in any battery and recharge it there, which has been useful.

We do a lot of airdrop technology, which, of course, is very relevant to the 82nd. We are in development right now of an automatic actuation device to make sure that the static line parachutes in the T–11 and the MC–6, if the paratrooper's chute doesn't work and their reserve chute, they don't pull it or aren't in a capacity to pull it, it will automatically pull itself, to make sure that our paratrooper is okay.

Then just from the fundamental perspective, we're looking at how we can get more expeditionary mobile firepower for the 82nd. This is something we've been doing with our Maneuver Center of Excellence: How can we give them capability that is expeditionary and then gives them lethality and protection while they're doing their mission?

Those are just some of the things in the broad category of area that we've been working.

Senator HAGAN. Those all sound great. Thank you.

Let me move to a question on the Rapid Innovation Program. Over the past few years we've added funds to the DOD budget for this program. It was intended to support programs that move technology out of the labs and small businesses and into the hands of the acquisition programs and warfighters more seamlessly.

I understand that we're still awaiting some assessments and how funded projects are progressing. Mr. Shaffer, what is your assessment of the quality of the areas being funded and the proposals being received under the Rapid Innovation Program? Do the topic areas and proposals represent ideas of importance and interest to DOD?

Mr. SHAFFER. Yes, ma'am, I think that the quality has been good. I think that we are working on the right things, because all of us work with our Rapid Innovation Program funding managers to go out for our highest priorities. We held a review, I want to say it was the 28th of either February or March. We're just now getting to the end of completion of the first year's funding. So projects are coming through. Right now it looks like about 50 percent of the projects are going into some type of transition to program of record.

Senator HAGAN. When you say the first year's funding?

Mr. SHAFFER. Yes, ma'am. I want to say it was 2012 or 2013 start, but remember there was a long Continuing Resolution, so we didn't get the money until the end of the year. Then we had to go competitive. We got the money for fiscal year 2012 out the door at the end of fiscal year 2013. It's 2-year money. Those projects now are just ending.

In fact, we've only completed four or five projects total. It looks like our pickup rate's going to be about 50 percent. That is about the same percentage of transition as the traditional small business innovative research program.

We're working with that office to see, are there things from both programs we can bring together to improve both programs? Frankly, it's too early to tell you whether or not the program adds additional value, and even if it did, we'd have to get to a more stabilized funding stream before we can take on that size chunk of program, ma'am.

Senator HAGAN. Okay. Ms. Miller, Ms. Lacey, and Mr. Gooder, each of your Services are managing funds under this program also. Do you have any early assessments on the value of the program in terms of its abilities to support real service needs?

Ms. LACEY. Ma'am, the fiscal year 2011 new starts were restricted to urgent needs, which is certainly important. So many urgent needs that were coming in from DOD, the actual need was not necessarily a program of record for this response to answer to. So we're still working through those transitions where it was a response to an urgent need.

We've only finished two of them so far, and I believe, like Mr. Shaffer, that it's premature to judge the entirety of the program based on a data point of two from a large number.

Senator HAGAN. Mr. Gooder?

Mr. GOODER. Yes, we actually have a success story out of the Rapid Innovation Program. Out of 2011, we developed a hand-held instrument for quality assurance on surface preparation processes used in the F–35, in manufacturing the F–35. Currently, those processes require manual testing of 30,000 nut plates on each plane to ensure correct bonding of materials. So the current failure rate is about 1 percent or 300 netplates, and each failure requires individual repreparation and rebonding with supervisory oversight.

The Rapid Innovation Program, the project, the hand-held device that we've developed, it's going to significantly reduce the failure rate of those bonded net plates. We've had about 2,200 proposals out of the Rapid Innovation Program. There's a great response from industry over the last few years. We really view it as us being able to get out there and tell industry what our problems are and their responding.

We think it's going to turn out well for the Air Force.

Senator HAGAN. Ms. Miller, what are your thoughts on this program?

Ms. MILLER. Ma'am, like the others, I would tell you it's too early to really say whether this has paid off. The Army, my predecessor, had established this program to do a slightly different focus, where we were looking at getting industry to look at our enduring challenges. The Army has a standard set of challenges. We're always looking for better force protection, lighter weight soldier gear. We're looking for timely mission command and the list goes on.

We had sent that out as the enduring challenge set that we wanted industry to respond to. The goodness of this program is we saw outreach to industries that we hadn't seen before, so it was touching a different category of responders, and they came in with interesting ideas. It also aligns well to our S&T program, so when

we look at the 48 fiscal year 2011 contracts that were let, about 38 are looking, I'll say, green, because they're aligned to where S&T is going anyway. It gives us an alternative path, an option, that we would then spin into something that will eventually go into a program of record.

We've been looking at how we're now shifting our focus to try to get those transitions to acquisition and bring in more ideas like that as we go out into this fiscal year 2014 data call.

Senator HAGAN. We are running out of time. Ms. Miller, in your written testimony you indicated that over the years the rigid and insular nature of the defense laboratories have caused an erosion of the synergy that's critical to the discovery, innovation, and transition of S&T that's important to national security. My concern is what forces do you think made the DOD labs become rigid and insular? Maybe you can just spend a minute, and then you can give me a written response.

Ms. MILLER. I can give you a written response.

Senator HAGAN. Sorry. Yes, okay, let's just do that.

[The information referred to follows:]

Over the past 60 years there have been many organizational changes and consolidations throughout the Department of Defense; however, the research laboratory structure and operation have not changed. Policies related to physical and information security and personnel rules have led our labs to become rigid and insular. In particular, physical and information security rules make collaboration with universities and industry partners that have evolved with changing research and the economic environment more difficult, and make direct collaboration with foreign nationals nearly impossible. The erosion of the university/industry/government lab synergy that is vital to the discovery, innovation, and transition of science and technology critical to national security is a direct result of these policies. Additionally, civil service personnel policies make it difficult for researchers to move from one lab to another, or move from government service to academia, or industry and back again.

The globalization of technology requires novel and new collaboration mechanisms that will reenergize the university/industry/government lab synergy. The pace of technological change from 1990 to 2013 far exceeds the technology pace observed from 1950 to 1990 and will more than likely continue to increase beyond 2013.

An example of that renewed collaboration is the Army Research Laboratory's (ARL) Open Campus concept, which I described in my written testimony. Through the Open Campus framework, ARL scientists and engineers will work collaboratively and side-by-side with visiting scientists, including foreign nationals, in ARL's facilities, and as visiting researchers at collaborators' institutions. The global academic community, industry, small businesses, and other government laboratories benefit from this engagement through collaboration with ARL's specialized research staff and unique technical facilities. These partnerships will build research networks, explore complex and singular problems, enable self-forming expertise-driven team building that will be well-positioned for competitive research opportunities, and expose science and engineering students to realistic research applications and perspectives, helping to ensure our Nation's future strength and competitiveness in these critical fields.

Senator HAGAN. Back on the Rapid Innovation Program, if any of you have recommendations for this subcommittee to consider as we review the program and its benefits, I'd like to see those, too.

I appreciate, Mr. Shaffer, you and DOD with our S&T and all of the other individuals and witnesses here and what you do for your divisions. So please know that we are open, would love to hear further elaboration of any of the questions we asked or didn't ask today. We'd like to see that.

I just wanted to be sure that Mr. Kendall knows that we need to have a Secretary of Defense for Research and Engineering. I wanted to be sure we noted that.

Thank you very much for your testimony today. This hearing is adjourned. Thanks.

[Whereupon, at 3:45 p.m., the subcommittee adjourned.]

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR KAY R. HAGAN

SECTION 1107 OF THE NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2015

1. Senator HAGAN. Ms. Miller, Ms. Lacey, and Dr. Walker, what is the status of implementation of the authorities and flexibilities of section 1107 of the National Defense Authorization Act (NDAA) for Fiscal Year 2014?

Ms. MILLER. The Department of Defense (DOD) has developed a Federal Register Notice (FRN) implementing most of the flexibilities contained within section 1107 of the NDAA for Fiscal Year 2014. The FRN has been reviewed through the Army and is currently within the office of the Assistant Secretary of Defense for Personnel and Readiness (ASD(P&R)). Pending ASD(P&R) review, the FRN will be published and the flexibilities can be used by all of the DOD Science and Technology Reinvention Laboratories (STRL). The flexibility authorized in section 1107(h) is not included in the FRN and is currently being reviewed within the Army to see how to implement it within the bounds of other legislation related to civilian personnel.

Ms. LACEY. Section 1107 authorities fall broadly in two categories: appointments and management.

DOD is in the process of preparing a FRN that would regulate the Direct Hire Authority (section 1107(a)) and Senior Scientific Technical Manager (section 1107(f)) positions by the STRLs across the components. This FRN is currently with DOD(P&R) for coordination. Once it has been fully vetted through DOD, it will be submitted for publication. The Assistant Secretary of the Navy (Manpower and Reserve Affairs) and Deputy Assistant Secretary of the Navy (Civilian Human Resources) will issue deployment protocols to make the authority available to STRL directors.

Section 1107(h) Exclusion from Personnel Limitations pertains to the management of personnel. Section 1107(h) notes that STRL directors shall manage workforce strength, structure, positions, and compensation in a manner consistent with the budget available for the STRL. Generally, these authorities are a feature of the Navy Working Capital Fund operating model and were already available to Navy STRLs. The Secretary of Defense has determined that section 955 of NDAA for Fiscal Year 2013 overrides section 1107(h). As such, the Office of the Secretary of Defense (OSD) established budget targets for the Department of the Navy, which flowed in turn to the STRLs. These budget targets apply an indirect restriction on workforce size.

Dr. WALKER. Section 1107 of the NDAA for Fiscal Year 2014 provides valuable hiring authorities for the Air Force Research Laboratory (AFRL). We appreciate the support Congress has provided to our laboratory in this regard.

The Air Force is currently working with OSD on implementation guidance for the authorities in section 1107. Once the implementation guidance is released by OSD, Air Force approval authorities will coordinate on Air Force-specific guidance and provide it to AFRL. The laboratory will benefit greatly once able to fully utilize the flexible authorities.

SCIENCE AND TECHNOLOGY REINVENTION LABORATORIES

2. Senator HAGAN. Ms. Miller, Ms. Lacey, and Dr. Walker, who in your Service is the lowest level decisionmaking authority to authorize the lab directors of STRLs to use the authorities as intended by this subcommittee?

Ms. MILLER. The flexibilities authorized in section 1107 of the NDAA for Fiscal Year 2014 need to be codified within a FRN before they can be adopted by the STRLs. The lowest level of decisionmaking authority within the Army for the FRN is the Assistant Secretary of the Army for Manpower and Reserve Affairs; however, the FRN still needs approval from the office of the ASD(P&R) prior to being published.

Ms. LACEY. Section 1107(a) Authority to make Direct Hire: Once the FRN is published, this authority will be available for use across the STRLs and Assistant Sec-

retary of the Navy (Manpower and Reserve Affairs) and Deputy Assistant Secretary of the Navy (Civilian Human Resources) will issue deployment protocols.

Section 1107(h) Exclusion from Personnel Limitations pertains to the management of personnel. Section 1107(h) notes that STRL directors shall manage workforce strength, structure, positions, and compensation, consistent with budget available for the STRL. Generally, these authorities are a feature of the Navy Working Capital Fund operating model and were already available to Navy STRLs.

Dr. WALKER. The hiring authorities detailed in section 1107 of the NDAA for Fiscal Year 2014 have not yet been delegated to the lowest level Air Force decisionmaking authority.

The Air Force is currently working with the OSD on implementation guidance for the authorities in section 1107. Once the implementation guidance is released by OSD, Air Force approval authorities will coordinate on Air Force-specific guidance (including lowest level decisionmaking authorities) and provide it to AFRL.

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH

3. Senator HAGAN. Ms. Miller, Ms. Lacey, and Dr. Walker, what is the advantage to your lab or other science and technology (S&T) organizations' performance to having a more diverse science, technology, engineering, and mathematics (STEM) workforce?

Ms. MILLER. Diversity and inclusion yield more diverse and innovative ideas. A wider range of experiences, knowledge, and cultural backgrounds yields a wider range of potential solutions and capabilities. Our soldiers benefit when people are looking at the challenges they face with a perspective that is reflective of the market we serve.

Specific benefits include:

- Diversity allows organizations to more closely mirror their customer base and understand their complex concerns.
- Diversity and inclusion present a positive environment for attracting the best talent and encouraging employee growth in social/cultural awareness.
- Diversity enriches the employee experience.
- Diversity is good for generating S&T-based capabilities because it brings in a greater breadth of ideas from which the best can be selected.

Ms. LACEY. The Navy S&T organizations rely on the expertise and innovative capacity of the STEM workforce to avoid technology surprise and to develop our own new offensive and defensive capacity. Bringing together scientists and engineers with different qualifications, backgrounds, and experiences enables effective problemsolving on the job. Similarly, diversity breeds creativity and innovation. A diverse STEM workforce is critical to maintaining the flow of a broad set of perspectives and backgrounds to support the generation of the widest possible range of scientific and engineering ideas and solutions.

Dr. WALKER. Air Force capabilities in our laboratories and S&T organizations are enhanced by diversity among its personnel. At its core, diversity provides our Total Force an aggregation of strengths, perspectives, and capabilities that transcend individual contributions. Air Force personnel who work in a diverse environment learn to maximize individual strengths and to combine individual abilities and perspectives for the good of the mission. Our ability to attract a larger, highly-talented, diverse pool of applicants for service in our S&T organizations, both military and civilian, and develop and retain our current personnel will positively impact our future Total Force.

Air Force decisionmaking and operational capabilities are enhanced by diversity among its airmen, uniformed and civilian, helping make the Air Force more agile, innovative, and effective. It opens the door to creative solutions to complex problems and provides our Air Force a competitive edge in air, space, and cyberspace. Diversity includes and involves all of us. It strengthens the United States and gives the Air Force a decisive advantage as we engage globally.

4. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, what is the benefit of a more diverse STEM workforce to DOD?

Mr. SHAFFER. Increased diversity will yield important benefits to DOD, including providing a technical workforce with a broad range of perspectives and capabilities from which DOD can draw to develop mission critical defense systems for national security. A diverse DOD workforce acts as a driving force for achieving a sustainable, technologically capable workforce for current and future defense needs.

DOD workforce diversity remains a mission critical imperative for DOD.

Dr. PRABHAKAR. Innovative thinking—thinking outside the mainstream—is at the heart of all technological advancement, and one of the best ways to make sure the United States is maximizing the diversity of ideas for consideration and integration into our S&T enterprise is to broaden the net and capture ideas from the most diverse collection of people. Put differently, people with different life experiences and world views will come up with different solutions to problems. This was the number one finding of a recent Forbes report based on a survey of more than 300 executives at enterprises around the world with revenues greater than $500 million each (in fact, 40 percent of the companies had revenues of more than $5 billion annually): Fostering Innovation Through a Diverse Workforce: http://images.forbes.com/forbesinsights/StudyPDFs/Innovation—Through—Diversity.pdf.

This is not just an "obvious" idea. A growing scholarly literature appears to confirm this correlation: Does a different view create something new? The effect of employee diversity on innovation: http://www.sciencedirect.com/science/article/pii/S0048733310002398.

In addition, a December 2013 Harvard Business review study found that more diverse companies out-innovate and out-perform others. How Diversity Can Drive Innovation: http://hbr.org/2013/12/how-diversity-can-drive-innovation/ar/1.

Simply put, diversity unlocks innovation.

Ms. MILLER. The Army and our soldiers are a diverse community with wide ranging needs for scientific and technical capabilities in combat, tactical situations, training scenarios, sustainment, and logistics. Our research capabilities need to be representative of the stakeholders we serve and their needs so that we may better understand the environment in which they serve. A more diverse STEM workforce brings a broader mix of ideas, skills, and approaches to provide those technology-based capabilities.

Ms. LACEY. DOD, in general, and the Department of the Navy in particular, rely on the expertise and innovative capacity of the STEM workforce to avoid technology surprise and to develop our own new offensive and defensive capacity. Bringing together workers with different qualifications, backgrounds, and experiences are all key to effective problem-solving on the job. Similarly, diversity breeds creativity and innovation. A diverse STEM workforce is critical to maintaining the flow of a wide range of perspectives and background to support the generation of the most comprehensive and capable set of innovative warfighting technologies.

Dr. WALKER. Diversity is a strategic imperative, critical to mission readiness and accomplishment, and a leadership requirement. As the global threat environment continues to evolve, the DOD Total Force will confront complex, asymmetric operational environments, and unconventional tactics, necessitating full employment of all DOD assets. A diverse STEM workforce allows DOD to meet these challenges and thrive in the face of opposition.

We defend the greatest nation in the world—a democracy founded on the promise of opportunity for all. It is a nation whose demographic makeup parallels the environment in which we live—continually changing—and DOD must change to maintain and sustain its future forces. To the degree we truly represent our democracy, we are a stronger, and more relevant force. The Air Force views diversity as a strategic imperative. Diverse backgrounds and experiences bring inherently different outlooks and ways of thinking, the key to innovation in organizations as well as our success in the STEM community. We gain a strategic advantage by leveraging the diversity of all members and creating an inclusive environment in which each member is valued and encouraged to provide ideas critical to innovation, optimization, and organizational mission success.

5. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, what ideas do you have for the committee to consider to promote diversity in the DOD STEM workforce?

Mr. SHAFFER and Dr. PRABHAKAR. DOD has launched a collaborative, DOD-wide STEM Diversity Campaign (SDC) to foster awareness, build skills, and widen pathways into DOD's technical workforce to enhance diversity. Support of this effort will assist in promoting diversity in the DOD STEM workforce.

DOD's SDC has identified priority areas including driving home the DOD commitment to diversity to internal as well as external audiences through "30 Under 30" role models; creating pathways into DOD laboratories; and engaging DOD in a national mentoring initiative, Million Women Mentoring. These initiatives, among others, will serve to foster awareness, build skills, and widen pathways into DOD's technical workforce to enhance diversity.

Ms. MILLER. To promote diversity in the STEM workforce, we must first build a broad, diverse STEM talent pool from which to hire that workforce. We need investment in efforts to increase STEM literacy—having the knowledge and skills to be

competent in using STEM methods and tools—outside more traditional venues in order to recruit, develop, and retain diverse talent. We need investments in initiatives that lay a foundation for competitiveness from underserved communities and it needs to begin in the formative years, while students are in elementary school and haven't yet been taught to be afraid of STEM or haven't already lost interest or confidence in building their STEM skills. We must integrate building diversity as an integral part of our workforce initiatives rather than a subset that works in parallel to workforce initiatives. At a time when scientific and engineering capabilities help improve lives and rebuild our economy, we must reach and retain the best possible talent instead of limiting ourselves to the most accessible talent from the traditional STEM talent pool. This requires long-term, strategic, and sustainable investment.

One idea we use within the Army Educational Outreach Program is to use a pipeline of programs to help build diversity in the talent pool beginning at an early age (grades 4–5), continuing with our UNITE initiative—a 4- to 6-week, pre-collegiate summer program for talented high school students from groups historically underrepresented and underserved in STEM and the Research in Engineering Apprenticeship Program—a summer program that places talented high school students from that same population in research apprenticeships at colleges and universities.

Ms. LACEY. DOD has a number of excellent programs in place to promote a robust STEM workforce pipeline, including internships, scholarships, and specialized training programs. Rather than creating new programs, we believe that a better solution would be to grow or expand existing programs to accommodate additional young people, particularly underrepresented populations.

Dr. WALKER. I recommend the subcommittee support the efforts of the SDC, a DOD effort. The objective of the SDC is to foster awareness, build skills, and widen pathways into DOD's technical workforce for women and underrepresented minorities. The SDC highlights work accomplished across the Nation where DOD has a significant S&T presence. The SDC encourages the Services already embedded in S&T areas to engage with diverse communities.

For example, the Air Force has partnered with the SDC to support the American Society for Metals (ASM) Materials Teacher Camp which will take place this summer at Howard University in Washington, DC. The ASM Materials Teachers Camp invites teachers who work in underrepresented communities and teaches them how to use low-cost, simple labs and experiments using everyday materials. In turn, the teachers can integrate the skills they have learned into lesson plans to engage and excite future STEM leaders in their classrooms.

MINORITIES

6. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, what recommendations do you have to increase or improve engagement between DOD and Historically Black Colleges and Universities, and Minority Institutions (HBCU/MI)?

Mr. SHAFFER and Dr. PRABHAKAR. We believe that the statutory authorities in place will adequately support initiatives aimed at improving engagements. In addition to webinars and workshops for HBCU/MI, we are engaging with senior management of the DOD components to develop strategies for ensuring that our research program is more inclusive. HBCU/MI and their principal investigators (PI) need an incentive to leave the comfortable environment created by the OSD program and any other funding opportunities that are reserved for HBCU/MI, and they need encouragement to compete with other institutions of higher education across all DOD programs. We need to look at providing some form of preference that may allow funding of a technically meritorious proposal that may not otherwise be funded based on available funding. This would have the dual benefit of freeing up program funds reserved for HBCU/MI for additional HBCU/MI and PI and providing greater probability of success in competition with other institutions of higher education.

Ms. MILLER. We should continue to more fully utilize our ongoing efforts and initiatives to be inclusive and invigorate our relations with HBCU/MI—through our relationships as research partners in our university-based centers, through Educational Partnership Agreements, by fostering internships for HBCU/MI students in both our labs and our academic partners, and by including HBCU/MI faculty members on our evaluation panels.

Ms. LACEY. Currently, Navy is expanding its outreach to HBCU/MI with a number of initiatives. We are encouraging white paper submissions by HBCU/MI institutions in response to DOD/Office of Naval Research (ONR) Broad Area Announcements and Funding Opportunity Announcements; site visits to HBCU/MI campuses

to observe project progress and make recommendations for funded projects such as DOD Centers of Excellence; briefings to HBCU/MI faculty regarding DOD/ONR programs and opportunities that are available to academic institutions, including HBCU/MI; and ONR conference and event support that heightens awareness of ONR programs that are available to academic and research opportunities at HBCU/MI, including: the National Society of Black Engineers Conference, the Hispanic Association of Colleges and Universities Conference and Forum, and the Hispanic Engineer National Achievement Awards Conference.

Recommendations for further engagements are as follows: (1) Increase efforts to ensure the inclusion of HBCU/MI faculty on DOD review panels and other advisory boards; (2) Include specific language in Broad Agency Announcements, Funding Opportunity Announcements, and other solicitations aimed at increasing the recruitment and retention of HBCU/MI students; and, similarly, (3) Encourage the creation of programs that will recruit, reward, and retain effective HBCU/MI faculty.

Dr. WALKER. I recommend the subcommittee continue to support innovative programs such as the Air Force Minority Leaders Program. Congress has been a great partner to the Air Force Minority Leaders Program, for which we are very appreciative.

The Minority Leaders Program began in 2005 and integrates HBCU/MI in efforts across the AFRL enterprise. Through the Minority Leaders Program, a diverse group of students, faculty, scientists, and engineers build lasting relationships with the Air Force to conduct scientific research and create and encourage diversity in the STEM workforce.

7. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, how are you currently engaging HBCU/MI?

Mr. SHAFFER and Dr. PRABHAKAR. Within the OSD, we continue to work on two fronts to engage with HBCU/MI-internally within DOD and directly with HBCU/MI.

As part of our longer-term strategy, we are engaged in outreach efforts that explain the DOD business processes to potential investigators and provide information on areas of research interest to DOD. We conducted a hands-on workshop for HBCU in May 2012, and used a webinar format in August 2013 with over 300 individuals representing 97 HBCU/MI. We also make additional efforts to ensure that DOD staff is familiar with the capabilities of HBCU/MI.

We continue to encourage HBCU/MI to compete for funding opportunities and to undertake to ensure that DOD staff consider HBCU/MI faculty for opportunities at DOD that go beyond funding. For example, we have encouraged the DOD components to provide opportunities for faculty HBCU/MI, to participate in research at DOD laboratories through the Intergovernmental Personnel Act.

Ms. MILLER. The Army currently engages HBCU/MI through several initiatives and methods. We currently fund five Centers of Excellence at various HBCU under the Partnerships in Research Transitions (PIRT) program. These centers are located at Howard University-Language and Computer Science, Howard University-Engineering, Delaware State University, Hampton University, and North Carolina A&T University. The PIRT program's principal objective is to enhance programs and capabilities of a select number of high-interest scientific and engineering disciplines through Army-relevant, topic-focused, near-transition-ready innovative research. Last summer, 13 PIRT interns were placed at the Amy Research Laboratory. Additionally, we have HBCU/MI partners as members of the Army High Performance Computing Research Center; the Automotive Research Center; and the Micro Autonomous Systems Technology, Robotics, and Network Science Collaborative Technical Alliances.

Our labs and centers also conduct targeted outreach to the Grants and Sponsored Programs offices of HBCU/MI to provide awareness of all funding opportunities, including the core Broad Agency Announcements. Program managers proactively provide notice and information to interested parties about HBCU/MI funding opportunities.

Beginning in fiscal year 2013 and continuing this year, we have made use of multiple Educational Partnership Agreements with educational institutions to transfer and/or enhance technology applications and provide technology assistance (including equipment loans and surplus donations) and curriculum development for all levels of education. We also utilize HBCU/MI faculty members to serve as evaluators for our core research proposals.

Ms. LACEY. Currently, the ONR HBCU/MI program is focused on strengthening its portfolio by encouraging a greater research capacity at these institutions. While looking at ways to accomplish this, we are also working to make better connections between the HBCU/MI students and our array of internship and scholarship programs that already exist. To augment its goal, the ONR HBCU/MI portfolio has sig-

nificant programs in place that include: the ONR Summer Faculty Research Program, which provides science and engineering (S&E) faculty members with the opportunity to participate in research at naval labs for a 10-week period during the summer; the Faculty Sabbatical Leave Program, which provides S&E HBCU/MI faculty the opportunity to conduct research at naval laboratories while on sabbatical leave; and the Naval Research Enterprise Internship Program, which provides opportunities for HBCU/MI undergraduate students to participate in research under the guidance of a research mentor at a participating naval lab for 10 weeks during the summer.

We are also encouraging white paper submissions by HBCU/MI institutions in response to DOD/ONR Broad Area Announcements and Funding Opportunity Announcements; site visits to HBCU/MI campuses to observe project progress and make recommendations for funded projects such as DOD Centers of Excellence; briefings to HBCU/MI faculty regarding DOD/ONR programs and opportunities that are available to academic institutions, including HBCU/MI institutions; and ONR conference and event support that heightens awareness of ONR programs that are available to academic and research opportunities at HBCU/MI institutions, including: the National Society of Black Engineers Conference, the Hispanic Association of Colleges and Universities Conference and Forum, and the Hispanic Engineer National Achievement Awards Conference.

Dr. WALKER. The Air Force engages HBCU/MI primarily through our Minority Leaders Program. The Minority Leaders Program began in 2005 and successfully integrates HBCU/MI across the AFRL enterprise. Over 475 students and 100 professors have participated since the beginning of the program.

The Minority Leaders Program establishes collaborative research partnerships between AFRL, academia, and industry to develop critical technologies to support the warfighter in more than 25 schools in 11 States. The method of collaboration begins with pairing an HBCU/MI with a mentor university within close proximity to the college or university. This pairing enables efficient use of technical talents, leadership, and resources that enhance the efforts performed at the HBCU/MI.

MILITARY CHILDREN

8. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, what ideas do you have to increase the DOD S&T community's engagement with military children, especially to enhance their access to high quality STEM educational opportunities and experiences?

Mr. SHAFFER and Dr. PRABHAKAR. There are several initiatives to increase the DOD S&T community's engagement with military children, especially to enhance their access to high quality STEM educational opportunities and experiences. These initiatives include partnerships with DOD/Federal S&T professionals (both civilian and military) for school-based and after school activities to use expertise from DOD/Federal facilities and laboratories to stimulate STEM experiences.

In addition, we are looking at increasing direct outreach activities at schools near DOD S&T facilities; in this case, our researchers can visit schools to let students know the value of STEM

This will not be a quick fix but rather a long-term commitment to increase participation in STEM activities for military children. While this is not a simple problem, we will continue to explore opportunities for our DOD dependents.

Ms. MILLER. Where we can reach them (geographically), we can utilize our existing assets—our laboratories and STEM professionals—to provide STEM opportunities to our military family dependents. The challenge is, the Army's STEM assets aren't geographically aligned to the bulk of our military families which limits the use of our strongest STEM capabilities and our ability to provide authentic real-world hands-on experiences to students under 18. Through the Army Educational Outreach Program's eCYBERMISSION, we provide online exposure to students and have intense targeted outreach to DOD Educational Activity (DODEA) schools in our national program efforts. We are looking at other areas where we can provide direct mentorship to our military dependent students and the best way to continue this effort is to directly engage with DODEA and support their existing education structure and institutions.

Ms. LACEY. The Secretary of the Navy is committed to taking care of Navy and Marine Corps families, including efforts to assure that our children have access to quality STEM educational opportunities whether they go to school on our bases or in surrounding communities. While responsibility and most resources for K–12 STEM education (including the National Defense Education Program K–12 and STARBASE funding) were removed from DOD and therefore the Navy and Marine

Corps starting in fiscal year 2014, the naval S&T community is engaged in the interagency STEM reorganization effort with one goal being to make sure that the families of naval personnel are afforded access to programs that are now the explicit responsibility of the Department of Education, the National Science Foundation, and the Smithsonian Institution. We encourage our laboratory and warfare center leadership and employees to use STEM education as a means of community engagement and to volunteer their time to improve the STEM skills of children in communities hosting our facilities. Some base community relations funds may be applied to these efforts.

Dr. WALKER. As the Chief of Staff of the Air Force states in Bright Horizons 2.0—the Air Force STEM Workforce Strategy, all airmen, military and civilian, are encouraged to become "STEM ambassadors" in their communities. A culture of outreach to communities surrounding all Air Force bases, including those attended by military children, is pervasive among our airmen. Many bases employ a designated Education Outreach Coordinator who works with local schools to create programs to interest students in Air Force S&T with the assistance of local teachers and Air Force volunteers.

To increase the DOD S&T community engagement with military children, the messages in the Bright Horizons strategy should continue to be embraced by our airmen. Military and civilian scientists and engineers should be encouraged by their leadership to participate in STEM programs in their local communities. Inspiring the next generation of STEM leaders is an important mission to the Air Force.

9. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, what can the subcommittee do to support these efforts?

Mr. SHAFFER and Dr. PRABHAKAR. DOD appreciates the subcommittee's continued support for DOD S&T community's engagement with military children and teachers, especially to enhance their access to high quality STEM educational opportunities and experiences. This involves increasing initiatives that engage DOD/Federal S&T professionals (both civilian and military) in results-driven, school-based and after-school activities using expertise available at DOD/Federal facilities and laboratories.

Ms. MILLER. The subcommittee could empower DODEA to enhance STEM curricula in their target school areas; especially those areas that are traditionally low ranking, with STEM-centered school systems that have proven capabilities as examples. The Harmony School model is a remarkable success that can serve as an example.

Harmony School has a successful model that prepares students for higher learning in a safe, caring, and collaborative atmosphere through a quality learner-centered educational program with a strong emphasis on STEM. These schools, established in underserved communities, are founded on the belief that excelling in mathematics and science prepares youth to succeed in college, the workplace and the 21st century.

Each school concentrates on specific elements that are required to successfully accomplish this mission: (1) enriched curricula and authentic assessment, (2) effective school management, (3) parental involvement, (4) technology integration, (5) sound fiscal management, (6) leadership and character development, and (7) safety.

The best way to serve our military families is to establish schools that support these same principles and provide support throughout the military child's educational development and not through a one-time enrichment experience.

Ms. LACEY. The Secretary of the Navy is committed to taking care of Navy and Marine Corps families, including efforts to assure that our children have access to quality STEM educational opportunities, whether they go to school on our bases or in surrounding communities. The Department of the Navy has responded quickly to the Federal STEM reorganization by focusing our portfolio and goals towards the President's intent. Recognizing that one basis of a strong and effective military rests in the knowledge that our children are cared for, the subcommittee can help by assuring that we can continue to apply our resources, as appropriate, to assure that STEM education opportunities remain available to the families of our sailors, marines, and civilians.

Dr. WALKER. To support the DOD S&T community's engagement with military children and enhance their access to high quality STEM educational opportunities and experiences, I recommend the subcommittee encourage the Services to be actively involved in their local communities as ambassadors to mentor and champion the next generation to pursue interests in STEM. Working together, our impact is greater than working individually. Additionally, creating synergy among Services will increase the diversity and the number of S&T opportunities to which military children have access.

EXTRAMURAL PERFORMERS

10. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, in your fiscal year 2015 budget request, how much requested funding will be available for new competitions for extramural performers?

Mr. SHAFFER and Dr. PRABHAKAR. Within the Assistant Secretary of Defense for Research and Engineering portfolio, we expect approximately 90 broad area announcements worth $200 million during fiscal year 2015.

Ms. MILLER. We estimate that approximately 10 percent of total 6.1 (Basic Research) funding, and 15 percent of 6.2 (Applied Research) and 6.3 (Advanced Technology Development) funding will be available for new competition in fiscal year 2015.

The Basic Research amount to be competed represents approximately one-third of the Single Investigator Program, the Multidisciplinary University Research Initiative, and the Defense University Research Instrumentation Program funding requested for these elements of extramural basic research.

Ms. LACEY. The naval S&T budget can be viewed as fitting into four primary areas—Discovery and Invention (D&I), Leap Ahead Innovations (Innovative Naval Prototypes (INP)), Acquisition Enablers (Future Naval Capabilities (FNC)), and a Quick Reaction capability to respond to emerging requirements.

D&I: D&I consists of Basic Research and early Applied Research. Roughly 25 to 30 percent of the fiscal year 2015 budget request is open to new performers across the various research areas.

Leap Ahead Innovations: The biggest portion of leap ahead innovations are the INP. The INP projects are developed every other year and are typically set up so that in the initial year the entire program is approved. In fiscal year 2015 we are starting no new INP programs. The ongoing INP will continue with current providers.

Acquisition Enablers: Acquisition Enablers include FNC—component technologies that deliver in a 2- to 4-year timeframe. For the FNC program, approximately 17 percent of the fiscal year 2015 budget request is open to new performers.

Quick Reaction: Quick Reaction consists of TechSolutions, Swampworks, and Naval Warfighter Experimentation. Each fiscal year, TechSolutions uses approximately 90 percent of its annual budget allocation to support new ideas that are generated by Navy/Marine Corps operators. Performers within the TechSolutions venue include the Naval Research Enterprise (mainly Naval Warfare Centers) and those organizations are encouraged to partner with industry partners, when appropriate. The SwampWorks and Naval Warfighter Experimentation allocations typically have about 50 percent of their budget available for new start projects using existing contracting paths.

Dr. WALKER. Approximately $300 million per year of the Air Force S&T budget is open for new performers to compete for S&T funding. This is based on the extramural budgets by program element and S&T contracts normally being re-competed every 5 years. With an S&T extramural budget of approximately $1.5 billion per year, one-fifth would be open to new performers to compete.

11. Senator HAGAN. Mr. Shaffer, Dr. Prabhakar, Ms. Miller, Ms. Lacey, and Dr. Walker, how do you integrate the Small Business Innovation Research and Small Business and Technology Transfer (SBIR/STTR) programs into your research and development (R&D) activities?

Mr. SHAFFER and Dr. PRABHAKAR. The integration of SBIR/STTR with other R&D activities is inherent in our process that links the small business programs to the Assistant Secretary of Defense for Research and Engineering (ASD(R&E)) high priority technology areas. The ASD(R&E) establishes high priority R&D technology areas based on technological opportunities and emerging threats. Subject matter experts in OSD, in coordination with the DOD components, develop SBIR/STTR topics that address the high priority areas. In turn, the SBIR/STTR topics are the basis for the solicitations for proposals. The process undertakes to ensure that small businesses are integrated into R&D activities and that they are addressing DOD's most important technology needs.

Ms. MILLER. The Army SBIR/STTR program offices work closely with Army Program Executive Offices (PEO) to identify emerging technology needs and technology transition opportunities through its Technology Assistance Advocates and its Commercialization Readiness Program. The Army is also actively working with OSD Office of Small Business Programs to implement reporting and incentive requirements called for under the recent SBIR/STTR reauthorization.

Ms. LACEY. The R&D component of acquisition funding for Department of the Navy Programs of Record (PoR) is a primary source of follow-on, or Phase III, fund-

ing for Navy SBIR/STTR projects. ONR, with its commitment to "delivering innovation to the Fleet," requires its FNC to identify, leverage, and integrate SBIR/STTR-funded efforts into FNC. Successful integration starts with topic development, as over 80 percent of Navy SBIR/STTR topics are sponsored by an acquisition PoR or FNC, allowing the program to plan for the insertion starting with Phase I. Sometimes a PoR or FNC identifies past SBIR/STTR awards that address a technology need. In such cases the Navy SBIR/STTR program office provides for sequential second Phase II reach-back awards to be made. Here, the PoR or FNC must develop a Technology Transition Agreement that shows how and when the technology will be inserted and clearly identify out-year follow-on non-SBIR/STTR funds that will be used to complete the integration.

The Navy SBIR/STTR program office also funds the Transition Assistance Program (TAP), which provides both small business mentoring and SBIR/STTR transition management, followed by the Navy Opportunity Forum. TAP is open to all of our Phase II firms and the forum is the culmination of the 11-month TAP where these firms present the planned insertion path to over 800 attendees from DOD PoR and prime integrators. TAP clearly helps firms obtain Phase III funding; 70 percent of TAP firms obtain Phase III dollars, vice only 39 percent of non-TAP firms. The Navy record of direct follow-on contracts to SBIR/STTR firms is unmatched in DOD, with $725 million in fiscal year 2012 alone. This shows the attractiveness of these technologies to BA 4 and above R&D funding sources.

Dr. WALKER. The Air Force includes technologies developed within SBIR/STTR programs in our technology roadmaps which ensures very early integration into the planning of R&D activities. Within our AFRL, the technology directorates coordinate with weapon system PEO and develop topics for future SBIR/STTR programs that support their technical requirements. Therefore, the end-user requirement demand flows from the Air Force Major Commands through the PEO to the laboratory and small business community. The laboratory provides the technical representatives to manage the research. As the research matures into a Phase II SBIR, the technology directorates can incorporate promising SBIR/STTR results into their funded applied research and advanced technology development efforts for additional maturation.

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