

**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 (chairman of the subcommittee) presiding.

Committee members present: Senators Hagan and Fischer.

Majority staff member present: Arun Seraphin, professional staff member.

Minority staff member present: Daniel C. Adams, minority associate counsel.

Staff assistants present: ????

Committee members' assistant present: Peter W. Schirtzinger, assistant to Senator Fischer.

**OPENING STATEMENT OF SENATOR KAY R. HAGAN,
CHAIRMAN**

Senator HAGAN. Good afternoon, everybody. The Emerging Threats and Capabilities Subcommittee meets today to continue our review of the Department of Defense's 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, or the S&T programs. I am pleased that we have the DOD's S&T leadership team with us here today, led by Al 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 Miller from the Army, Ms. Mary 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 DARPA. We welcome all of you and we look forward to your testimony.

Our defense S&T enterprise plays many important roles within the Department of Defense. 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 science and technology development needs to be done—excuse me.

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 science and technology 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 committee 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, Chairman Hagan. I am pleased to come before you today to testify about the state of the Department's science and technology 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.

The Department is in the third year of a protracted budget draw-down. As highlighted by Secretary Hagel, there are three major investment areas that comprise the Department'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 come investments. DOD invests in science and technology first to mitigate new and emerging threat capabilities. We see significant needs in electronic warfare, cyber, weapons of mass destruction, 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 science and technology is to develop technology surprise. We see significant opportunity in autonomy, human systems, quantum sensing, and big data.

While there are challenges, the Department 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 and in understanding the brain writ large. In addition to the DARPA brain initiative, the Department 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 TBI-induced injury. 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 suc-

cessful 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 systems and the Electromagnetic Rail Gun. In fact, the Navy has been testing and will demonstrate a 32-megajoule multi-shot 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 in the future.

Thank you.

[The prepared statement of Mr. Shaffer follows:]

Senator HAGAN. Thank you, Mr. Shaffer.

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.

Senator HAGAN. I do like a field trip. [Laughter.]

Mr. SHAFFER. Yes, ma'am.

Senator HAGAN. Ms. Miller.

STATEMENT OF HON. MARY J. MILLER, DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH AND TECHNOLOGY

Ms. MILLER. Madam Chairman, thank you for the opportunity to discuss the Army's science and technology 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 the Department of Defense, 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 five years, new programs will not be initiated as originally envisioned, and the Army's science and technology 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 committee 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 science and technology 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 PEO aviation in 2006 and was implemented in Afghanistan using Kiowa Warriors, helicopters, and Shadow UAVs.

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 CONOPS for conducting manned-unmanned teaming within the Army. VWIT 2 is currently going into the Apache Block 3 fleet.

In PRESBUD 15 you will see the Army S&T portfolio increasing emphasis on research areas that support the next generation of combat vehicles, A2AD technologies, such as Assured Position, Navigation, and Timing, soldier selection tools, and 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, and thank you again for all that you do for our soldiers.

[The prepared statement of Ms. Miller follows:]

Senator HAGAN. Thank you, Ms. Miller.

Senator FISCHER.

Senator FISCHER. Thank you, Madam Chair. I would just ask that my opening statement be included in the record, please.

[The prepared statement of Senator Fischer follows:]

[SUBCOMMITTEE INSERT]

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 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 two 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 understanding with—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.

But to be competent people must do actual hands-on work. We have made that a priority in the Department. 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 system 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 sixties with technology that dated from the thirties. 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 VLS 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—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 committee 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:]

Senator HAGAN. Thank you.

Mr. Gooder.

Mr. GOODER. Thank you. Chairman Hagan, Ranking Member Fischer, and staff: I'm pleased to have the opportunity to provide testimony on the fiscal year 2015 Air Force science and technology 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 decrease from the fiscal year 2014 President's budget request. However, when compared to the overall Air Force RDT and 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 QDR.

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, or the 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. An-

other 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 the 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 rescope 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 one 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 Mr. Walker follows:]

Senator HAGAN. Thank you for joining us.

Dr. Prabhakar.

**STATEMENT OF ARATI PRABHAKAR, Ph.D., DIRECTOR,
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY**

Dr. PRABHAKAR. Thank you, Madam Chairman 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 and 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 five and a half decades, but of course the world in which we live has changed and changed and continues to change today. So 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 Chairman, of the things that you highlighted in your opening statement.

So for example, today we look at the complexity of our military systems. We realize that 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. So 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 and weapons and 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.

So that's just a very quick glimpse of some of the things that we're working on today. But 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.

So 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 a big hole behind, 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 he and 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 just a great example of the power of what you've given us.

We're currently under a cap that limits our use of 1101s to 60. You've given us that number. It's been terrific. We've really appreciated it. But we are now—we have now fully used that allocation. 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, have been for many, many decades. It's just that we are using the 1101

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.

So that's number one. Second, 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 year 2009 and 2013 our budget declined by 20 percent in real terms. The fiscal year 2014 appropriation 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 have some real—we're seeing 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 the 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.

But 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.

So I really want to thank you for your support. It's critical for the work that we're all doing, and I'll be very happy to answer any questions along with my colleagues.

[The prepared statement of Dr. Prabhakar follows:]

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's. 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 this reduction—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. But given the constraints that I had, 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. Of 200 million, will cut about 1,500 grants nationwide, give or take.

We also will—and again, 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 science and technology. 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 the Department.

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—we didn’t like doing that—we put more money into 6.3 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. So we couldn’t take money out of force structure right now, so 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 longer term out, 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—I won’t mention which one—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 STEM education. If you’ve been around me any period of time, you understand how important I take science, technology, engineering, and math 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. If you look at—I know the National Science Foundation and the Department of Ed 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. And 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.

So, Mr. Shaffer, I know that OMB has previously told the Department of Defense 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 servicemen. 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 Policy and Readiness, our personnel and readiness portfolio. We're working with Ms. 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. And the DOD STEM strategic plan is aligned with the Federal plan to achieve Federal and Department 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. And any other comments.

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.

[The information referred to follows:]

[SUBCOMMITTEE INSERT]

Senator HAGAN. Okay.

Ms. MILLER. Ma'am, the Army did not lose our funding for K through 12 educational outreach. Our Army educational outreach program, AEOP, 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 in to 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 could come up with some concrete ideas on what we can do.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chair.

Mr. Shaffer, last year we discussed duplication and focusing research on warfighting needs. You mentioned the Reliance 21 process and how Senior Executives Service members were reviewing their portfolios. But 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. But 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, very well, and I'm seeing evidence of it as our people interact.

So I'd offer my colleagues to say the same or back me up, or refute that.

[The information referred to follows:]

[SUBCOMMITTEE INSERT]

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 de-

velopment collaboratively through the Joint Technology Office, the High Energy Laser Joint Technology Office.

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 high energy laser 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 High Energy Laser Science and Technology 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've got progress along the way. The Navy's already going out on a ship and they'll tell you about—Mary Lacey will tell you about when we're going to deploy on a ship. And the Air Force is also looking at how they can use solid-state lasers.

Then there's DARPA, which always bring in another alternative way to do high energy laser, perhaps in a different construct, but as effectively and efficiently. If we can get the technology to prove out, we can insert it.

So 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. And I believe we can.

So 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.

Ms. LACEY. The 10,000-foot view—

Senator FISCHER. 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.

So I will get you a complete answer on exactly what they're doing. But it is in direct support of the—

Senator FISCHER. So diet and age?

Ms. LACEY. Yes, ma'am. When they join the Navy they join for life.

Senator FISCHER. And they have a pretty good life, I think, as well.

Ms. LACEY. They do.

Senator FISCHER. Yes, the dolphins. Thank you.

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. So 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 execs at this table are sitting down for two full days to review just six areas. So 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, pretty extensive use of executive time, to spend that amount of time.

We're going to go through it and figure out what the Department has to do, how industry can help us with our IR and 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.

So I think we've put our foot on the gas, ma'am.

Senator FISCHER. Thank you, Madam Chairman.

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, weapons of mass destruction, 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, just as Mr. Shaffer just said, he wants DARPA to be disruptive in these areas.

So 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 I expected, given the situation that we're in that you described with budget pressures

and a lot of pressure on the Department right now—it was my expectation that we would be getting, 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 that are—they don't compute when you put them all together and you project out into the future.

So 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. You know, 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.

And when we have—when the working model is that we've got 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 capabilities that we have today. But of course, that same strategy is now what's killing us.

So finding the way to break that is the core of a lot of our programs. In the space domain, just to pick one example, in the space domain to get to a different model is going to require a variety of different components. One I think we touched on a minute ago 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. So 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, in your page 11 you talked about how China's got a planned launch of 100 satellites through 2015.

Mr. SHAFFER. Yes, ma'am. And 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, very focused and will create tremendous challenges for us. So Arati said that the Department 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 committee to do everything we can to support DARPA's efforts at investing in those high-risk, high payoffs. So if you have suggestions for us—and I take your suggestion on the Section 1101 process, where you said you've got 60 positions and those are filled. Sixty out of how many, and what would you like that number to be, or do you have a recommendation on that?

Dr. PRABHAKAR. Well, thank you very much for the support on that, because it is so critical to getting the people that we need.

The Department 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 a legislative, very different from the Department'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.

But 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've got about one minute before I'm going to switch it back to Senator Fischer. But another thing, when we were talking about staffing, once again, Mr. Shaffer, you were talking about the average age of the scientists in and that a number of seasoned employees that are—some of the younger employees that 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.

As far as other things you can do—

Senator HAGAN. Which seems a given to me.

Mr. SHAFFER. You know, it seems a given, but it is very, very difficult, because every community in the Pentagon and the military thinks 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 our Department. 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. So we're monitoring that, ma'am.

[The information referred to follows:]

[SUBCOMMITTEE INSERT]

Senator HAGAN. Thank you.

Senator Fischer.

Senator FISCHER. Thank you, Madam Chair.

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, and I'm curious to know what processes do you use to ensure the greatest return on investment for our warfighters.

Dr. PRABHAKAR. Well, 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, back to this theme we were touching on a minute ago, 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. So we think that's not—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 technology, very powerful technology, is globally available and moves at a very fast pace, and the United States does not have a monopoly really on any technology field any more.

So 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 effort with your managers? And with the shortage of money then, how are you going to do that?

Dr. PRABHAKAR. Yes. Well, I think that's a question that's hard to answer for the entirety of what national security threats we face. But 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 po-

tentially 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. It's not—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. And as they develop new concepts of employment, those then feed back into how we shape our technology programs.

So those have been—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.

So 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 science and technology 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 up front, 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. So I think it's 15-ish 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 APL are FFRDC's and UARC's to start to really develop, redevelop, our analytic capability.

Senator FISCHER. Thank you very much.

Mr. SHAFFER. Yes, ma'am.

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.

But 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. I actually—well, first off, I think that 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, girls of all colors, all ethnic backgrounds into science if they can do hands-on touching of it.

But 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 as well, 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. As you know, the statistics are that women tend to drop out in the sciences and technology. 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 the Department of Defense 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. And we do lose young women in middle school.

Ms. Lacey.

Ms. LACEY. Ma'am, if I could, I'll address—the Navy only has two DODEA 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 Dalhgren and the other one is at Quantico. So 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, very successful there in stimulating the population to consider the U.S. Navy as a career option.

But 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. So if we want to influence the workforce 15, 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 ROTC that we're looking to get out. It's a specific program for EW cyber, to try to pull those folks in 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. Brothers 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 that we're looking to host this summer. So 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 source of the—the Nations of origin that would be represented around the table. And 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 science and technology workforce in the United States is that's foreign-born. Even knowing that I was going to be sort of—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 have—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.

But 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

three, so it wasn't me—it was my parents who made the immigrant decision, not me. But 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.

Now, I think there are obviously valid reasons; that you have to think through security issues and figure out how you manage that. But that is another place where I think the Department 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. Well, 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. So in a little bit broader context, I think it's still a vital and important part of what we do.

But 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 HBCUs, the historically black colleges and universities, 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 reduced, further reduced to \$24 million. So in 2010 it was 67, you're proposing now 24.

Given our diversity and technical hiring challenges, this is disturbing. Given that the HBCU's edge roughly 20 percent of black science and engineering students, undergraduate students, who 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. Irregardless 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. So I believe in fiscal year 2010 there had been a previous decision, and I think it was the Rothy decision, that didn't let us spend any money for 1 year in HBCUs.

Senator HAGAN. The Rothy decision?

Mr. SHAFFER. I will get the exact to you. But there was a protest on—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 to \$35 million. So coming down to \$25 million, hated doing it this year. We did it because we had across-the-board cuts.

But we've done something to focus the program this year. In fact, we're starting two centers of excellence. So we've heard the people here at this table talk about how do we better use some of the le-

vers. 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 MIT, but they're certainly as good as University of Vermont where I went. So 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, very late in obligating and executing money.

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. Well, it seems like we shouldn't be penalizing the students who attend these universities. I think maybe better oversight from the DOD's Department could make a big difference.

But when we're cutting specifically at HBCUs in this time, when you look around this room, when you look around, the need for diversity, we should be doubling those funds instead of cutting them, because if we want to have—and I think diversity brings so much to the table when we're talking about all areas.

Mr. SHAFFER. Yes, ma'am.

Senator HAGAN. So I would like to see what steps we can take to strengthen the tie between DOD and HBCUs. You know, I've got a number of HBCUs in North Carolina, 10.

Mr. SHAFFER. You have very good ones.

Senator HAGAN. I know we do. And I remember one time—and I can't remember who it was at this 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. So 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've got 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 science and technology. Let me give you a recent example. Paint is a big problem for the Marines, 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.

And 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. But 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.

So we've been working on that in the science and technology 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. So 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 Marines have 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. So 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. 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, as you know, 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 CCOM, which is our Communications Electronics Research and Engineering Center, and then at our Soldier Research, Development, and Engineering Center, coupled with PEO Soldier, who actually has been able to field our technology, which has been very effective. We did a lot of this in Afghanistan.

So 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. And 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 pool 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? And do the topic areas and proposals represent ideas of importance and interest to the DOD?

Mr. SHAFFER. Let's see. 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 funding program managers go out for our highest priorities. We held a review, I want to say it was the 28th of either February or March—I don't remember; all the months blend together right now.

So 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, et cetera, et cetera. So we got the money for fiscal year 2012 out the door at the end of fiscal year 2013. It's two-year money. Those projects now are just ending.

So in fact we've only completed, we've only completed four or five projects total. But 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.

So 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. MILLER. 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 the Department, 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 RIF 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 one percent or 300 netplates, and each failure requires individual re-preparation and rebonding with supervisory oversight.

So the RIF 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. So we've had about 2,200 proposals out of the RIF program. So there's a great response from industry over the last few years. So we really view it as us being able to get out there and tell industry what our problems are and their responding.

So we think it's going to turn out well for the Air Force.

Senator HAGAN. Ms. Lacey, we only have a couple more minutes, and I know we've got to call the hearing—we have to adjourn. But what's your thoughts on this program?

Ms. LACEY. 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 science and technology 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 kind of aligned to where science and technology 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.

So 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 science and technology 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 if you can give me a written response.

Ms. LACEY. I can give you a written response.

Senator HAGAN. Sorry. Yes, okay, let's just do that.

[The information referred to follows:]

[SUBCOMMITTEE INSERT]

Senator HAGAN. Back on the rapid innovation program, if any of you have recommendations for this committee to consider as we review the program and its benefits, I'd like to see those, too.

I appreciate, Mr. Shaffer, you and the Department of Defense with our science and technology 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 an acting—that we need to have a Secretary of Defense for Research and Engineering. So I wanted to be sure we noted that.

But thank you very much for your testimony today, and the meeting is adjourned. Thanks.

[Whereupon, at 3:45 p.m., the subcommittee adjourned.]