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Subcommittee on Strategic Forces

COMMITTEE ON
ARMED SERVICES

UNITED STATES SENATE

TO RECEIVE TESTIMONY ON THE DEPARTMENT OF ENERGY'S ATOMIC DEFENSE ACTIVITIES AND PROGRAMS IN REVIEW OF THE DEFENSE AUTHORIZATION REQUEST FOR FISCAL YEAR 2022 AND FUTURE YEARS DEFENSE PROGRAM

Wednesday, May 19, 2021

Washington, D.C.

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U.S. Senate
Subcommittee on Strategic Forces
Committee on Armed Services
Washington, D.C.

The committee met, pursuant to notice, at 5:06 p.m. in Room SR-232A, Russell Senate Office Building, Hon. Angus King, chairman of the subcommittee, presiding.

Committee Members Present: Senators King [presiding], Rosen, Kelly, Fischer, Rounds, and Sullivan.

OPENING STATEMENT OF HON. ANGUS KING, U.S. SENATOR FROM MAINE

Senator King: I foolishly thought a 15-minute Senate vote would take 30 minutes. It actually took 50 minutes, and I apologize for that naïve assumption on my part.

This is hearing on the Department of Energy's atomic defense activities and programs in review of the Defense Authorization Request for Fiscal Year 2022. First I want to thank the witnesses for appearing at today's hearing on your defense-related programs to maintain our nuclear weapons stockpile, design the reactor to power our Navy's nuclear fleet, and clean up former Cold War defense production sites.

Dr. Verdon, you are representing the NNSA. You are undertaking the modernization of five warhead systems to meet Department of Defense requirements. This has put a tremendous strain on your production plants, and at the same time you are rebuilding the infrastructure required to handle nuclear and related materials, which, in some cases, dates to the Manhattan Project.

There are single point-of-failure risks to our deterrent. I want you to explain to the subcommittee how you are managing these programs and their key risks.

Admiral Caldwell, you uphold a lineage dating back to Admiral Rickover to design and build power reactors for our

Navy's aircraft carriers and submarine fleet, including the Columbia class ballistic missile submarine whose fuel will last over 40 years, the life of the boat. Like Dr. Verdon, I would like you to explain to the committee the challenges you face, especially in rebuilding nuclear infrastructure to support the Navy's operational fleet.

Finally, Mr. White, you have perhaps the hardest job in the Department of Energy, which is the cleanup of former Cold War nuclear production sites. At the Hanford site in Washington State alone, you are responsible for 55 million gallons of radioactive waste and 177 underground storage tanks, some of which are leaking. I will want to know from you what the Department is doing to meet the commitments it has made to the communities in the region to clean up these sites.

Again, let me thank everyone for appearing today. After Senator Fischer's opening statement each witness will have 5 minutes for their opening statements and then we will alternate with members present for 5-minute rounds of questions.

Senator Fischer?

OPENING STATEMENT OF HON. DEB FISCHER, U.S. SENATOR FROM NEBRASKA

Senator Fischer: Thank you, Mr. Chairman, and thank you to our witnesses today.

One point that I always find interesting is that the witnesses before us today represent about 75 percent of the Department of Energy's budget, and yet the important roles the Department of Energy and the NNSA, in particular, play in supporting our nuclear enterprise is often overlooked.

But their contributions are absolutely vital. As nuclear posture reviews of the last two administrations have affirmed, a modern and responsive nuclear infrastructure is absolutely necessary to support our nuclear deterrent.

While progress has been made toward achieving this goal, significant challenges remain, and like the Department of Defense's modernization efforts, there is simply no margin for additional delay. As Admiral Richard noted earlier this year, the consequences of failing to modernize our infrastructure are immense. In his testimony, he stated, quote, "If the nation does not continue to address these concerns, no amount of money will be able to adequately mitigate operational risks associated with key stockpile and infrastructure capability losses," end quote.

That is a powerful statement, and it reflect the Department of Energy's importance to our national security.

So, gentlemen, I thank you for the vital work that you each do and for appearing before us today, and I look forward to your testimony.

Thank you, Mr. Chairman.

Senator King: Mr. Verdon?

STATEMENT OF HONORABLE CHARLES VERDON, ACTING ADMINISTRATOR, NATIONAL NUCLEAR SECURITY ADMINISTRATION

Mr. Verdon: Chairman King, Ranking Member Fischer, and members of the subcommittee, thank you for the opportunity to testify today. On behalf of the men and women of the nuclear security enterprise I express our appreciation for this subcommittee's strong support, bipartisan support, for NNSA's nuclear security mission, as demonstrated most recently in the fiscal year 2021 National Defense Authorization Act and the fiscal year 2021 budget for the Department of Energy.

Chairman King, a written statement has been provided to this subcommittee and I respectfully request that it be submitted for the record.

Senator King: Without objection.

Mr. Verdon: So we meet today against the backdrop of a world marked by growing security challenges. China and Russia are modernizing their nuclear arsenal, investing significantly in resources and delivery platforms, and have made clear that nuclear weapons will be a vital element of their state craft.

At the same time, the risk for proliferation of nuclear weapons and weapons of mass destruction pose profound and existential dangers. Recognizing these global security challenges, the President's FY 2022 Discretionary Funding

Request for NNSA reflect support for the three enduring missions which Congress charged the NNSA in the year 2000: ensuring the safety, security and effectiveness of the U.S. nuclear stockpile; reducing the threat of nuclear proliferation and nuclear terrorism around the world; and providing nuclear propulsion for the U.S. Navy's fleet of aircraft carriers and submarines that are critical to the U.S. national security and our allies.

NNSA continues to focus on ensuring the safety, security, and military effectiveness of the U.S. nuclear stockpile. Our alignment and synchronization with the Department of Defense, coordinated through the Nuclear Weapons Council remains essential and continues to improve. The FY 2022 Discretionary Funding Request enables NNSA to execute its warhead modernization and infrastructure modernization efforts begun under the Obama administration.

The administration is beginning its undertaking of a formal review of the efforts to modernize our nuclear deterrent to include the DOD delivery platforms, the nuclear weapons required for those platforms, and the NNSA infrastructure needed to produce and maintain those weapons. Regardless of the review's specific findings, so long as we retain a nuclear arsenal we must have the infrastructure and the science, technology, and engineering to produce and maintain the nuclear weapons stockpile.

Unfortunately, the NNSA production infrastructure has atrophied considerably, both in terms of the physical infrastructure and the capabilities needed within those facilities. Continued recapitalization is an imperative. The potential impacts to the U.S. deterrent, if not addressed, are no longer over the horizon. They have become visible.

Key also are attracting and retaining the personnel needed to continue to ensure our stockpile remains safe and effective and to operate and maintain NNSA facilities safely and securely. As NNSA mission scope increases, so does the demand for increased personnel to execute the missions to include supporting new facilities and capabilities brought online and moving to 24/7 operations at many sites across the complex.

In addition our mission to ensuring continued effectiveness of the nuclear stockpile, nonproliferation also remains an important and growing priority. NNSA's Office of Defense Nuclear Nonproliferation is critical to implementing the President's call to "lock down fissile and radiological materials around the world." The FY 2022 Discretionary Funding Request enables NNSA's Office of Defense Nuclear Nonproliferation to continue to work worldwide with our partners to prevent states and non-state actors from developing nuclear weapons or acquiring weapons-

usable nuclear or radiological materials, equipment, technology, and expertise.

With regards to our third mission of providing nuclear propulsion for the United States Navy, the Office of Naval Reactors remains at the forefront of technological development in naval nuclear propulsion by advancing new technologies and improvements in naval reactor performance. This preeminence provides the U.S. Navy with a commanding edge in naval warfighting capabilities. Again, the discretionary budget put forth for FY 2022 supports the Office of Naval Reactors to continue their programs that are so vital to our security of our nation and our allies.

And then finally, despite the challenges posed by the COVID-19 pandemic, I am pleased to report that NNSA did not miss a single milestone or DOD requirement during this period. This achievement is a testament to the professionalism of the NNSA's world-class workforce and the leadership of our sites and their deep commitment to our national security missions.

So I thank you again for the strong support of this committee and the opportunity to testify before you today, and I stand ready to answer any questions you have.

[The prepared statement of Mr. Verdon follows:]

Senator King: Thank you, Dr. Verdon. Mr. White?

STATEMENT OF WILLIAM WHITE, ACTING ASSISTANT SECRETARY OF ENERGY FOR ENVIRONMENTAL MANAGEMENT

Mr. White: Chairman King, Ranking Member Fischer, and members of the subcommittee, it is an honor to appear before you today.

As the largest environmental cleanup program in the country, the Department of Energy's Office of Environmental Management is committed to cleaning up to the legacy of the national defense programs that helped end World War II and the Cold War. Even as we grappled with the COVID pandemic, 2020 represented an inflection point for the EM mission. The dedication and resiliency of the workforce, composed of Federal and contractor employees, resulted in a ramp-up in transformational tank waste capabilities, historic skyline changes, and a continued shrinking cleanup footprint.

EM achieved a first by completing removal of a former uranium enrichment complex at Oak Ridge in Tennessee. The last major component of the tank waste cleanup system at Savannah River was completed, accelerating our ability to tackle a key environmental risk there.

Our work was completed at the Tonopah Test Range in Nevada and at Separations Process Research Unit in New York, enabling this land to be transferred from EM.

EM has entered an era of progress built on the accomplishment of our workforce. Across this new era, EM is

well positioned to protect the environment, support broader national security missions, and prepare for the future.

Radioactive waste stored in underground tanks at Hanford, Savannah River, and Idaho is among the largest environmental challenges and risks facing the Department. After decades of preparation and support from Congress, and with construction of facilities required for the Direct Feed Low Activity Waste approach complete, Hanford is poised to begin tank waste treatment in December of 2021.

In South Carolina, the tank waste mission is accelerating through operation at both the Salt Waste Processing Facility and the Defense Waste Processing Facility.

In Idaho, we are working toward startup of the Integrated Waste Treatment Unit, which will treat the remaining sodium barium liquid radioactive waste there over the next decade.

EM is also focused on decontamination and decommissioning of excess contaminated facilities across the complex. We have made significant progress this year with the demolition of the Biology Complex facilities at Y-12, and preparations and work are underway on similar efforts at Oak Ridge National Laboratory, Lawrence Livermore, Lawrence Berkeley, and other sites. This important effort reduces risk and it also benefits the broader national security and

scientific research missions.

Modernization efforts are also underway at the Waste Isolation Pilot Plant to equip the facility to meet mission needs into the future. At the same time, EM is pursuing world-class technology development as the Savannah River National Laboratory develops innovative solutions in the fields of environmental cleanup, national security, science, and energy.

While remarkable progress has been achieved, the EM mission has decades to go. EM is undertaking a rational planning approach that will boost the ability to make progress in the short term and also advance longer-range mission goals. EM has an ambitious slate of priorities that span the next decade, and these are outlined in our Strategic Vision, a roadmap of priorities through 2031. Among the priorities, completion of our cleanup at four sites: the Nevada National Security site, Moab, Lawrence Livermore, and Sandia.

In order to support sustainable progress, EM is also investing in building and sustaining a workforce with future talent that promotes diversity and inclusion. We are also building on efforts to improve cost and schedule performance. In recent years, EM has demonstrated an ability to deliver results, completing several projects ahead of schedule and under budget. As the GAO indicated in

the latest high-risk report for the Department, EM has made strides in strengthening program and project management capabilities, and based on GAO recommendations, we will continue to focus on improving in this important area.

EM is putting the Federal investment in environmental cleanup to work. As we advance the cleanup mission for communities across the nation, a safety-first culture is paramount. Cleanup decisions will be based on sound science, and EM's mission will be informed by input from a diverse range of stakeholders, including those most impacted by the environmental legacy of the past.

I sincerely appreciate the subcommittee's continued support for the EM mission, and I look forward to working with you to continue to deliver progress.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. White follows:]

Senator King: Thank you, Mr. White, and thank you for that progress report, and we look forward to probing some of those questions with you.

Admiral Caldwell.

STATEMENT OF ADMIRAL JAMES CALDWELL, DEPUTY ADMINISTRATOR FOR OFFICE OF NAVAL REACTORS, NATIONAL NUCLEAR SECURITY ADMINISTRATION

Admiral Caldwell: Chairman King, Ranking Member Fischer, and distinguished members of this subcommittee, thank you for the opportunity to testify here today. I also thank this subcommittee for consistently supporting Naval Reactors. This enables my team to provide the Navy with propulsion plans that give our nuclear-powered warships the incredible advantage of unmatched reliability, speed, and endurance to conduct national security missions around the world. Naval Reactors' historical investment in advanced technologies has maintained our competitive edge in the maritime environment for decades. The Navy's highly capable nuclear-powered submarines and aircraft carriers have ensured our warfighting advantage over potential adversaries.

Today's strategic environment is dynamic and increasingly complex. Near-peer rivals are pursuing robust military modernization programs aimed at eroding our maritime preeminence and narrowing the capability gap. I am focused on renewing Naval Reactors' investment in cutting-edge technologies to deliver enhanced capabilities to the existing fleet and for future ships.

There are three areas vital to our ability to provide

24/7 support to the nuclear Navy. First is our small but highly skilled Federal workforce. It is our most important resource. I am focused on ensuring sufficient Federal staffing to meet the demands of sustaining today's fleet and growing future capabilities.

Second, we are renewing our investment in Naval Nuclear Laboratory research and development so that we can maintain superiority over our competitors. These efforts focus on technologies with the potential to deliver greater capability with lower acquisition and lifecycle cost. Specific areas of investment include advanced fuel systems, reactor core automated manufacturing and inspection, and next-generation instrumentation and control technologies.

Finally, I am investing in modernizing critical infrastructure and reducing my program's legacy environmental liabilities. Many of our facilities date back to the inception of the program over 70 years ago. We are increasing our emphasis on retiring facilities no longer in use, and we will do that in an environmentally responsible and cost-effective way.

In addition to these three areas, this committee's continued support has enabled significant progress on our three national priority projects. The first is the development of the reactor plant for the Columbia-class ballistic missile submarine. This supports the Navy's

number one acquisition priority. We began manufacturing the lead ship reactor core in FY 2019. This reactor will serve for the life of the ship for more than 40 years. We started construction of the lead ship in this year, 2021.

The second project is the refueling and overhaul of our land-based prototype reactor in New York. There is a dual benefit to this effort. It enables continued research and development to support the fleet and it will provide more than 20 years of training for the Navy's nuclear fleet operators.

The third project is the construction of the Naval Spent Handling Facility in Idaho, which will enable long-term, reliable processing and packaging of spent fuel from the Navy's nuclear-powered warships. Your support of this project has allowed us to make significant progress. To date, we have poured approximately 100,000 cubic yards of concrete. That represents nearly 30 percent of the required foundation concrete volume.

In closing, continued congressional support allows us to balance the investments in today's fleet with the future fleet, it allows us to expand the Navy's ability to project power and control the seas, and it allows us to remain ready for the high-end fight.

Thank you for this committee's longstanding, strong support of Naval Reactors, and I look forward to answering

your questions.

[The prepared statement of Admiral Caldwell follows:]

Senator King: Thank you, Admiral. I will begin with questions and we will rote through the committee.

Mr. Verdon, something you said caught my ear. A lot of what this committee, the sort of fundamental premise of this committee is deterrence. It is something that we are concerned with, and deterrence involves credibility of the deterrent itself. You said something about the limitations from not modernizing are no longer over the horizon but they are visible. My concern is they are also visible to our adversaries. Would you agree that that fact alone undermines the deterrent?

Mr. Verdon: I would certainly agree that that is a danger, and it is something, why we are moving as quickly as we can to address.

Senator King: And modernization across the nuclear enterprise is a part of maintaining deterrence.

Mr. Verdon: That is right.

Senator King: And the other thing that I think you mentioned that is very as part of your work is nonproliferation. One of the things that worries me is to flip deterrence on its head. Deterrence does not necessarily work with a non-state actor, with a terrorist organization. Sometimes they are okay with being blown up.

So in order to prevent attacks of that nature, nonproliferation becomes all the more important, so they

cannot get their hands on the material in the first place. Talk to me about your activities in nonproliferation.

Mr. Verdon: So yes, I totally agree with your assessment and we continue to work very, very hard with partners, you know, certainly within the United States but with partners around the world to make sure that we can track and prevent any theft of material, acquisition of material, technologies. That is something that we spend a considerable amount of time on to try to minimize the chance of any non-state actor getting the materials and/or the technologies necessary to do something, you know --

Senator King: I am going to ask you to make a qualitative judgment. How good are you at that? Are we able to follow nuclear materials with a high level of fidelity?

Mr. Verdon: You know, it is one of these things that you have -- I think based on evidence, I think we are doing a good job. Ourselves and our partners are doing a good job with this. We continue to look to improve. We do not rest on our laurels. We are always looking for new ways to see whether we can improve on how we do this. But, you know, we run tests, we run drills, we run all sorts of, you know -- we try to run tabletops to make sure that we are really exercising the skills correctly and we have everything we need in place. But we continue to advance the capabilities

in those areas to make sure that we never make a mistake.

Senator King: Are you receiving full cooperation and support from all of the agencies of the intelligence community? I do not want to hear if we have a problem about stovepipes.

Mr. Verdon: No. I think this is an area where I think everybody works very well together, that everybody recognizes the importance of this, and we see strong support and respect for roles and responsibilities and sharing of information and transparency as required. I think everyone does recognize the importance of this.

Senator King: Well, it is critically important, and I hope you will advise this committee if you feel that there is any limitation on the data that you are receiving.

Admiral Caldwell, I understand we stopped enriching fuel in 1992, and basically we are working off the stockpile. When do you see a need to further enrichment?

Admiral Caldwell: Sir, we have enough fuel to support our nuclear fleet through the mid 2050s, and that will depend on the Navy's decisions on force structure. But right now I am in good position through the 2050s. So eventually the nation is going to have to figure out how we provide that asset. We are working closely with the National Nuclear Security Administration and DOE on alternatives, and, you know, so we would be looking to have

some capability to produce the highly enriched uranium that we need by the 2040 time frame.

Senator King: Fine. I am going to have questions, Mr. Verdon, on pit production, and Mr. White, on where the progress is, but I am going to yield my time to Senator Fischer.

Senator Fischer: Thank you, Mr. Chairman. Dr. Verdon, at our hearing last week, Senator Rosen brought up underground testing, and Deputy Assistant Secretary for Nuclear Matters, Mr. Walter, he made the point that investment in NNSA's scientific capabilities were essential to help avoid the need to ever return to explosive testing. And he noted, in particular, the role that the Enhanced Capabilities for Subcritical Experiments program plays in that effort.

Can you talk about the connection between modernizing the complex and avoiding the need for testing, as well as the role subcritical experiments play?

Mr. Verdon: Certainly. So in terms of avoiding the testing, the examples that you brought up of Enhanced Capabilities for Subcritical Experiments as an example of an area where we recognized that we had a gap in some experimental data that we needed to help better improve our understanding of nuclear weapons in the absence of testing. So the subject matter experts identified a real state-of-

the-art facility that we call the Enhanced Capabilities for Subcritical Experiments that, if worked as designed, will actually give us the data that we used to acquire through nuclear testing. So if it works as designed, it actually will move us further away from the technical need for requiring a nuclear test.

And so we are working to do that. It will be located in the U1a tunnel complex at the Nevada National Security Site. And that, coupled with a recognition that we still need higher capability in computing, so that we will be putting online our first exascale machine in 2023, to address that gap as well.

So we still do invest in the scientific capabilities that, in particular, the laboratories and plants are key in identifying as gaps in their understanding that they need to fill to support our ability to do the work we need to do in the absence of testing. So all of these act to help us to forestall the need to technically have to return to testing.

Senator Fischer: And these experiments, they are vital to be able to certify the life-extended warheads of the older pits, right?

Mr. Verdon: They are vital for both ongoing and planned warhead modernization programs. So again, they are slated to come online in time to support, in particular, the W80-4 LEP, and the W87-1 modification program. We are using

those as drivers, the timeline drivers, to get those capabilities up.

Senator Fischer: Congress created the Stockpile Responsiveness Program several years ago in order to ensure that our scientists were exercising the full spectrum of skills necessary to support all phases of nuclear weapons lifecycle process. Dr. Verdon, can you give us your assessment of the contribution this program has made so far, and what role do you see it playing in the future?

Mr. Verdon: So, yes. I have been very impressed with the work that is being carried out in the Stockpile Responsiveness Program. I have seen it firsthand, both when I was still present at Lawrence Livermore National Laboratory as the leader of the weapons program there, and from here, from headquarters, that the workforce is exercising skills that are necessary, that they normally would not have gotten a chance to exercise. And some of the tasks we provided to them, the creativity that has come out from it has been impressive to see.

And so we do view it as a very important role in the training of our workforce, and I think we see very positive results from that, in that people can go from that program, train on that program and then move into the actual warhead modernization programs.

Senator Fischer: Doctor, what lessons has NNSA learned

from the delays it has encountered in the B61-12 Life Extension Program, and also the W88 Alt, and are there process improvements that can be applied to future life extension programs?

Mr. Verdon: So, yes. One of the first things we did, as soon as we started it, when we encountered the situations that we had in the 61 and the 88, we formed, actually, one inside review team and then a congressionally directed review team that went out and looked and really scrubbed hard. In fact, the Admiral was kind enough to lend us some people from his organization to be on one of the teams. And we really did a scrub of just what occurred, what happened, what lessons did we need to learn. And, indeed, very extensive reports and reviews were written, and we have embraced them and are actually implementing many, if not just about all of the recommendations, onto the W80-4 and the W87-1, as we speak.

So we have taken it very seriously. We are implementing changes based on the lessons that were identified, and we are already seeing benefit from those lessons being applied.

Senator Fischer: Thank you. Thank you, Mr. Chairman.

Senator King: Senator Kelly.

Senator Kelly: Thank you, Mr. Chairman, and thank you to our three witnesses for testifying today. This question

is for Admiral Caldwell.

So, Admiral, you have often described the Navy submarine force as being in high demand with a high OPTEMPO. And given our adversaries' significant investment in undersea capabilities, I think it is safe to say that this high demand will continue.

I would like to get your thoughts on the state of our industrial base. As you well know, we work closely with the private sector to deliver the Navy's nuclear-powered submarine capabilities. So how would you assess the health of our highly specialized shipyards who support these capabilities?

Admiral Caldwell: Sir, thanks for the question, and I do agree with you that our submarine force and our undersea forces are going to remain in high demand. I would like to break your question into a couple parts. First I would like to talk about the nuclear industrial base that supports my ability to deliver reactor cores, components, instrumentation, and the things to build the reactor plans.

As we downsized after the Cold War, we downsized that industrial base to the need to support our needs. That is a highly capable, small industrial base that I have a lot of confidence in. We spent a lot of time engaging with our partners in industry. We monitor their performance. We project ahead and forecast, as accurately as we can, what

the nation's needs are, and they have been able to continue to deliver what we need.

As an example, even during COVID, I am on track to deliver all my reactor plant components to the Columbia with margin. I think that is a real testament to the strength and the depth and the coordination and cooperation we have with the nuclear industrial base that supports me.

On the shipbuilder side, we have some challenges. If you think about where we have been as a nation, in the '80s and the early part of the '90s we built 30-plus Los Angeles-class submarines in about a 10-year period, and we walked away from that investment in being able to do that. We built a few submarines in the early 2000s. We started again on one Virginia per year, and then about the 2014-2015 time frame we started to build two Virginia-class submarines per year.

So in that vendor base you have a lot of things going on. First, you have an experienced workforce that was here in the '80s and '90s. A lot of those folks went home. So we have inexperienced folks that are now learning new trades, including at the supervisory level.

Additionally, you have existing vendors who we have now, with going to two Virginia per year and Columbia and even Ford aircraft carrier construction, we have increased the demand on those existing suppliers. And we have also

had to go reach out to new suppliers as well. So there is pressure on those suppliers to perform.

We have had some challenges. Senator King asked me, in a phone call earlier, about missile tubes. That was an example of problems in the vendor base. We have come through that with a lot of government oversight and a lot of detailed engagements, and we are going to get back on the cadence for that.

But I think if we are going to continue to build the submarine force and the carrier force that we need, we are going to have to continue to grow that industrial base. We are doing that with an enterprise-wide plan that looks at all of the vendors that support all those programs I just talked about, and I think what is key we have got to get after the basics, we have got to develop the workforce, and we are going to have to have the right oversight at the primes and also by the government.

Senator Kelly: Thank you. And on the training side, it sounds like you are building a new reactor in Schenectady, would be my guess there, right?

Admiral Caldwell: If I could comment on that, sir that is a reactor that has been in the program for decades.

Senator Kelly: Yeah.

Admiral Caldwell: In fact, I trained there when I first entered the Navy back in the early '80s.

Senator Kelly: And you are still able to use that reactor that was from the 1980s?

Admiral Caldwell: Yes. We are still able to use that reactor plant, which I think is an incredible testament to the way it was designed and the way it has been maintained. It has been refueled once, and we are now refueling it a second time. When we complete that refueling we will use that reactor for research and development for the U.S. Navy, and we will train operators for another 20 years. So if you think about that, that is going to be out to the 2040 time frame, and I trained on that in the early '80s.

Now in that modernization, we are modernizing the infrastructure and the instrumentation and control, so it will be an incredible asset for us going forward.

Senator Kelly: I was just assuming that by now you would have been building a new one there. Many of my classmates at the U.S. Merchant Marine Academy went to work there and are instructing, you know, the world's finest nuclear power plant operators are in the United States Navy.

Admiral Caldwell: I am ready to take you up there, sir, and show it to you.

Senator Kelly: Thank you.

Senator King: Thank you, Senator Kelly. Senator Rounds.

Senator Rounds: Thank you, Mr. Chairman. Gentlemen,

once again thank you for your service. Thanks for being here today.

Admiral Caldwell, the GAO has noted the challenges in maintaining ballistic missile submarines, the SSBNs, with regard to their operational capability due to unplanned delays and extended middle-life maintenance, refueling, overhauls, and refit periods. This is kind of following along some of the comments that you have just made with Senator Kelly.

Can you tell us how the efforts of the NNSA's Naval Reactors program, with respect to the life-of-ship reactor cores for the Columbia-class might address these issues, and whether there are other areas where the Naval Reactors program can support the Navy in improving turnaround times for SSBNs as well as carriers in the future?

Admiral Caldwell: Yes, sir. Thanks for the question. With regards to Columbia, we are building this life-of-ship core, which is designed to last 42 years. That is, in my opinion, a remarkable technological and manufacturing achievement. When you consider where we started with the program in refueling Nautilus at the 18-to-24-month point, and all that learning and all that growth in technology and manufacturing, we are now going to fuel a submarine that will last over 40 years.

That has tremendous benefit for the Navy. It will take

out that midlife refueling. It is going to allow us to operate that strategic deterrent mission with 12 boats versus the 14 we have today. That simple fact saves the U.S. Government $40 billion in total ownership costs to buy two additional ships. That is really, really important to the Navy.

Now in addition to that, we are investing in technology for today's fleet and the future fleet. So we are trying to get after adding capability to the fleet, and do that in a cost-effective way that reduces the construction spans. And so to get to your point, I am looking to see how can I build even more reliable components that last longer? How can I collect data and used advanced sensors and data analytics to analyze and do condition-based maintenance? And then my time is intimately involved with the shipyards in trying to make sure we have the right rigor, training, oversight in executing the availabilities.

I would like to say that, to your point about overhauls and whatnot, even in the midst of COVID, the shipyard that is refueling the Louisiana was able to achieve a best-of record in terms of the refueling timeline. That is remarkable, even in the midst of COVID.

Senator Rounds: May I ask, with regard to those such as the Boise, which has been in drydock, literally for years, it sounds to me like what you are sharing is that the

challenges for the Boise in terms of the extended delay for its midlife refueling and so forth was not because of the need for a delay with regard to the refueling of the reactor itself but rather the other shipbuilding portions of that refueling and midlife rerigging.

Admiral Caldwell: Fair statement. That is correct, sir. And if I could add a little context on that. Boise was headed in for an engineered overhaul, not a refueling. And the challenge with Boise is that we did not have the capacity in the shipyard to induct her. And rather than simply induct the ship and have her sit idle, we decided to roll her into the shipyard environment when we could accommodate that, and also take advantage of the capacity in the private sector.

So we are working hard to improve the capacity and the performance in our shipyard, and that will affect the Boise outcome as well. But just for the record, she is not being refueled, sir.

Senator Rounds: Thank you, sir.

Dr. Verdon, could you provide your perspective on the legality and practicality of the government entering into a partnership with the largest civilian enrichment service operating in the U.S., Urenco, for supplying low-enriched uranium to the Watts Bar Nuclear Plant, to produce tritium for weapons. I understand that the GAO wrote a report

saying that exercising this course of action is a policy question, and that national security needs for enriched uranium could be met if the government took this approach.

Could you share with me your thoughts on whether that is an appropriate path forward?

Mr. Verdon: Yes, sir. So we have actually conducted a pretty extensive analysis of alternatives of how to provide low-enriched uranium for our defense needs, and that was certainly one option that we carried forward amongst technical options of using centrifuges. So we kept it on the table because it was brought up.

We actually thought it was a pretty big lift to actually do it, but since it is potentially achievable, depending on the allies, we carried forward with the option on the table. But we are pursuing a technological path forward as well, and, you know, we are investing in centrifuge technologies so that we can offer the country a decision in the future of which way we want to go.

Senator Rounds: My time has expired, but I would like to pursue that perhaps at a later time. Thank you, Mr. Chairman. Thank you, gentlemen.

Senator King: Thank you, Senator Rounds. Senator Rosen via Webex, please.

Senator Rosen: Thank you, Chair King and Ranking Member Fischer, for holding these hearings. It is, of

course, a really important topic and important to us here in Nevada.

And so last week, of course, Deputy Assistant Secretary of Defense for Nuclear Matters, Andrew Walter, told this subcommittee that the Enhanced Capabilities for Subcritical Experiment program, or, much easier to say, the ECSE, will enable the NNSA to, quote, "continue gathering the data to conduct subcritical experiments to certify the nuclear stockpile and ensure that the designs we use in the future remain safe and reliable," unquote.

So, Dr. Verdon, could you provide us with an update on upgrades to the ECSE facility in the U1a complex at the Nevada National Security Site, and can you tell us how the new facility will help to improve our stockpile stewardship program, scientific capabilities of course including our understanding of plutonium.

Mr. Verdon: Yes. Thank you for the question. Yes, ECSE--easier to say than Enhance Capabilities for Critical Experiments--yes, as I mentioned, it is a state-of-the-art facility that will give us capabilities that we do not presently have within the complex to--in essence, you can think of it is take dental radiographs of an imploding primary, and getting multiple images of it as well other diagnostics. And it is just a capability that we do not have in the complex today.

So bringing that system up online will provide us data that we have not had since we did underground testing. And so we identified it as an important gap in our capabilities and we are moving out to implement it as we speak. And as I mentioned, its timelines are driven to support warhead modernization activities within the stockpile.

So it is a very important capability, and we are putting all effort into making sure that it comes up on time and within budget.

Senator Rosen: So we have lots going on, of course, in Nevada at--I still call it the Test Site. I have lived in Nevada over 40 years. But, you know, your mission is to secure the integrity of our nuclear stockpile, but what are you doing to improve and invest in areas such as resources and support for our workers in the site, and also building the people pipeline, and do you think that you have the funding that you need to bring up your functionality overall, as far as hardware and, of course, the people who work there?

Mr. Verdon: So, as I say, the Nevada National Security Site is a very important site for us, not only for the NNSA mission but I would for broader national security missions writ large. There are a lot of activities that take place at that site that are important.

And so we have a prioritized list that we revisit every

year for infrastructure improvements at the site, and we are executing infrastructure improvements that range from utilities to road, to, as I say, the Enhance Capabilities for Subcritical Experiments. They run the gamut.

You know, clearly we cannot move as fast as we would like to move, but I think we have a very methodical way that we are moving through it to upgrade, prioritized based on risk to program and risk to workforce safety, and we are moving through those in a very methodical manner to upgrade them over time.

Senator Rosen: Thank you. I appreciate that. And, of course, you know, quickly in the time I have left, we had a secret shipment of plutonium that ended up in Nevada, from South Carolina, and as a part of an effort to restore trust with the people of Nevada we know that NNSA is committed to removing that material, starting no later than this year and completing it by 2026.

Can you provide us, of course in this nonclassified setting, any updates on the removal of the plutonium?

Mr. Verdon: So I can't go into details but I will assure you that we are honoring the commitment that we made. So we are acting on what the commitment was, and we will continue to do so.

Senator Rosen: Thank you. I see my time is just about up. Maybe we can meet in a classified setting and get the

latest updates on that and some other updates on the pits and what is going on down there. Thank you so much.

Senator King: Thank you, Senator Rosen. Senator Sullivan.

Senator Sullivan: Thank you, Mr. Chairman. Admiral Caldwell, I wanted to talk a little bit about the culture of the nuclear Navy. I have always been fascinated by it. It is quite unique, I think exceptional in many ways. Were you interviewed by Admiral Rickover? Are you young enough, or old enough?

Admiral Caldwell: I am old enough to have been interviewed by Admiral Rickover.

Senator Sullivan: And how did that go?

Admiral Caldwell: I did not get to spend much time with him. He was unhappy with some of my academic performance and he kicked me out pretty quickly.

Senator Sullivan: Interesting. So it was a short interview?

Admiral Caldwell: It was a very short interview and I had to promise that I would improve my performance. But he accepted me, and I have to tell you, as I sit here today I am honored to have been in this program for what will be 40 years. And you are right, it has got an incredible culture. We hire fantastic people, and we work hard to retain them, and they do amazing work for us.

Senator Sullivan: So that is what I wanted to ask about. Oftentimes you have hearings when Senators or others think the culture has gone bad and something horrible has happened. And, you know, I never like talking about the nuclear Navy with its exceptional record and then you do not want an accident or anything. But it is quite unique, even within the military, even within, I think, American society. What is it that has enabled generations of naval officers and enlisted to operate our nuclear aircraft carriers, our nuclear subs in a way that is both focused on operational excellence and attention to detail, in an enterprise which is complicated, to say the least? But the Rickover culture, I think, some people criticize. I happen to think it is pretty remarkable. What do you think the secret sauce has been, and how do we make sure we continue to do it? Obviously, he is gone, but it is really remarkable, I think.

Admiral Caldwell: It is a remarkable culture, sir, and I invite you to have a further, deeper dialogue with you. But if I could summarize some of the key points is, first off, going out and finding and recruiting the best people that we can. And Admiral Rickover interviewed all of the officers coming into the program. I continue to do that today. And, in fact, in my job I have interviewed over 4,000 people to come into the program.

Senator Sullivan: So that continues.

Admiral Caldwell: That continues today, sir.

Senator Sullivan: You do not throw them out after 5 minutes, do you?

Admiral Caldwell: I am probably not as colorful as Admiral Rickover.

Senator Sullivan: Okay. I mean, if you do, that is okay too, I guess.

Admiral Caldwell: We aim to have high standards. We are absolutely dedicated to deep technical knowledge. We are brutally honest with ourselves in terms of our performance, and we expect that from all of our teams. We report when we do not do things well, and then we aim to learn from those things and roll that back into our culture. And we try to manage problems when they are very small, before they get big.

So there are many aspects to this, but it is the self-critical culture. It is this commitment to perpetually improving your team and continuing to learn from others and mistakes and continue to drive your performance. Admiral Rickover really set high expectations for his people, and we continue to do that today for all the folks in my headquarters as well as our officers and our sailors.

Senator Sullivan: And is there anything we can do? Sometimes that is a dangerous question, particularly when things are going well.

Admiral Caldwell: Well, I think the --

Senator Sullivan: Or should we just keep our hands up? What should we do to enable that?

Admiral Caldwell: The important thing about Naval Reactors is its alignment of authorities, responsibilities, accountability, and the money that supports us. This subcommittee's continued support for my program enables me to deliver what I need to for the U.S. Navy. It allows me to do the design and to maintain the high standards and keep our ships at sea. All of this stuff is wrapped together. So that is key, I think, and I will continue to convey to you what I think I need to run the program.

Senator Sullivan: And when Admiral Richardson became CNO, I remember that was considered a little, I don't know, "controversial" may be too strong a word. But it took the traditional, I think it is an 8-year, 4- to 8-year billet that you currently occupy. Is that a statutory billet, and does that help you, and is it 8 yeas and then you are done? And was it controversial? I thought Admiral Richardson did a great job when he was CNO, but what is your thinking on your billet, which is a little bit of a hard question.

Admiral Caldwell: It is an 8-year responsibility. It was outlined in an Executive order 12344. It was later codified into law. And it allows the director to gain continuity in the program and to live with their decisions.

Now Admiral Rickover is an extraordinary leader, and I think he had the opportunity to go lead our Navy, and I think that was great for our Navy. And I think for me and for the program it is good to have an 8-year director to get fully immersed, to make decisions, and then deal with the consequences of those decisions. That is part of being a nuclear-trained officer is owning the results and owning the path to get to success.

Senator Sullivan: Thank you very much. Thank you, Mr. Chairman.

Senator King: Thank you, Senator Sullivan. Admiral, following up Senator Sullivan's questions, I had the opportunity to spend a couple of days and a night on the USS New Mexico under the ice in the Arctic Ocean. And one of my clearest memories was -- they were enlisted people who were managing that reactor, and it was their reactor. You came away feeling that they had an ownership and a commitment to excellence that was quite extraordinary. And that was a clear memory from that trip, right up there with breaking through the ice when it was time to go home. But I compliment you on maintaining that culture that Senator Sullivan described.

Admiral Caldwell: Thank, sir. I think you said the optimal word: ownership. And when I think about it, we have young nuclear operators, maybe a 21-year-old operator

at the panel, controlling the reactor. It is pretty impressive what they can do. We are pretty proud of them.

Senator King: That was exactly my thinking.

Dr. Verdon, I have been to several storage facilities of nuclear warheads and there seemed to be a lot of them. Let me ask a question my constituents might ask if they were sitting here. Why do we need new warheads?

Mr. Verdon: So many times -- well, "new" is how you want to define it. Some of them are basically the modernization programs, they are actually replacing like for like, just using newer components, replacing, you know, aged materials or aging components.

Senator King: So to be clear, that are not entirely new warheads. They are components that are being changed to modernize.

Mr. Verdon: That is for a vast majority of what we have been doing to date has been what we call regular Life Extension Program, where you basically try to reuse as much of the componentry as you can and only replace that which you have to. And it is driven by age or, you know, in some cases these warheads were designed to only be in the stockpile for 20 years. So you run out of logistic supplies because the components have gotten so old and they are no longer made, so you have to upgrade them to the newer technologies.

So they are not new in that regard. There is no new military characteristics associated with the warheads.

Senator King: Thank you. Pits is a matter of some discussion. We have not been making pits, which are an essential component of a nuclear warhead, for some time. Number one, is it necessary to restart pit production?

Mr. Verdon: So my assessment, technically, is yes, it is. I think there are a number of reasons, one being to mitigate risks against what are presently now large uncertainties associated with what is called plutonium aging. It is really the cumulative impact of plutonium decay, radioactive decay, on an existing pit. And then also to address and be able to improve the safety and security of the warheads, based on new safety and security requirements. And then a third would be to potentially respond to what peer adversaries might challenge our deterrent for the future.

So I do assess that manufacturing, having the capability, a modest capability, of manufacturing new pits is important for our deterrent in the long term.

Senator King: So they have been manufactured at Los Alamos, but I understand that the plan now is to restart the program at Los Alamos but also to have a sister facility at the old MOX facility in South Carolina. Why two facilities?

Mr. Verdon: So when we explored the options of how to

re-establish pit manufacturing we looked at obviously one site and we looked at two sites. And, in particular, because we had the existing facility at Los Angeles, the Plutonium Facility Number 4, PF4, and what we formerly referred to as MOX facility at Savannah River, having those two existing facilities identified a way to implement pit production at a modest level of around 80 pits per year, which is the goal, but also having resiliency, because we have found at Los Alamos that we have had outages that have lasted a few months to 3 years.

Senator King: What do you mean by an outage? That is not a power outage.

Mr. Verdon: An outage, that a situation occurs at the production site that causes it to be offline for 3 years. And we have had that. We have actually experienced that. And having that kind of issue occur when you are trying to produce the warheads is not acceptable. It is hard to recover from.

So we identified that the two-site solution, particularly leveraging the existing facilities, was an efficient schedule and cost approach to re-establishing pit manufacturing for the United States.

Senator King: Aside from the resilience issue, was there any comparison made of costs of one versus two?

Mr. Verdon: So we have looked at that, and again, if

you factor in resiliency, if look at two sites that can produce 80 pits a year, you have to compare it to one site that is about 140 pits a year. And when we estimate that cost we estimate that to be almost twice as expensive as doing the two-site solution that have put forward today.

Senator King: Thank you. Mr. White, I keep promising I am going to get the questions, and they are still coming, but it is now over to Senator Fischer.

Senator Fischer: Thank you, Mr. Chairman. I am going to follow up a little bit on the pit production. While we know that Los Alamos and Savannah River are the primary production sites, I got to visit you out at Lawrence Livermore a few years ago as well. Can you talk a little bit about the role that Lawrence Livermore is going to be playing in this, as we look at the efforts, the plutonium efforts of NNSA?

Mr. Verdon: So the present example is a perfect one of the W87-1, where Lawrence Livermore is responsible for the design of that warhead and responsible for the design of the pit that is going to go into that warhead. So they are actually playing a key role as the design agency, working with the Los Alamos production agency. It is not enough just to put the equipment in. You actually have to show that what is produced with that equipment is acceptable for use in the stockpile, and Lawrence Livermore will be playing

a key role in showing that what Los Alamos, and ultimately Savannah River, would produce is acceptable for use in the stockpile.

Senator Fischer: And will the technicians at Livermore be able to produce those pits as well? Will you be training them to do that?

Mr. Verdon: Right now there is expertise at Lawrence Livermore in pit production that is being used to peer review the Los Alamos and Savannah River efforts, but right now there is not plans to have them doing hands-on work.

Senator Fischer: If Livermore was going to start in pit production, what kind of investments would have to be made there?

Mr. Verdon: There was a pit production capability at Lawrence Livermore but it was decommissioned. So it would be, again, a pretty big expense to stand it back up. And it was not of the size that would be necessary right now. We would have to increase the size of it.

Senator Fischer: Okay. Thank you all. I appreciate you being here today. Thank you, Mr. Chairman.

Senator King: Just a couple more questions. Mr. White, I mentioned in the opening statement 177 leaking tanks at Hanford. Is that the right number, and what are we doing?

Mr. White: So that is the total number of tanks that

we have at Hanford, sir, but it is not the number that we believe are leaking.

Senator King: Do you have a number on those which you think are leaking?

Mr. White: Yes, sir. There are two tanks at Hanford that we believe are actively leaking. Over the 70-year life of the site, we believe over 60 of the single-shell tanks have leaked at some point in the past.

I think this highlights the importance of a couple of things in terms of our ability to manage that aging tank infrastructure. One is it highlights the importance of the mitigation measures that we have taken over the past three decades to ensure that we are managing the risk of that aging infrastructure. For those single-shell tanks that are the most vulnerable, we have pumped out most of the drainable liquids from those tanks starting in the 1980s. And so for the actively leaking tank we identified recently, for example, most of the liquids in that tank had been pumped out.

Senator King: So you are triaging the tanks according to their risk.

Mr. White: Yes, sir. And we have also installed pump-and-treat systems in the tank farms that prevent the contamination from the history of operations at the site from reaching the groundwater. We have built up a tank

integrity program to ensure that we are monitoring very closely the levels in the tanks and also monitoring the integrity of the infrastructure.

Senator King: Do you feel confident in your groundwater protection efforts, because this site, I understand, is not all that far from the Columbia River.

Mr. White: The tank farms are several miles from the Columbia River, so depending on your --

Senator King: Groundwater travels.

Mr. White: And the groundwater does travel. It takes a number of decades for contaminants to migrate from the tanks to the groundwater, but we have every indication that the pump-and-treat systems that we are putting in place are, in fact, very effective.

I think this does highlight, though, the importance of moving forward to the ultimate solution, which is to treat and dispose of the tank waste at Hanford.

Senator King: My understanding is there a classification process for what is coming out of the top part of the tanks, but what about the really bad stuff that is in the bottom? Is that going to be the same process? There is a grout process, I understand. Is that the answer for the more contaminated?

Mr. White: For the low-activity vitrification capability we are standing up now, that treats the low-

activity part.

Senator King: Right.

Mr. White: The sludge that you are talking about, that typically is in the bottom of tanks, will most likely be a high-level waste component. There is also a vitrification capability that we need to stand up to treat that as well. We are currently in discussions with the State of Washington on the best approach to use to stand up that vitrification facility over the course of the next decade or so.

Those two capabilities together, however, do not treat all of the tank waste at Hanford, and this gets to the need for supplemental treatment capability. This committee, in the past, has been very interested and very helpful in pushing us to do research and development into options to do that treatment of the supplemental waste streams. We had an FFRDC look at those in 2017. There were options ranging from grouting to vitrification to steam reforming.

We have not made a decision yet on those options. Last year's NDAA asked us to update that R&D effort, and we are in the process of doing that. We have contracted with Savannah River National Lab to do that update. We are also working with the National Academies to look at the study as the labs do that R&D effort.

At some point over the course of the next few decades we will begin to also need to stand up those supplemental

capabilities in order to really get to the bulk of the 50 or more million gallons of tank waste that exists.

Senator King: I sit on the Energy and Natural Resources Committee with Senator Wyden and Senator Cantwell, so I am channeling them now. But you have used "decades" twice. One is in the motion of groundwater and the other is finding the solution. There is a danger here. I mean, there are some deadlines, and do you feel that we are making adequate progress?

Mr. White: I do. I am very impressed with what the site has done in terms of our ability to stand up the initial vitrification capability on the low-activity side. I believe we will meet our regulatory milestone of having that up and running by the end of December 2023.

We are currently working with the State of Washington and the EPA, trying to figure out what the next approach is going to be on the high-level side. I am hopeful we can come up with something that is feasible and practical, from a technical perspective. But I agree with you, time is of the essence.

Senator King: Thank you. And, Admiral, you deal with waste at Idaho National Lab. Is that program on track? Can we feel some confidence there?

Admiral Caldwell: Yes, sir, you should feel some confidence there. I ship my spent fuel to Idaho, and

package it for interim storage in steel containers, and then put it in concrete overpacks. I have, today, over 75 percent of my spent fuel is in a concrete overpack in road-ready storage, and additionally, we have responsibilities and commitments to the State of Idaho. I have a near-term commitment to have any fuel that was in the pool before January 1, 2017, had to be out of the pool by January 1, 2023, and I am going to meet that milestone 18 months in advance of the milestone.

So you should have confidence with what we do, and we will continue to do that. The spent fuel handling facility that we are building out there will allow us to continue to process that fuel and also to continue to meet our responsibilities with the State of Idaho, and to do so in an environmentally responsible way.

Senator King: Thank you. Senator Fischer, any further questions?

I want to thank all of you for your testimony here today. Again, I apologize for being late at the beginning of the meeting. But I also want to thank you for the important work that you are doing. This is some of the most sensitive and important work in our society. Each of you has a different aspect of it, and I just so respect your attention to the detail. And know that you have the support of this committee, and also know that you are doing a

significant service to the country. So thank you all.

Without further questions, the hearing is adjourned.

[Whereupon, at 6:11 p.m., the subcommittee was adjourned.]