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Introduction

Chairman Rogers, Ranking Member Cooper, and distinguished members of the Strategic Forces Subcommittee, thank you for the opportunity to testify today on "Nuclear Weapons Modernization Programs: Military, Technical and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy." I am Paul Hommert, President and Director of Sandia National Laboratories. I am pleased to join here today General C. Robert Kehler, Commander, U.S. Strategic Command; Madelyn R. Creedon, Assistant Secretary for Global Strategic Affairs; and Dr. Donald L. Cook, Deputy Administrator for Defense Programs, National Nuclear Security Administration (NNSA). I will first take the opportunity to congratulate General Kehler on his upcoming retirement and to thank him for his commitment to the nation's nuclear deterrent systems and for his tireless work devoted to our nuclear weapons modernization programs. In this context, I would like to highlight that, for the first time since 1992, Sandia is simultaneously executing three modernization programs, which are in full-scale engineering development: the B61 life extension program (LEP), the W88 Alteration (ALT) 370, and the Mk21 Fuze Replacement.

Sandia is a multiprogram national security laboratory owned by the United States Government and operated by Sandia Corporation[1] for the NNSA. Sandia is one of the three NNSA laboratories with responsibility for stockpile stewardship and annual assessment of the nation's nuclear weapons. Within the U.S. nuclear weapons enterprise, Sandia is uniquely responsible for the systems engineering and integration of the nuclear weapons in the stockpile and for the design, development, qualification, sustainment, and retirement of nonnuclear components of nuclear weapons. Sandia's nuclear weapons mission is focused on three imperatives. First, take care of the U.S. current stockpile through, for example, annual surveillance, as well as provide for stockpile maintenance through limited-life component exchange; second, sustain the stockpile into the future through

[1] Sandia Corporation is a subsidiary of the Lockheed Martin Corporation under Department of Energy prime contract no. DE-AC04-94AL85000.

LEPs and ALTs, which include technology replacement to avoid strategic surprise; and third, maintain and advance Sandia's required engineering and science capabilities, operations, and infrastructure.

While nuclear weapons represent Sandia's core mission, the science, technology, engineering, and business professional capabilities required to support this mission position us to support other aspects of national security as well. Indeed, there is natural, increasingly significant synergy between our core mission and our broader national security work, including research and development in synergistic defense products, cyberspace, nuclear assessments and warning, and global nuclear dangers. Examples of areas where Sandia has applied its expertise with a direct nexus between nuclear weapons (NW) work and non-NW benefits for the nation include the development of tools for the warfighter to use in order to safely disable improvised explosive devices. This achievement was made possible by the deep expertise in explosives required for our NW mission, global monitoring systems for nuclear material detection, and our contributions to cyber defense, which are enabled by our long-standing work in the command and control of nuclear weapons.

Major Points of This Testimony

My statement today before this subcommittee will focus on the requirements driving the B61 LEP and the current program status. I also will touch on Sandia's role in the overall "3 + 2" future stockpile vision.

Ms. Creedon is representing the U.S. policy perspective at this hearing, General Kehler is representing military requirements, and Dr. Cook will provide an enterprise-wide perspective for the NNSA. Sandia's role is to work within the NNSA enterprise to provide technology and products that support the implementation of U.S. policy and meet military requirements. Following are the major points of my testimony:

1. In order to sustain high confidence in the safety, security, and reliability of the B61 into the next decade, it is our technical judgment that we must complete the life extension program currently being executed.
2. We are well into the full-scale engineering development phase of this program, with the baseline design review scheduled for September 2015.
3. To date, we have costed $253 million of the $2.65 billion estimated incremental cost for Sandia on the B61 LEP, which was specified in the Weapon Development Cost Report (WDCR).
4. At Sandia, **we met all major FY13 program milestones for the B61 LEP** on (or under) cost although sequestration caused some of the work scope to be deferred to FY14.
5. We put in place rigorous project management expertise to ensure **ongoing adherence to plan for all our modernization efforts**.
6. We have drawn upon resources and expertise nurtured through interagency work on broader national security challenges to meet the urgent demands of our core nuclear weapons mission.
7. However, the impacts—both to schedule and lifecycle cost—of ongoing FY14 budget decisions have yet to be established. It is likely that we will have delays in schedule and higher costs.

The B61 LEP: Sustaining the B61 Safety, Security, and Reliability

Every year, the directors of the three NNSA national security laboratories and the commander of U.S. Strategic Command (STRATCOM) are required by law to assess the state of health of the U.S. nuclear weapons stockpile. Based on an extensive technical evaluation, Sandia's director submits a letter to the secretaries of Energy and Defense and the chairman of the Nuclear Weapons Council (NWC), assessing the reliability and safety of each U.S. nuclear weapon type and noting potential concerns.

Regarding the B61, in recent years, my letters have documented concerns related to technology obsolescence and aging. While the B61 is currently safe and secure, these concerns continue to increase. For example, in the past three years, we have observed time-dependent degradation not seen before in electronic, polymer, and high-explosive components. This observation is not surprising given the age of the B61 weapon system, the oldest units of which were manufactured and fielded in the late 1970s with some components dating back to the 1960s. As planned, the B61 LEP we are currently executing addresses all known aging-related issues.

The program is also addressing technology obsolescence. Electronic components of the B61 were designed and manufactured decades ago. Outdated technologies, such as vacuum tubes, are exhibiting performance degradation and are difficult to evaluate and assess with confidence. The new radar for the B61 LEP will be based on the modern technology of radio-frequency integrated circuits.

This life extension also contains an explicit approach to trusted design. For example, we are manufacturing all application-specific integrated circuits in Sandia's trusted foundry.

Encryption algorithms, which are fundamental to the security of the B61, are assessed by the National Security Agency to have certain upcoming expiration dates, so key features associated with use control and denial must be upgraded.

The B61 receives important signals from the aircraft used to deliver it, and the aircraft interface of the B61 needs to be updated from analog technology to an adaptable interface that can also accommodate digital technology to ensure compatibility with planned future aircraft upgrades and the F-35 Joint Strike Fighter.

Following direction from the Project Officers Group, chaired by the U.S. Air Force, the B61 LEP will consolidate four of the current versions, or Mods, of B61 bombs (the B61-3, B61-4, B61-7, and B61-10) into a single Mod, the B61-12. The result will be reduced U.S. Air Force nuclear weapon management complexity, as well as reduced cost for ongoing maintenance, training, and stockpile evaluation. With the B61-12, there will be just one weapon type. This Mod consolidation is made possible through use of a Tail Kit, which is the responsibility of the U.S. Air Force and is designed to provide increased targeting accuracy. In turn, increased accuracy allows the military yield requirement to be lowered for the LEP design.

B61 LEP updates, including Mod consolidation into just one weapon type, will overall dramatically reduce the amount of special nuclear material for this weapon type. Updated safety and security features also will be included in the B61-12, consistent with presidential directives and national policy.

In summary, the B61 LEP includes a prudent mix of the following:

(1) Requalification and reuse of existing components that we can certify for an additional 20-year lifetime,
(2) Remanufacture of some existing component designs, and
(3) Replacement with new designs, where required.

This approach to the program reduces the number of components to be developed and reduces the technical and programmatic risk associated with the life extension, but it does add lifetime risk to the B61-12. The resulting B61-12 design is the minimum that

- Meets threshold military requirements, including compatibility with future digital aircraft interfaces,
- Addresses known end-of-life and technology obsolescence issues,
- Updates safety and security over the currently fielded systems, and
- Consolidates the B61 Mods 3, 4, 7, and 10 into a single B61 Mod 12.

Cost and Schedule Performance on the B61 LEP

NNSA has provided to Congress an estimate of approximately $8 billion over 12 years for the full program just described, including the production and deployment of the required number of nuclear bombs. Within that cost estimate, there is a $2.65 billion estimated total incremental cost for work on the B61 LEP at Sandia, which was specified in the WDCR. This estimated cost includes an appropriate amount of contingency. There are additional resources applied to the B61 LEP from base capability programs; however, these are relatively small and would be costed for capability sustainment independent of the B61 LEP.

Thus, from our perspective, the most relevant cost number for the B61 LEP work at Sandia is $2.65 billion. This cost represents approximately 40% of the incremental cost for the B61 LEP across the enterprise. At the time of this testimony, we have costed $253 million of the $2.65 billion. Against those expenditures, we have met all major milestones on (or under) cost. These milestones include system-level mechanical environment tests, radar flight performance tests, and functional electrical compatibility tests.

The B61 LEP can be thought of as having three major phases—design, component and system qualification, and production. We are currently approximately 60% complete on design, with baseline design review scheduled for September 2015. In FY14, work on qualification will increase.

There has been considerable discussion about schedule slip or cost growth on the B61 LEP. With respect to this topic, I can only address Sandia's role; however, as the predominant design agent for the LEP, we recognize the impact of our work on the overall enterprise schedule.

Regarding schedule, there are two overarching causes for slip: technical issues and budgetary changes. With respect to technical risk, I have the highest level of confidence that technical issues will NOT cause impact to Sandia's schedule performance. I say this for two reasons. First, we do not view this program as inherently high technical risk, especially when compared with other product development programs conducted at Sandia. The B61 LEP does not involve significant changes to environmental or functionality requirements; therefore, the inherent technical risk is

lowered. Second, we manage our contingency funds (~10%) in a manner that continuously buys down risk against a formalized risk register. So, for example, higher risk elements of the program, such as Tail Kit integration or component reuse, receive early and enhanced focus. As mentioned, we are well into program execution, and early success supports our confidence. For example, at the start of our full-scale engineering development, the radar component was high on our risk register. As you may be aware, in August we tested our new radar for the B61-12. The test of the new design was so successful that we have decided to eliminate two additional tests that were originally planned, saving an estimated $300,000.

With respect to budgetary changes, I cannot be as sanguine. In FY13, sequestration impacts caused some technical activities to be moved into FY14. We estimated the schedule impact of those shifts to be relatively small—on the order of 2 to 3 months over the life of the program (within overall schedule contingency). However, at the time of this testimony, we are operating against a FY14 resource allocation that, on an annual basis, is at least 23% below the FY14 requirement, as contained in the most recent NNSA-approved Baseline Change Requests to the Selected Acquisition Report, approved in October 2013. Obviously, unless addressed, budgetary changes of this magnitude will have significant schedule impact. As with any large program activity, schedule slip will result in an increase in overall program cost. We recognize the overall fiscal environment in which we are operating and will work at all times to minimize cost growth as a result of budget-induced schedule slip.

Another aspect of cost growth is labor rates. We are committed to managing labor costs and have confidence in our forward pricing rates used in our cost estimate, which take into account upcoming changes in pension and health care cost obligations. Once again, our initial performance validates our confidence as our labor costs for FY13 and now FY14 are modestly below the forward pricing rates we used in our cost estimate.

Achieving a High Level of Programmatic Performance

As illustrated by data in the section above, we have achieved a high level of programmatic performance on the B61 LEP and, indeed, the same is true of the two other modernization programs in full-scale engineering development at Sandia—the W88 ALT 370 and Mk21 Fuze Replacement. This achievement was the result of the deliberate and focused efforts of our leadership over the past several years.

Among these efforts are collocation of the core design teams, enhancements to our classified networks reflective of the volume of work, and most significantly, staffing and training of the workforce. The staffing requirement for these modernization efforts exceeds 1,000 people. I am pleased to report that, despite numerous periods of budget uncertainty over the past two years, we have been extremely successful at staffing the program against a very aggressive staffing plan. Two staffing approaches have allowed us to achieve the required staffing levels for the modernization programs: (1) internal staff movements from other Sandia programs that require skills synergistic with those for the nuclear weapons program and (2) external hiring. Since 2010, we have hired some 500 advanced-degree scientists and engineers. The overall number of members of the workforce at the Laboratory remained essentially flat through this period. Of those we hired new to Sandia,

approximately 58% are early in their professional careers. The modernization program provides opportunities for these new technical staff to work closely with our experienced designers: from advanced concept development to component design and qualification, and ultimately to the production and fielding of nuclear weapon systems. It is very important that we provide individuals such as these with an environment where they can undertake the multiyear learning it takes to technically steward the nation's nuclear stockpile now and into the future, after the modernized warheads are in the stockpile. We have a new and strong contingent of scientists and engineers prepared to take on that challenge, and we must strive to provide the stability, focus, and national commitment that will enable their success.

Finally, another major effort of our leadership has been implementing an increased level of project management rigor. Our technical experts are partnered with project management professionals, skilled practitioners using a suite of formal tools, such as resource-loaded schedules, requirements tracking systems, and sophisticated risk management and mitigation methods. We are moving to an Earned Value Management System (EVMS), which is a way of quantitatively measuring where one is in the execution of a project regarding schedule and cost. While these approaches add to execution overhead, they provide essential insights and early indicators for a project of this scope and duration. With EVMS, we can use tailored assessments to look at cost and schedule performance indicators on a monthly basis, examine each subsystem, and track more accurately how each team is doing in developing those subsystems—and we can make immediate, early changes if necessary, applying more or fewer resources to each particular element of the project, as required.

We believe Sandia has an achievable plan, and today we continue to be on schedule and on budget relative to the March 2020 first production unit (FPU) documented in the Selected Acquisition Report. We are adjusting our plans as the fiscal situation evolves and are confident that we have the expertise and tools in place to effectively manage the program going forward.

Further Modernization Efforts at Sandia

The B61 LEP is the first and most urgent in a series of LEPs and ALTs required to sustain the U.S. nuclear stockpile into the future, in keeping with the "3+2" strategic vision of the stockpile codified in the NWC-approved baseline plan. We share the vision of a 3+2 stockpile, although the pace and sequencing of the path to that vision are not yet fully known and will be driven by global security imperatives and moderated by fiscal realities.

Our successful record of using common technologies and components across multiple systems that have been deployed in the U.S. stockpile has helped reduce development risk and manage development costs. We are extending this approach to development of the Arming, Fuzing, and Firing (AF&F) system. Today, a modular AF&F design is being developed for the W88 ALT 370, the Mk21 Fuze Replacement, and potentially for the W78/88-1 LEP. By capitalizing on work we have done over the past decade on modular warhead architectures and adaptable nonnuclear components, Sandia is supporting the NWC's plan for stockpile modernization cost-efficiently and with reduced risk. Although not directly interchangeable to accommodate missile interface differences, the underlying technologies and components are eminently adaptable to each of these

warhead applications and thus result in cost savings and reduced risk. In addition to the ballistic missile warhead applications, these same technologies and, in some cases, nearly identical components are being used in the B61 LEP. As in the past, rigorous performance testing in qualification, production, and surveillance mitigates the common-mode failure risks attendant to this approach. In addition, the microelectronics fabrication complex at Sandia and the Kansas City Plant provide the nation with a secure, responsive infrastructure for addressing production or design issues if they arise.

W88 ALT 370

Sandia is currently executing full-scale engineering development (Phase 6.3) on the W88 ALT 370, which involves replacing the AF&F system. The current FY19 FPU schedule for the W88 ALT 370 is driven by the overall Navy program and schedule, components reaching their end of life, and the need for additional surveillance quantities.

Mk21 Fuze Replacement

The W87 Arming and Fuzing Assembly, an Air Force subsystem, requires replacement with a current plan for an FPU in FY20. Alignment of this program with the B61 LEP and W88 ALT 370 allows the Air Force to receive approximately $85 million in savings as a result of using the common radar module. Use of other common and adaptable components will result in additional savings. This program is funded entirely by the Air Force. We have recently entered Phase 6.3 for this program as well.

Together, the B61 LEP, W88 ALT 370, and Mk21 Fuze Replacement, provide substantive required upgrades to all three legs of the U.S. nuclear weapons triad. That force posture has been consistently reaffirmed through official U.S. national security policy reviews and most recently in the updated *Guidance for Nuclear Forces Employment* transmitted to Congress.

W78/88-1 LEP

With a longer time horizon, we are working with NNSA and the Department of Defense (DoD) to study options for the W78/88-1 LEP. We completed a 120-day study, which was a tri-lab effort to examine options for reentry system modernization to include warheads that are interoperable across both the Intercontinental Ballistic Missile and Submarine Launched Ballistic Missile legs of the triad.

Additional Modernization Efforts

We delivered to NNSA preliminary reports on the options and considerations for the Long-Range Standoff Cruise Missile or Air-Launched Cruise Missile replacement.

Sustaining the Current Stockpile

Sandia, together with the other two NNSA national security laboratories, has key responsibilities in ensuring the safety, security, and effectiveness of the nation's nuclear deterrent. The stockpile surveillance and assessment program plays a crucial role in establishing that required confidence in our nuclear deterrent. It is through stockpile surveillance that nuclear weapons are taken apart to test

the components. Test results provide the necessary data to help us assess the safety, security, and reliability of the stockpile.

Stockpile Surveillance and Assessment

Findings from conducting this program provide the technical basis for our annual stockpile assessment reported to the President of the United States and inform decisions about required elements of the life extension programs and their timelines.

Multiple drivers heighten the importance of the surveillance program. Among them are the following: an unprecedented age of the stockpile, which includes many subsystems that were not originally designed for extended life; smaller stockpile numbers, which heighten the importance of individual warhead reliability; scoping decisions for stockpile life extensions; and for at least the next 20 years, surveillance of a stockpile that will contain simultaneously both our oldest weapons and life-extended weapons. The latter group must be examined for possible birth defects and for further aging of reused components.

The FY13 funding allocation after sequestration impacts required that we constrain surveillance efforts; current indications are that the FY14 funding for Sandia will impose additional constraints on our surveillance program. Despite funding constraints, Sandia is committed to fully support the flight test program with the DoD. However, we cannot provide annual laboratory testing, as historically we have done, for each system in the stockpile. The testing period will have to be stretched out. At the same time, our efforts to implement the component testing and new diagnostics and models fall further behind. These capabilities provide understanding of margins, uncertainties, and trends needed to (1) ensure the stockpile is safe, secure, and effective; (2) understand the lead times necessary to respond to aging issues that would have the potential to reduce stockpile safety, security, or reliability; and (3) support decisions on scoping for stockpile life extensions. Furthermore, several of our key surveillance facilities located in New Mexico, California, Texas, and Nevada are being operated with minimal investments in spare parts and preventative maintenance; as such, we are at risk for extended test outages due to equipment failures. To minimize the risk to the stockpile, given the realities of the current fiscal environment, we continue to apply a risk-based prioritization of our surveillance activities. A reduction in the number of systems requiring surveillance can also mitigate the pressure on the surveillance budget. Successfully completing the current modernization efforts should enable decisions regarding any reductions in stockpile types or numbers.

Advancing the Tools of Stewardship

During the stewardship era, the quintessential challenge was the elimination of underground testing. The sustained support received for stewardship has allowed us to make enormous progress in our understanding of nuclear weapons function in the absence of underground testing and has enabled us to attract talented staff. We must continue to advance and apply the tools of stewardship during today's modernization era.

Science-Based Infrastructure and Capabilities

Sandia's capabilities are essential to its full life-cycle responsibilities for the stockpile: from exploratory concept definition to design, development, qualification, testing, and ultimately to ongoing stockpile surveillance and assessment.

The FY13 funding for the recapitalization of our silicon fabrication facility, the requirements for which I have addressed in prior testimony, enabled us to replace the single most-expensive and highest-risk item in the facility. The FY14 budget must support the recapitalization program at the planned level.

I will restate that Sandia stewards for the nuclear weapons program, as well as for the Department of Energy's nonproliferation payloads, the microelectronics research and fabrication facility, where we design and fabricate an array of unique microelectronics, specialty optical components, and microelectromechanical system devices. The FY14 budget, to which we are currently planning, negatively impacts recapitalization and will increase the risk for delivering the B61 LEP and for producing the radiation-hardened components required by the W88 ALT 370 and all future reentry system LEPs. As we go forward on modernization, our microelectronics fabrication facilities, which form the basis of our trusted foundry, will be critical to ensuring the integrity of our supply chain.

In addition to the silicon fabrication facility, we have significant recapitalization needs at various experimental and test facilities critical to the success of the B61 LEP, W88 ALT 370, and future LEPs, particularly at the Tonopah Test Range. The FY14 budget will hamper our ability to reduce risk to the modernization program through lack of investment in those capabilities.

Sandia's high-performance computing capabilities are vital tools for our mission responsibilities in stockpile surveillance, certification, and qualification, and they continue to prove to be indispensable to our broader national security work. Current indications are that the FY14 budget negatively impacts our high-performance computing capabilities.

I want to emphasize that the investments in our stewardship tools over the past 15 years enable cost reductions in our modernization efforts through increased use of computational simulation, which reduces the amount of qualification testing; allows, for the first time, confident qualification of some components without either nuclear testing or expensive aboveground facilities; and affords important insights into the challenge of predictive aging for our older stockpile.

Synergy between Our Nuclear Weapons Mission and Broader National Security Work

Today's national security challenges are complex and highly diverse. The NNSA laboratories are contributing solutions to those challenges. To energize and sharpen its nuclear weapons competencies, Sandia relies on its broader national security work. The symbiotic relationship between the nuclear weapons mission and broader national security missions prevents insularity and creates a challenging, vigorous scientific and engineering environment that has helped us attract and retain the new talent we need. Such an environment is essential for us to succeed against the

challenges we now face. Let me give you two examples that highlight the way in which this symbiotic relationship works at Sandia.

First, I will give a technology example. Sandia has led the development of real-time processing and high performance-to-volume ratio technologies for synthetic aperture radar (SAR). Both technologies were made possible by our extensive radar design and development work for nuclear weapon fuzing. The technologies have been leveraged and are currently used by the DoD. The extensive SAR work has sharpened our radar design competencies and kept Sandia aligned with advances in radar technology, such as radio-frequency integrated circuits. We applied these modern technologies to the design of the replacement radar for the B61 LEP, the W88 Alt 370, and the Mk21 Fuze Replacement with a high degree of commonality, which leads to cost savings.

My second example is Sandia's satellite program, which spans about five decades and has grown steadily with numerous customers. This program, which provides our nation with critical national security capabilities, has brought with it a very rigorous program-management environment for moving advanced technology within tight schedule requirements. We have leveraged the knowledge accumulated in these areas to our nuclear weapons program.

I strongly believe that today it is not possible for my Laboratory to deliver consistently on the commitments to the nuclear weapons program without the synergistic interagency work that attracts top talent, hones our skills, and provides stability through the cycles of the nuclear weapons program.

Government commitment to the broad national security work of the laboratories is essential for the United States to ensure the preeminence of our nuclear weapons and to enable multidisciplinary technical solutions to other complex and high-risk national security challenges. In no way does our interagency work detract from our focus to execute our core nuclear weapons mission.

Conclusions

We are committed to continuing to provide the leadership and management expertise and attention required for successful execution of the stockpile modernization programs consistent with national security policy, NWC authorization, military requirements, NNSA direction, and congressional funding. As a Federally Funded Research and Development Center, we are dependent on timely, stable funding allocations, and encourage your support to the extent possible in this environment.

We appreciate the many ways in which Congress has supported the nuclear weapons program over the past few years, most notably with anomalies to spend at rates associated with the full President's budget requests for Weapons Activities during continuing resolutions and approval of reprogramming requests. At Sandia this approach has allowed us to stay largely on track for these critical programs.

We continue to struggle with the uncertainty associated with possible continuing resolution and sequestration outcomes, and the numerous and wide-ranging funding scenarios for support of this program in FY14 and beyond. Timely resolution of these issues is critical to sustaining morale and retention of our staff, and to staying on track with the scope and schedule required to support

U.S. nuclear deterrent objectives. We welcome continued communication between congressional committees and the national laboratories so we can be fully aware of possible and probable outcomes and can plan accordingly.

Finally, I want to end on a personal note. In a professional career now spanning more than 37 years, I have had the extraordinary privilege to work at three institutions whose core responsibility is nuclear weapons: the Atomic Weapons Establishment in the United Kingdom, the Los Alamos National Laboratory, and of course Sandia National Laboratories. In that time, I have worked with many exceptional individuals who have dedicated their professional lives to the innovation, science, and engineering excellence required to ensure that these unique devices of mankind are safe, secure, and reliable. I fully recognize the fiscal environment in which we are operating, and throughout my testimony I have indicated our focus on cost management and cost efficiency. However, my experience deeply reminds me that nuclear weapons are the last place for half measures or corner cutting. Thank you for your support and for having us here today to testify.