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Chairwoman Hartzler, Ranking Member Moulton, and members of the Subcommittee, thank you for inviting me to testify today. I am Dr. Charles McMillan, Director of Los Alamos National Laboratory. I am pleased to have the opportunity to continue the discussion we began last fall with the Strategic Forces Subcommittee regarding the status of the nation's nuclear weapons infrastructure. I appreciate your interest in this important subject and efforts to address it.

As I previously testified, the National Nuclear Security Administration (NNSA) Laboratory and Plant infrastructure is the foundation upon which our country's nuclear weapons enterprise is built. Many critical elements of today's nuclear weapons complex are in urgent need of recapitalization. Our weapons program is still second-to-none; however, to maintain this position, we must invest today in the facilities and scientific tools of tomorrow.

As one of three Laboratory Directors required by law to report to the President each year about the status of our nation's nuclear deterrent—and as someone who has devoted my entire 30-plus year career to the U.S. nuclear weapons program—I understand the diverse set of capabilities necessary across the enterprise to ensure the safety, security, and effectiveness of the stockpile.

As is the case with many elements of the nation's infrastructure, investments made in the nuclear enterprise during the Cold War continue to pay significant dividends. In addition, infrastructure investments made during the past 20 years as part of the stockpile stewardship program support our ability to reuse, refurbish, or replace many of our key nuclear components. Looking forward, a stable and predictable investment profile is essential to ensuring that we possess the capabilities required to respond appropriately to evolving or emerging technical or geopolitical challenges.

As Congress and the Administration undertake the process of developing a national infrastructure strategy, particularly as it pertains to the nuclear weapons enterprise, I believe that we must look beyond our immediate needs to ensure that our nation has the flexibility to meet both today's challenges as well as the challenges of an unpredictable future. The current set of scientific tools used to manage the stockpile provide our weapons scientists with insights that were unimaginable two or three decades ago. These are available today because of funding decisions Congress made 15 to 20 years ago; these decisions were informed by the belief that scientific analysis was the best method to support the stockpile without additional full-scale

nuclear testing. Today, your decisions will help set the course for the nuclear enterprise of 2030.

What are the essential features of the nuclear enterprise of 2030? It will require modern facilities to handle high explosives, hazardous materials, plutonium, tritium, and uranium for both research and production, as well as the ability to manufacture radiation-hardened electronics in a trusted foundry. New scientific facilities like the Enhanced Capability for Subcritical Experiments (ECSE) in Nevada—and others—will be needed to qualify new materials and manufacturing processes prior to introducing them into the stockpile.

While Los Alamos is leading the ECSE effort, we are working in partnership with Lawrence Livermore, Sandia National Laboratories, and the Nevada National Security Site, which will house this capability. ECSE will provide enhanced diagnostics for subcritical experiments that are essential to our continuing stockpile stewardship activities. Similarly, the future of stewardship requires an advanced understanding of "materials in extremes," a capability that can help us better understand the nature and behavior of materials as they experience the environments of an implosion. High Performance Computing, through the Advanced Simulation and Computing and Exascale Programs, will be necessary to integrate the data and discoveries from these new capabilities together into a framework that can be used by our nation's nuclear weapons scientists and engineers to continue to certify the stockpile.

With that in mind, the need to invest in the people who are the stewards of the stockpile must not be overlooked when discussing infrastructure investment; in fact, the two must go hand-in-hand. The ability to attract, educate, and retain the bright minds who are our next generation of weapons scientists is integral to, and dependent upon, such investment. While Life Extension Programs exercise a subset of the skills needed to care for the stockpile, new opportunities such as the Stockpile Responsiveness Program, should it be funded, represent the potential for an important advance in creating opportunities for exercising the full range of skills associated with nuclear weapons design. Our experience during two decades of Stockpile Stewardship has shown that skills that are not exercised will be lost; we learn by doing.

Madam Chairwoman, we have made progress on modernizing infrastructure across the NNSA enterprise. However, more must be done if we are to retain our leadership position. The NNSA has a substantial backlog of deferred-maintenance projects. Nearly a third of those projects are at Los Alamos alone. Additional resources devoted to maintenance will alleviate part of this backlog; however, some of these facilities must be replaced—something that can only be done via funded infrastructure projects. Many of these projects are shovel-ready today. Should an infrastructure bill be funded, the laboratories and plants could make significant strides toward a modernized nuclear infrastructure. Work of this character would create jobs and provide economic opportunity.

With that as an introduction, I am going to focus the remainder of my testimony on three areas that I hope will help inform your decisions about how to more efficiently direct scarce resources to the NNSA enterprise and better prepare our nation for the future. I will draw most of my examples from Los Alamos since I know them best. As you will see, though, especially in my analysis of policies that are designed to manage risk, the benefits of finding efficiencies and eliminating hurdles apply across the entire enterprise.

- The first area I will discuss are the so-called **"shovel-ready" projects**, because any resources directed to them can provide immediate near-term benefit.

- The second area I will discuss are the various elements necessary for sustaining the **plutonium infrastructure at Los Alamos**, while simultaneously trying to control costs and maximize efficiencies.

- Finally, I will discuss what I consider to be one of the most important issues—**managing risk** and eliminating hurdles as it pertains to acquiring and effectively using the infrastructure across the NNSA enterprise.

Shovel-Ready

As I begin this discussion, I would like to acknowledge NNSA (NA-50) for its efforts in identifying the magnitude of deferred maintenance and repair needs across the enterprise.

For the purpose of this hearing, I define "shovel-ready" projects as those that are capable of execution within the next two years. In general, the shovel-ready projects I am addressing are more tactical efforts that, by themselves, should not be expected to solve long-term strategic infrastructure problems.

During a recent series of NNSA site reviews, more than $3 billion worth of needed investments across the enterprise were identified, with $1.3 billion of those at Los Alamos alone.

To illustrate the funding gap, Los Alamos spends about $150M annually to maintain its facilities. This falls far short of the National Research Council's recommended metric of 4% of Replacement Plant Value (approximately $14B at Los Alamos), which would indicate an annual investment closer to $550M. This disparity is typical across the nuclear enterprise. Given this annual gap between infrastructure need and current funding levels, NA-50 estimates of deferred maintenance are credible.

It is reasonable to ask whether a substantial infusion of infrastructure money can be effectively used at a laboratory like Los Alamos. Recent history indicates this can be

done; examples of successful execution include American Recovery and Reinvestment Act funding ($270M), and the Cerro Grande fire recovery appropriation ($340M).

At Los Alamos, shovel-ready infrastructure projects can be grouped into four broad categories:

1. general infrastructure and maintenance,
2. facility disposition/risk reduction,
3. equipment needs as part of the scientific infrastructure, and
4. line-item construction projects

Balanced funding across these four categories is necessary to ensure success; and success will have significant positive impacts on all of the Laboratory's national-security missions.

Below, I will provide several examples of projects that we believe to be shovel-ready. I will discuss the impacts that completing those projects would have on our essential missions.

To give you a sense of the scale of our challenge, Los Alamos National Laboratory covers an area roughly the size of the District of Columbia. Every year we make tough calls when setting priorities for infrastructure and maintenance spending. Mission priorities rank highest, with roads, electrical infrastructure, and offices as lower priorities. As a result, we currently have some employees in "temporary" trailers that have been in use for more than 30 years, and we regularly have to manage rodent issues, leaking roofs, and other effects of aging. Such an environment is not conducive to hiring the nation's best-and-brightest workforce, and certainly does not provide our laboratories with a competitive edge in recruitment and retention when contemporary private-sector technology companies offer sleek and inviting campuses. Infrastructure investments would allow us to demolish old structures and move the workforce of the future into offices and laboratories that are appropriate for their mission. As an example of the efficiencies we are exploring, this year we are moving forward on the acquisition of modern, modular structures that are built offsite and installed at the Laboratory.

Investing in facility disposition/risk reduction would allow us to take down old office and laboratory spaces we currently do not use, but which we must continue to maintain in a safe condition. If we can eliminate these structures, we would redirect maintenance funding from these old structures to other better priorities.

Equipment investments would allow for the procurement of research equipment such as vessels that support tests at the Dual-Axis Radiographic Hydrodynamic Test Facility (DARHT) and U1A underground test facility in Nevada. These vessels, while not part of a facility structure per se, are in fact essential large-scale experimental equipment. Procurement of these vessels would help the nuclear complex increase

the tempo of experiments that are required for our current Life Extension Program (LEP) work. These procurements would be utilized by all of the laboratories. The nuclear weapons enterprise relies on both off-the-shelf and one-of-a-kind scientific and technical equipment to support stockpile stewardship.

Plutonium Infrastructure

The projects listed so far have designs that are mature enough that we could begin execution fairly quickly. However, there are critical capabilities that extend beyond "shovel-ready," but would benefit significantly from increased investment.

Our country currently has an extremely limited capability to manufacture plutonium pits. Through the first two phases of NNSA's Plutonium Strategy, Los Alamos is repurposing parts of two existing facilities in order to move analytical chemistry and materials characterization capabilities out of the 1950's-era Chemistry and Metallurgy Research (CMR) building. Fully executing these two phases should allow us to achieve a production capacity of 30 pits per year. Once these two steps are executed, we effectively have no more opportunities to refurbish existing nuclear space at Los Alamos because this space will be at capacity, yet insufficient to accommodate the future mission portfolio.

Phase 3 of the plutonium strategy, for which an Analysis of Alternatives is currently underway, calls for the construction of plutonium modules that would connect as extensions to PF-4. These modules will provide two important capabilities: first, the ability to reach the capacity requirement of 80 pits per year established by U.S. Strategic Command (USSTRATCOM) and documented in the National Defense Authorization Act (NDAA); second, and perhaps as important, the project will allow us to move the highest risk radiological activities to modern facilities. This would help extend the life of PF-4 and delay a replacement cost of many billions well into the future. As Director, I am doing everything possible to ensure that we maximize the life of PF-4, and I have proposed to NNSA a series of multi-year investments for the facility while simultaneously developing strategies to drive efficiencies as we safely execute work. Timely completion of the Analysis of Alternatives is necessary to meet our pit production goals at the end of the next decade—a target that will be challenging under the best of circumstances. We have no room for error.

Hurdles to Efficient Execution of Infrastructure Projects

The Committee has asked that I provide some specific suggestions to address hurdles that we face in infrastructure projects.

I believe that pre-project analyses and reviews, while certainly important, could be streamlined and done in a more timely fashion. It is also critical that operational and safety decisions, made during the planning phase of a project, remain unchanged once the project is completed and operation begins. Once a project has been

completed, debates (particularly those based on local interpretation of regulations) can lead to delays in starting operations and add unanticipated costs.

The laboratories and plants have used General Plant Projects (GPP) as a very efficient way to address modest-scale infrastructure needs. Efficiency is achieved by matching the level of review and project formality to the complexity of the project. For more than eight years, these projects have been capped at $10M. One way to reduce hurdles would be to raise the GPP limit to $30M, and index the limit to inflation. This is a proposal that shares the strong support of my colleagues at Livermore and Sandia.

Another barrier that could be eliminated is the current policy requiring each site to dispose of an unneeded facility (of the same type) during the same fiscal year as new space is built[1]. The unintended consequence of this policy is that sites are forced to sub-optimize and hang on to old, unneeded facilities (with the accompanying risk that comes with them) while working through the planning for a replacement facility, rather than disposing of obsolete, unneeded facilities as soon as is safe and practical.

For smaller, low-hazard acquisitions (such as light laboratory and office space), innovative acquisition processes can be enhanced and streamlined. I believe there are additional opportunities for the enterprise to creatively provide infrastructure through third-party financing (TPF) arrangements, and public/private partnerships. As I noted during my testimony last fall, the Administrative Support Complex (ASC) at Pantex is a precedent that illustrates effective use of third-party financing.

Finally, leased properties are a cost-effective solution for a site's portfolio. While we understand that the government wants to limit this approach to only what is needed, multiple reviews and time-consuming transactions are currently required to renew existing leases and pursue new, cost-effective leases. Sites should be allowed to manage their facility portfolios in the most cost-effective, streamlined manner, and provide the government with performance, rather than the extensive, transactional process currently in place.

If the objective is that the NNSA enterprise executes its mission effectively for the nation, some of this unnecessary bureaucracy should be eliminated or streamlined.

Managing Risk

Risk is inherent to laboratory and plant operations. A short and necessarily incomplete list of risks includes programmatic, safety, security, nuclear, financial, and project risks. I applaud the growing trend within the government and the Department of explicitly discussing and managing these risks. However, making

[1] National Strategy for the Efficient Use of Real Property, OMB, Spring 2015; DOE Real Property Efficiency Plan, November 2016; DOE Order 430.1c

changes in this area is a daunting task. Past practice has led government managers to attempt to minimize risks within their domains of responsibility. This leads to an improper balance of risk elements between projects, program, and operations across a site, and oftentimes we observe that minimizing one risk results in the emergence of others. Thus, an organization responsible for safety may attempt to minimize accidents without regard to programmatic costs, or a project manager may work to meet project costs without regard for the security consequences. These forces can easily lead to bizarre and costly results (for example wanting to put an engineered fire suppression system on an electric forklift when a colleague standing by with a fire extinguisher would be adequate). Furthermore, balancing the many components of risk, rather than attempting to minimize each individually, is a much more complex task for the department, its plants, and laboratories. It is inevitable that occasionally, risk will become reality. If we are to avoid regression to managing the components of risk in a fragmented rather than an integrated fashion, we must all respond by learning, correcting, and moving on. Sophisticated and mature management of risk may well be the most important hurdle Congress can address to improve efficiency**.**

Closing

In closing, I want to thank the Subcommittee again for its continued interest in the infrastructure that plays such an essential role in our nation's security. Should Congress provide additional funding to accomplish the NNSA mission, such funding could help to make necessary progress toward providing the infrastructure to support strategic deterrence in a time of uncertainty.