

Arms Control and International Security Papers

Volume I | Number 18

September 9, 2020

Deterrence and the U.S. Nuclear Weapons Infrastructure

by Christopher A. Ford



The Arms Control and International Security Papers are produced by the Office of the Under Secretary of State for Arms Control and International Security in order to make U.S. State Department policy analysis available in an electronically-accessible format compatible with “social distancing” during the COVID-19 crisis.

Deterrence and the U.S. Nuclear Weapons Infrastructure

by Christopher A. Ford¹

This latest addition to the Arms Control and International Security paper series — prepared by Under Secretary of Energy and National Nuclear Security Administration Administrator Lisa Gordon-Hagerty and with an introduction by Assistant Secretary Ford — offers a perspective upon the United States’ nuclear deterrent needs and what NNSA is doing to meet them.

Introduction: Infrastructure as Deterrent

We are pleased to publish below a paper by Administrator [Lisa Gordon-Hagerty](#) of the U.S. [National Nuclear Security Administration](#) (NNSA) on the importance of the U.S. nuclear weapons production infrastructure. It is of surpassing importance that we not forget these points, though in the past U.S. leaders seem too often to have done so.

U.S. officials and policy elites have often debated exactly how many and what sorts of nuclear weapons and delivery systems are needed, but our defense planners have long understood the importance of maintaining a robust nuclear force in order to deter aggression against us or our allies. During the many decades that this has been a key point of emphasis in U.S. strategy, it has also been a commonplace understanding that such deterrence hinges upon the possession of actual nuclear weapons.

The importance of having nuclear weapons in hand and signaling this possession to others has long been accepted as a critical part of nuclear strategy, both for

deterrence and — in the practice of militarized authoritarian regimes — for purposes of saber-rattling and coercive nuclear intimidation. (Who can forget, for instance, all those parades of missiles on Red Square during the Cold War, or the threatening spectacle the Chinese Communist Party tried to conjure on international television with the [giant parade of missiles organized in Beijing in October 2019 to celebrate the 70th anniversary of the Party’s seizure of power in China?](#)) It is also well understood that a completely secret nuclear capability deters no one, as reflected in Dr. Strangelove’s famous quip in Stanley Kubrick’s eponymous dark comedy satirizing the Cold War arms race: “The whole point of the Doomsday Machine is lost if you keep it a secret!” So actually having, and being understood to have, nuclear weapons has essentially always been part of the nuclear deterrent equation.

Less well understood, however — or at least not always remembered — is that what lies behind the actual possession of nuclear weapons is also a critical part of

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deterrence: the infrastructure that has produced these weapons, that can maintain and replace them as and when needed, and that can develop new capabilities, if needed, in order to maintain deterrence as the security environment changes. Such infrastructure is not merely associated with the maintenance of nuclear deterrence; it also directly provides much deterrent effect itself.

By way of example, remember that Ukraine, Kazakhstan, and Belarus ended up with thousands of nuclear weapons and delivery systems on their soil after the collapse of the USSR. Assuming that these newly sovereign states had the capability to launch those weapons, one might presume these assets to have given them a formidable nuclear deterrent capability, at least initially. Yet it was also the case that these countries had not inherited elements of the Soviet nuclear weapons infrastructure that would have permitted them to maintain these weapons over time, much less to replace and modernize them upon their eventual obsolescence. Over the years, therefore, it was clear that these capabilities would degrade in terms of their safety and operational reliability, ultimately becoming unusable for lack of the infrastructure needed for their upkeep. This was, no doubt, one of the factors that helped make these countries willing to dismantle these inherited systems, with all three countries eventually eliminating all of them and joining the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) as non-nuclear-weapon states. (Another factor, of course — at least in the case of Ukraine — was the commitment to Ukraine’s territorial integrity given by Russia in the [Budapest Memorandum of 1994](#), the fate of which tragically suggests important lessons about the relative value of Russia’s promises.)

This helps highlight an important lesson: weapons without an adequate supporting infrastructure cannot provide deterrence for long. Some of this thinking also seems to have been behind the disarmament community’s support for the Comprehensive Test Ban Treaty (CTBT) in the 1990s. At that time, it was feared that nuclear weapons — and particularly the extraordinarily sophisticated designs that had come out of the U.S. weapons laboratories late in the Cold War — might become unreliable, for purposes of sophisticated deterrent planning and contingency warfighting scenarios, without a continuation of actual explosive testing. Some disarmament advocates clearly hoped to use the CTBT’s prohibition upon such testing as a tool of “disarmament by stealth,” expecting that in a no-testing environment,

existing nuclear arsenals would over time simply wither on the vine, essentially atrophying in place until they eventually became unusable. The degree to which modern stockpile stewardship has reduced this danger, and has (so far) allowed the major powers to retain viable nuclear arsenals, attests to the “heroic science” that has gone into the improvement of weapon diagnostics and simulation capabilities since the 1990s. It also illustrates the critical role of infrastructure in maintaining deterrence.

This is a point that many observers tend to forget in assessing nuclear strategy. Having a robust and effective nuclear weapons infrastructure is vital if one is to maintain any meaningful deterrence over time, and it is also of enormous importance in deterring “breakout” from arms control agreements and in avoiding the dangerous spiral of an unconstrained nuclear arms race. Your adversary, for instance, does not need to know only that your existing weapons will ensure that aggression would exact from him an entirely unacceptable cost. That adversary *also* needs to know that you can keep him in this position of being deterred for as long as you need to, regardless of what he does. And this is the role of the nuclear weapons development and production infrastructure: a robust infrastructure tells the adversary that he cannot out-build and overwhelm you in an arms race. Maintaining such an infrastructure thus contributes both to baseline deterrence and to preventing treaty “breakout” and arms racing.

The importance of a robust nuclear infrastructure may not be as intuitively obvious as the importance of maintaining a viable arsenal of “weapons in being,” but it has been critical from the very dawn of the nuclear age. It made an enormous difference, for instance, whether the United States remained dependent for its production of nuclear weaponry exclusively upon enriched uranium produced by the Manhattan Project’s [Y-12 electromagnetic and K-25 gaseous diffusion production plants](#) at Oak Ridge, Tennessee, or whether it could also turn to plutonium produced at the [water-cooled production reactors at Hanford](#), Washington. As Thomas Reed and Danny Stillman pointed out in their classic study *The Nuclear Express*, with the technology of the day, uranium enrichment was slow and expensive, whereas production reactors such as the ones at Hanford could “[churn out plutonium at a prodigious rate](#).” The availability of this second material pathway had tremendous implications for the United States’ ability to

produce additional weapons if it needed to do so, and this would have been clear to knowledgeable observers at the time.

Infrastructure can be so important to nuclear deterrence, in fact, that some have suggested the possibility that one could have “nuclear deterrence” without even having weapons at all. Jonathan Schell’s 1984 book *The Abolition*, for instance, took this position, which was also suggested by Michael Mazarr in his 1997 work on “virtual nuclear arsenals.” In some such conceptions, it was felt that it might be possible to dismantle all the world’s nuclear weapons, while still relying upon nuclear deterrence to prevent large-scale conflict, on the theory that if former possessors retained the ability to reconstitute their arsenals on short notice, would-be aggressors would be dissuaded by the prospect of their victims’ rapid nuclear re-weaponization. Taking inspiration from the insight that a nuclear weapons production infrastructure itself provides a degree of deterrence, such thinkers hypothesized that it might be possible to rely *exclusively* upon infrastructure-based deterrence, in the absence of nuclear weapons themselves.

In fact, such entirely “weaponless” deterrence would likely be highly undesirable, producing terribly destabilizing dynamics not merely by giving countries powerful incentives in time of crisis to race each other to reconstitute nuclear arsenals, but also actually giving the first reconstituted possessor strong reasons to use nuclear weapons preemptively, before the other side got them too. Ironically, therefore, such crisis instability and nuclear use incentives might well make a world of “weaponless” deterrence more likely to result in nuclear war than today’s world. (Not for nothing, for instance, did the great nuclear deterrence theorist Thomas Schelling describe a world free of nuclear weapons but capable of easily rebuilding nuclear weapons as hopelessly unstable: “Every crisis would be a nuclear crisis, any war could become a nuclear war. The urge to preempt would dominate; whoever gets the first few weapons will coerce or preempt.”²)

Nevertheless, even though truly “weaponless” deterrence would not work, it remains true that infrastructure does contribute to deterrence in important

ways. Since at least the days of the Nuclear Posture Review of 2002, for instance, it has been part of U.S. nuclear weapons policy to acquire what is called a “responsive” nuclear weapons production infrastructure — that is, one capable not merely of indefinitely maintaining the viability of whatever the current U.S. arsenal might happen to be, but also of meeting whatever future deterrent needs might arise if the security environment deteriorates.

This longstanding emphasis in U.S. nuclear policy represents an acknowledgement not just of the importance of infrastructure in baseline deterrence, but also of its importance in deterring arms race behavior (or treaty “breakout”) by nuclear adversaries by making sure that they know the U.S. infrastructure can produce what we need in response to any future threats they might present. Having a “responsive” infrastructure also has the benefit of allowing the United States to field a smaller nuclear force than it would otherwise have to maintain. (If we were unable to build more weapons in response to expanding future threats, we might have to keep larger numbers of them on hand today, as a hedge against such potential future needs.)

Building and maintaining a responsive nuclear weapons infrastructure — capable of meeting present needs but also prepared to meet future ones if threats expand — must therefore be seen as a critical aspect of nuclear deterrence. In theory, U.S. nuclear planning has long recognized this. In practice, however, prior U.S. administrations, and Congresses, have too often dropped the ball.

To be sure, there has long been bipartisan support for the more intuitively obvious steps of continuing to maintain existing U.S. weapons and delivery systems and modernizing them as needed in order to avoid block obsolescence. There has also long been political support for the “heroic science” of U.S. nuclear stockpile stewardship — a cause which has managed to win support from both the Left and Right because such capabilities are both essential to maintaining deterrence in a no-testing environment and essential to maintaining the viability of that no-testing environment. And all of this is a very good thing.

² Thomas C. Schelling, “A World Without Nuclear Weapons?” *Daedalus* (Fall 2009), at 124, 125-26.

As Administrator Gordon-Hagerty makes clear below, however, despite the outstanding caliber of our nuclear weapons establishment, much of its physical infrastructure has been neglected, and has been permitted to fall into a notably dilapidated state. As she recounts, over half of NNSA facilities are now more than 40 years old, and about a third actually date back to the Manhattan Project itself.

The current Administration is working to turn this around, not least with a Fiscal Year 2021 Weapons Activities budget request that represents more than a 25 percent increase above the enacted FY20 level. There is much work still to do as we climb out of the hole dug by prior administration budgets and Congressional appropriations. As we noted in the 2018 Nuclear Posture Review, “[t]he current threat environment and future uncertainties now necessitate a national commitment to maintain modern and effective nuclear forces, as well as the infrastructure needed to support them.” We are committed to ensuring that the United States’ deterrent

will be able to continue to rely upon a robust and effective nuclear infrastructure for many years to come.

For that reason, the ACIS Papers series is pleased to publish Administrator Gordon-Hagerty’s paper in order to draw attention to these challenges and the urgent need to meet them. We hope readers will take these lessons to heart, and that the U.S. policy community will remain strongly committed to healing our infrastructure.

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Deterrence and the U.S. Nuclear Weapons Infrastructure

by

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The United States today faces nuclear weapons threats from its great power competitors — the Russian Federation and the People’s Republic of China (PRC) — of a sort that it has not faced since the Cold War. Responding to the challenges of great power competition is a central feature of the [2017 National Security Strategy](#), the [2018 Nuclear Posture Review](#), and the [2018 National Defense Strategy](#). In meeting these challenges, the National Nuclear Security Administration (NNSA) has a critical role to play. This paper thus explores the challenge, and how NNSA is helping keep the American people safe and secure in response.

I. The Nuclear Deterrent and U.S. National Security

Before anyone had ever heard of COVID-19, the United States was clearly already facing an increasingly dynamic and dangerous international environment. As Russia’s strategic forces are undergoing a comprehensive modernization, it is also pursuing novel nuclear weapons not covered by New START, and developing and deploying new nuclear warheads and launchers. These efforts include upgrades for every leg of the Russian nuclear triad of strategic bombers, sea-based missiles, and land-based missiles, including recently deployed ones armed with a hypersonic glide vehicle. Russia is also developing three new intercontinental range systems, the Sarmat heavy ICBM, an intercontinental, nuclear-armed, nuclear-powered, undersea autonomous torpedo and a nuclear-armed, nuclear-powered cruise missile.

China continues to increase the number and capabilities of its nuclear force. Moreover, its lack of transparency regarding the scope and scale of its nuclear modernization program raises questions regarding its future intent. China has developed a new road-mobile strategic intercontinental ballistic missile (ICBM), a new multi-warhead version of its DF-5 silo-based ICBM, and its

most advanced ballistic missile submarine armed with new submarine-launched ballistic missiles (SLBM). Chinese state media have also indicated efforts are underway to develop a new nuclear-capable strategic stealth bomber, which will give China a nuclear triad, though Beijing has not formally acknowledged such a pursuit. It has also deployed a nuclear-capable precision guided DF-26 intermediate-range ballistic missile capable of attacking land and naval targets and is also reportedly developing new low-yield nuclear weapons.

Amidst ongoing tensions in the Middle East, Iran has continued to increase its stockpiles of enriched uranium in defiance of its commitments it made in the 2015 Joint Comprehensive Plan of Action (JCPOA). On Friday, June 19, 2020, the International Atomic Energy Agency’s Board of Governors adopted a resolution calling on Iran to provide prompt access to two undeclared locations where the IAEA has questions about potential undeclared nuclear materials and activities. Iran has also retained a vast archive of documents and materials related to its past nuclear weapons program, raising questions about whether it intended to preserve the option to resume such a program at some point in the future. Iran’s development of increasingly long-range ballistic missile capabilities and activities to destabilize neighboring governments has continued apace since the JCPOA was concluded. And in East Asia, North Korea remains a major concern, exemplified by its continuing pursuit of UN-prohibited nuclear weapons and missile capabilities.

It is not just the threat of great powers increasing their stockpiles or regional adversaries crossing the nuclear threshold that is troubling. Worse, these states have made clear that nuclear weapons will be a vital element of their statecraft that threaten U.S. interests around the world. Russia believes that limited nuclear first use in extremis – to potentially include low-yield weapons – is important to its defense and it maintains a greater number and variety

of non-strategic nuclear systems to dissuade further escalation in a crisis or conflict.

So what is the United States to do in the face of these threats?

In his last major address before the House of Commons in March 1955 Winston Churchill noted:

“Unless a trustworthy and universal agreement upon disarmament, conventional and nuclear alike, can be reached and an effective system of inspection is established and is actually working, there is only one sane policy for the free world . . . that is what we call defence through deterrents. This we have already adopted and proclaimed. These deterrents may at any time become the parents of disarmament, provided that they deter. To make our contribution to the deterrent we must ourselves possess the most up-to-date nuclear weapons, and the means of delivering them.”

Indeed, as the world celebrated the 30th anniversary of the Cold War’s end last year, we were reminded – or should have been reminded – of the important role nuclear deterrence played in keeping what historian John Lewis Gaddis called “The Long Peace” for over four decades. A credible U.S. nuclear deterrent supported American diplomacy, crisis management, and the resolution of international disputes throughout the Cold War, to include crises such as the Taiwan Straits crises in the 1950s, the 1962 Cuban Missile Crisis, and the Yom Kippur War in 1973.

Although today’s challenges are more multifaceted, Churchill’s words still hold true. For amidst this international turmoil, the effectiveness and credibility of America’s nuclear weapons capability reassures our friends and allies and serves as the ultimate deterrent against a nuclear attack by those who wish to harm us. Although nuclear weapons do not deter every threat in the world, they do deter the very worst threats and underpin every other aspect of our national security.

II. How the NNSA Maintains America’s Nuclear Deterrent

In the face of these growing foreign nuclear threats, the [2018 Nuclear Posture Review](#) (NPR) committed the

United States to maintaining a nuclear posture that is “second-to-none” by modernizing and recapitalizing all three legs of the nuclear triad. In order to meet this objective, the National Nuclear Security Administration must achieve three vital, overarching tasks:

1. We must maintain confidence in our knowledge of the state of the current nuclear weapons stockpile.

Our nuclear weapons stockpile is safe, secure, and effective, but careful planning and action is necessary to maintain these systems at these standards. As the stockpile continues to age, certification becomes an increasingly difficult task as nuclear weapons systems continue to evolve beyond the conditions under which they were designed and tested. We know plutonium ages, but there is no established observable precedent for when Pu-239 will age its way to failure. By 2030, the average age of the plutonium pits within these warheads will be 50 years old. Although we have reason to be confident in plutonium’s stability through 80 years, we know that not all pits are created equal, and that increased time in service is accompanied by an increased risk of deterioration and a decreasing confidence in the warhead’s safety and reliability.

To support the NPR, the U.S. Department of Defense (DoD) has determined a requirement for NNSA to be capable of producing no fewer than 80 plutonium pits per year. Based upon an analysis of alternatives, an engineering assessment, and a workforce analysis conducted by both internal and external experts, in 2018 the Nuclear Weapons Council endorsed NNSA’s recommendation to pursue a two-site approach that meets pit production requirements while managing the risks and costs associated with increasing production rates. Los Alamos National Laboratory’s will produce 30 war reserve pits per year beginning in 2026, and the Savannah River Site will produce 50 pits per year starting in 2030.

Additionally, as noted in a 2012 National Academies of Science study, “[a]ging and remanufacture of components will also require an improvement to the scientific underpinnings of stockpile stewardship.” Thus, it is critical for America to maintain the scientific, engineering, and technical expertise necessary to maintain our nuclear weapons stockpile, and starting now allows us to

complete work while scientists and engineers with knowledge of pit production are still in place. Nuclear weapons entail a large set of specialties and sciences to work, and integrated teams from multiple disciplines need to be able to work together to successfully produce a nuclear warhead. For additional perspective, this same expertise is also critical to NNSA's defense nuclear nonproliferation programs that underpin U.S. arms control initiatives and international efforts to safeguard nuclear materials and prevent nuclear smuggling.

NNSA is also working to modernize the tools used to certify the existing nuclear weapons stockpile by using high performance computing and artificial intelligence. In 2022, our first exascale supercomputer, "El Capitan," is slated to be delivered at Lawrence Livermore National Laboratory. El Capitan will achieve a sustained performance of more than 1.5 exaFLOPS, or 1.5 quintillion calculations per second, a 10-fold improvement over today's most advanced computing capabilities. This capability will enable researchers from both of NNSA's nuclear weapons design laboratories – Livermore and Los Alamos – to run 3D simulations and calculations at resolutions that are difficult, time-consuming, or even impossible using today's state-of-the-art computers.

2. *We must carry out warhead acquisitions in order to meet America's deterrent requirements as determined by the Department of Defense.*

We continue to execute multiple modernization programs to address aging, unavailability of replacement parts, and integration with DoD's modernized nuclear weapons delivery systems. In Fiscal Year 2021, if authorized and approved, NNSA will conduct five weapons modernization programs. These include:

- Two Life Extension Programs (LEPs) to refurbish warheads to extend the service life of weapons by 20-to-30 years while increasing safety and security: the B61-12 gravity bomb for the U.S. Air Force, and the W80-4 for use in the U.S. Air Force's new Long Range Standoff (LRSO) cruise missile;
- The modification of the W87-1, which will replace the legacy W78 and support the Air Force's Ground Based Strategic Deterrent;

- One major alteration, the W88 Alt 370, for the U.S. Navy's Trident II D5 submarine launched ballistic missile (SLBM); and
- Pending congressional authorization, W93, a SLBM warhead based upon currently deployed and previously tested nuclear designs, necessary for the gradual transition to a smaller SLBM force aligned with *Columbia*-class ballistic missile submarines.

These warhead modernizations enhance the margin against failure, increase safety, improve security, replace limited life components, address component obsolescence, and support DoD delivery platform modernization.

What these modernization programs do not do is equally important. For example, we are not trying to match Russia's large arsenal of non-strategic nuclear weapons on a weapon-for-weapon basis. Instead, we are pursuing a qualitative and comprehensive approach towards maintaining a viable deterrent for the future at a time of rising threats. Indeed, this modernization strategy is not solely aimed towards meeting near-term threats the United States may encounter over the next three to five years, but rather attempts also to look forward in terms of decades to hedge against risk and prudently plan for future contingencies.

3. *We must provide nuclear propulsion for the U.S. Navy's fleet of aircraft carriers and submarines.*

The Navy's ballistic submarine force is the most survivable leg of our nuclear triad, guaranteeing a second-strike capability and contributing to deterring potential adversaries from attempting a preemptive nuclear strike against U.S. and allied and partner targets. This level of survivability and ultimate deterrent is only possible due to the ability of our nuclear-powered submarines to operate undetected anywhere in the world's oceans. Moreover, because the Navy's nuclear fleet accounts for over 40 percent of its major combatant vessels, these nuclear propulsion systems enable it to maintain its "forward presence." This important mission strengthens international stability by demonstrating U.S. commitment to allies and, if necessary, provides a rapid response capability in times of crisis. Both of these missions bolster the credibility necessary for deterrent threats to be

effective. Indeed, since the *USS Nautilus* was first put to sea in 1955, the Nuclear Navy has logged over 7,200 reactor years of accident-free operations and travelled over 167 million miles on nuclear energy, enough to circle the earth 6,700 times.

III. Return to Great Power Competition

Just as Rome was not built in a day, designing, building, and deploying the weapons that underpin our Nation's nuclear deterrent takes time. From the moment policymakers decide to replace a warhead to the day it is deployed can take a decade or more. Because of this long lead time, it is critical that we work to be prepared for unknown contingencies and requirements to ensure the safety, security, and effectiveness of the U.S. nuclear weapons stockpile. After the Cold War, America shifted its focus from great power competition to other emergent issues. Meanwhile, in an important and necessary effort to reduce the tensions and distrust that marked our relations with the former Soviet Union, we dramatically reduced our nuclear weapons stockpile. Few anticipated that the threat posed by other states' nuclear arsenals would be at its current level three decades later. Consequently, America's defense plutonium capabilities at the Rocky Flats Plant were shuttered in the early 1990s, and we de-inventoried Lawrence Livermore National Laboratory's plutonium facility in 2010. Further, we continued to delay addressing critical infrastructure requirements.

This two-decade de-prioritization of great power competition had a deleterious effect on the Nuclear Security Enterprise's unique defense industrial base. To begin with, the stringent regulatory requirements necessary for nuclear safety limit the number of private sector businesses that can perform the technical work supporting our nuclear deterrent. Moreover, because it would be a significant security risk to have multiple entities capable of making nuclear weapons, we cannot go to the "open market" for nuclear components and must serve as our own defense-industrial base. Consequently, the lack of foresight following the Cold War's end meant that this unique defense industrial complex essentially ceased to exist as the few private sector companies from which we could procure materials either went out of business or moved on to other opportunities. Whereas the Enterprise previously had four vendors who supplied high-explosives, for example, there is now only one, which

creates the risk of a dangerous, single point of failure in our supply chain.

Equally troubling, we also reduced investments in modernizing and developing the Enterprise's infrastructure. As a result, over half of NNSA facilities are more than 40 years old, and roughly one-third date back to the Manhattan Project. Although people can reasonably disagree about "how many" nuclear weapons are sufficient for maintaining deterrence, so long as we retain even *one* warhead in our arsenal, we must have the infrastructure and technology to produce and maintain it safely and securely. This fact remains true whether Russia or China build one or 1,000 nuclear weapons per year. Despite the need for state-of-the-art facilities, in many places, our facilities have exceeded their useful life and the reliability to keep our deterrent strong. Thirty-two percent of our total NNSA infrastructure assets have been determined insufficient to meet mission needs, including 91 percent of lithium-related infrastructure, 53 percent of plutonium-related infrastructure, and 40 percent of high explosives-related infrastructure — all of which are critical materials for nuclear weapons. NNSA's partner laboratories, plants, and sites are doing spectacular work to keep these sites operating, but many activities are being conducted on borrowed time.

The 2018 NPR stated: "There is now no margin for further delay in recapitalizing the physical infrastructure needed to produce strategic materials and components for U.S. nuclear weapons." In addition to strategic materials facilities, this infrastructure includes laboratories, manufacturing plants, and material production sites across the country spanning 2,000 miles of roads, 2,100 square miles of land, and 36 million square feet of facility space that our workforce needs to fulfill its national security mission.

As important as state-of-the-art facilities are, moreover, they mean nothing without the right people. The effectiveness and credibility of our nuclear deterrent is directly supported by our scientific, engineering, and technological capabilities — or, more precisely, by the work performed every day by the 50,000 scientists, engineers, chemists, managers, technicians, and support staff that comprise the Nuclear Security Enterprise's workforce. Yet, even as the demanding global security environment noted above illustrates that we are facing our heaviest workload in decades, more than one-third of our workforce will be eligible for retirement over the next five

years. As with infrastructure modernization, the window of opportunity we have for regenerating this critical asset is closing. As weapons designers with nuclear test experience retire, it is important to enable them to mentor and empower the next generation of stockpile stewards.

IV. Moving Forward Under President Trump

Despite these challenges, there is cause for optimism that America can reinvigorate our nuclear deterrent for generations to come. The President and Congress now recognize that our aging nuclear weapons means there is no longer any margin to delay the Nuclear Security Enterprise's recapitalization. As of July 1, the House and Senate Armed Services Committees authorized our FY 2021 Weapons Activities budget request, which represents a 25.2 percent increase above the FY2020 enacted level. This will enable NNSA to meet the Trump Administration's goal of modernizing America's nuclear weapons stockpile and infrastructure, and meet national security requirements after decades of neglect. This funding will enable us to continue to recapitalize aging infrastructure. Projects such as the Uranium and Lithium Processing Facilities at Y-12, the Nevada National Security Site's U1a Complex Enhancements Project, the High Explosive Science and Engineering Facility at Pantex, and the proposed Savannah River Plutonium Processing Facility will repair, replace, and modernize critical materials facilities vital to the warhead design and production that will underpin our nuclear deterrent capability for decades to come.

While much has been said about NNSA's poor record of delivering major construction projects on budget and on schedule, various Government Accountability Office (GAO) and congressional reports identified the root causes behind a series of poor project outcomes. NNSA took these challenges seriously, and across three administrations committed to implementing solutions to address these root causes. NNSA recognized the need for a strong, integrated management team comprised of experienced professionals and experts in acquisition, design, and construction contract management to implement best practices and improve overall performance in this critical area. Consequently, the Office of Acquisition and Project Management (APM) was established in 2011 to improve NNSA's contract and project management performance and capital project delivery. Since then, NNSA has completed 23 major construction projects in seven states

with an overall value of \$2.0 billion on time, and under budget. Recognizing this progress, in March 2019 the GAO reported to Congress that "NNSA has enhanced its capability to estimate costs and schedules, and to assess alternatives for programs and projects" and has "made progress by implementing best practices in several areas, such as those for estimating costs and schedules in nuclear weapons refurbishment activities and capital asset acquisitions."

While there is more to be done, this is an extraordinary accomplishment given the size and unique challenges associated with NNSA infrastructure projects. The cliché "good enough for government work" obviously cannot apply to the Nuclear Security Enterprise. Consequently, the stringent regulatory requirements necessary for nuclear safety makes the construction overseen by APM the most complex work of any entity in either the private or public sectors. NNSA's laboratories and plants are Government-owned, contractor-operated facilities. This special relationship is driven in large part by safety, security and national defense concerns, where there is no commercial industrial base. As a result, it is NNSA's responsibility to identify the requirements for and fund the infrastructure necessary to maintain the nation's nuclear deterrent. This is why we often must serve as our own industrial base for nuclear-related facilities and products.

In a similar fashion, because recruiting and retaining the next generation of highly-skilled scientists and engineers is vital to our national security, NNSA is pursuing an aggressive hiring strategy with a goal of adding an estimated 4,000 – 6,000 employees annually across the National Security Enterprise. To meet this goal, we are breaking the paradigm of traditional government hiring practices to reflect a more corporate approach, working enterprise-wide. In 2019 we held two job fairs in Washington, D.C., and hosted eight "Nuclear Security Enterprise Days" at universities across the country as part of a nationwide, integrated initiative with our Management and Operations partners to recruit the next generation of nuclear security experts. Partly as a result of this new approach, NNSA's laboratories, plants, and sites hired nearly 7,000 employees in FY 2019. We have even continued this effort through the COVID-19 pandemic by taking part in and hosting two "virtual" job fairs, including one specifically tailored for America's military service academies. And to further help develop, train, and recruit the Enterprise's workforce of the future, last year NNSA

funded over \$100 million in grants and cooperative agreements with top universities across the country.

As part of these efforts, we have also significantly increased our outreach to, funding for, and partnerships with Minority Servicing Institutions (MSI), such as Historically Black Colleges and Universities and Hispanic Serving Institutions. The Minority Servicing Institutions Partnership Program (MSIPP) is designed to build a sustainable science, technology, engineering, and math — or STEM — pipeline that prepares a diverse workforce of world class talent through strategic partnerships between MSI and the Nuclear Security Enterprise. MSIPP aligns investments in university capacity and workforce development with NNSA mission areas to cultivate a technical workforce and to enhance research and education capabilities at those institutions. MSIPP supports 10 consortia consisting of 38 MSI partners as well as NNSA laboratories, production plants, and sites.

The Nuclear Security Enterprise’s primary function is the application of science to our national security missions, and nothing is more crucial to scientific inquiry than the ability to challenge assumptions. Just as the Manhattan Project included scientists and engineers from a variety of national origins and both sexes, working side-by-side with colleagues of different colors and creeds exposes us to experiences and perspectives that challenge our own outlooks not only on scientific and professional matters, but on the larger world. Diversity is a force multiplier, and NNSA espouses those very ideals. I believe that NNSA is moving in the right direction on diversity. In 2019 we doubled the number of minority hires over the past year, funding the academic costs for almost 200 minority students, and launched 10 new degree programs aligned with NNSA core capabilities. Additionally, the percentage of minorities in programs such as the NNSA Graduate Fellowship Program is on the rise. Although I can’t declare that we have reached an ideal state, we have seen indicators of progress.

As with our weapons modernization programs, these efforts are not merely a short-term expedient to address short-term problems, but represent a hiring strategy to ensure America has the scientific and technical expertise to manage our nuclear deterrent for the next 20 years and beyond.

V. Conclusion

Testifying before the Senate Armed Services Committee in February 2020, U.S. Strategic Command Commander Admiral Charles Richard declared:

“To maintain a credible deterrent in this environment requires us to modernize and recapitalize our strategic forces to ensure our Nation has the capability to deter any actor, at any level. Doing so requires we remain committed to modernizing and recapitalizing our strategic forces and supporting infrastructure.”

Modernizing and recapitalizing the nuclear triad is not a three-year, four-year, or a five-year endeavor, however. We need to think broadly, and to think strategically in order to mitigate against potential risks to our nuclear weapons stockpile and the vital deterrent capability it provides. Because of the long lead times involved in this work, it is imperative that the next generation of nuclear deterrence starts now.

Although there is still a great deal of work to be done, the Nuclear Security Enterprise has turned the corner. Whereas the past several years have been spent planning, we are now moving toward execution. Our timeline for modernizing the nuclear stockpile and recapitalizing the necessary infrastructure is aggressive – in some cases, we are asking our sites and partners to perform tasks in 10 years that would normally take 15 to 20 years. This has led some to question whether the Enterprise has the capacity to achieve the goals set out by us. While this schedule may be aggressive, however, it *is* achievable. Over the past two plus years as NNSA Administrator, I have seen firsthand the Nuclear Security Enterprise workforce’s passion and dedication, and what it can accomplish. I believe that people who are betting against us are betting against the ingenuity and dedication of the American workforce. Given stable resources and continued commitment by current and future Administrations and Congress, we will be successful in carrying out our unique and indispensable roles in supporting the United States’ strategic deterrent mission.



Arms Control and International Security Papers

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