THE INFLECTION POINT AND THE U.S. NUCLEAR SECURITY ENTERPRISE

BRAD ROBERTS AND WILLIAM TOBEY, CO-EDITORS

Center for Global Security Research Lawrence Livermore National Laboratory in partnership with the Office of National Security and International Studies Los Alamos National Laboratory

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Drew Walter is the deputy assistant secretary of defense for nuclear matters in the Office of the Under Secretary of Defense for Acquisition and Sustainment. He is responsible for carrying out the Office of Nuclear Matters mission "to ensure the continued credibility, effectiveness, safety, and security of the U.S. deterrent in order to deter nuclear and non-nuclear attack; assure U.S. allies and partners; achieve U.S. objectives if deterrence fails; and hedge against an uncertain future." Nuclear Matters is the Department of Defense (DOD) focal point for a wide range of issues related to the U.S. nuclear weapons stockpile, nuclear counterterrorism, and nuclear counterproliferation.

Preface Brad Roberts and William Tobey

In releasing his National Security Strategy in October 2022, President Biden argued that "our world is at an inflection point. How we respond to the tremendous challenges and the unprecedented opportunities we face today will determine the direction of our world and impact the security and prosperity of the American people for decades to come."¹ In follow up, the Department of Defense issued an unclassified summary of its new National Defense Strategy, where Secretary of Defense Lloyd Austin argued that "business as usual at the Department is not acceptable" and directed the department to "act urgently to sustain and strengthen U.S. deterrence."² What do these judgments and decisions imply for the U.S. nuclear enterprise? What forms of business as usual are no longer acceptable? What does the U.S. nuclear enterprise have to contribute to sustaining and strengthening deterrence, urgently?

To address these questions, this Occasional Paper includes a selection of essays from people inside the Department of Energy's nuclear complex or close to it in the Department of Defense. Some focus on the eroding security environment and shifting national policy context, whereas others focus on the progress of the complex in coming to terms with new challenges and some of the opportunities ahead. Taken together, they provide a comprehensive view of an enterprise gripped by the need to transform but struggling with many challenges, both legacy and new.

Some of the essays included here are derivative of presentations originally delivered in Washington D.C. on April 27, 2023 to the symposium on Strategic Weapons in the 21st Century coorganized by Lawrence Livermore and Los Alamos National Laboratories (this was the 17th annual symposium). Our two laboratories agreed to collaborate on the preparation of this Occasional Paper with the hope that our combined effort will prove more informative to leadership and public deliberation than our separate efforts. The views expressed here are the personal views of the authors—except for those writing in an official capacity.

¹ National Security Strategy (October 2022), citation from the presidential cover letter.

^{2 2022} National Defense Strategy, U.S. Department of Defense (October 27, 2022). Quotation is from the secretary's cover letter.

Nuclear Deterrence and National Security in a Decisive Decade

Colin Kahl

Since the dawn of the atomic age, nuclear weapons have played a defining role in the international security environment—both as unique features of America's strategic deterrent and as sources of unthinkable danger that demand responsible stewardship and a vigorous commitment to diplomacy. As President Joe Biden has observed, we are in a "decisive decade" characterized by growing geopolitical competition as well as shared challenges that cross borders. Nuclear weapons are an important feature of this evolving security environment. Despite our best efforts to reduce the global salience of nuclear arsenals, potential adversaries continue to emphasize nuclear weapons in their military strategies while nuclear proliferation remains an enduring global challenge.

To meet these challenges, the United States is taking an integrated approach to sustaining and strengthening deterrence, as articulated in President Biden's National Security Strategy (NSS), the Department of Defense's National Defense Strategy (NDS), and Nuclear Posture Review (NPR).

America's nuclear weapons continue to play a unique role in defending the U.S. homeland, deterring strategic attacks, deterring aggression, and contributing to a resilient Joint Force. That's why the Department of Defense is advancing deterrence and strategic stability by pursuing a comprehensive and balanced nuclear strategy; maintaining and investing in flexible nuclear capabilities; and reinvigorating our alliances to advance extended deterrence and assurance.

Of course, deterrence alone will not reduce nuclear dangers. As Secretary of Defense Lloyd Austin has said, "Nuclear powers have a profound responsibility to avoid provocative behavior, and to lower the risk of proliferation, and to prevent escalation and nuclear war." During the Cold War, the United States and the Soviet Union were able to negotiate practical measures to reduce nuclear risks even when their relations were otherwise strained. Today, nuclear powers should recognize their continued obligation to enhance transparency and pursue mutual, verifiable agreements to mitigate nuclear risks.

Nuclear Weapons and the Security Environment

As outlined in the NSS, "the People's Republic of China (PRC) harbors the intention and, increasingly, the capacity to reshape the international order in favor of one that tilts the global playing field to its benefit." For this reason, the NDS describes the PRC as the Department's "pacing challenge"—the most comprehensive and serious challenge to U.S. national security.

A core and troubling part of that challenge is the PRC's significant and fastpaced expansion, modernization, and diversification of its nuclear arsenal. The PRC is expanding the number of its land, sea, and air-based nuclear delivery platforms and constructing the infrastructure to support this growth, including by increasing its capacity to produce and separate plutonium. The PRC is also rapidly establishing its silo-based, solid-fueled modernized ICBM force, which will eventually consist of over 300 total silos. The PRC's intercontinental-range nuclear forces are complemented by several theater-range, road-mobile ballistic missile systems. The PRC is also developing advanced nuclear delivery systems, such as a strategic hypersonic glide vehicle and a fractional orbital bombardment system potentially capable of delivering nuclear payloads. All told, the U.S. intelligence community assesses that if the PRC continues the current pace of its nuclear force expansion, it could field a nuclear arsenal of about 1,500 nuclear warheads by 2035. And the PRC is also taking steps that suggest it intends to increase the peacetime readiness of its forces by moving to a launch on warning posture.

While the ultimate aim of the PRC's nuclear expansion remains uncertain, the trajectory of these efforts indicates that it wants a large, diverse nuclear arsenal with a high degree of survivability, reliability, and effectiveness encased in an opaque nuclear posture. These capabilities, once developed, could provide the PRC with new options before and during a crisis or conflict to leverage nuclear weapons for coercive purposes, including through military provocations directed at the United States or our allies and partners in the region.

Even as the Department of Defense paces its efforts to the China challenge, the war in Ukraine continues to demonstrate that Russia cannot be ignored. As described in the NDS, Russia remains an acute threat. Unlike China, Russia is not capable of dominating the international system. But Russia's nuclear arsenal is capable of inflicting unimaginable destruction. Russia continues to field the largest and most diverse nuclear arsenal on the planet, even as it pursues a suite of novel and exotic nuclear systems. In addition, Russian military doctrine has enshrined a lower threshold for the use of nuclear weapons than other states—and that threshold may decline further as Russia's conventional forces continue to suffer attrition in Ukraine. We must therefore take seriously the challenge that Russia poses to our interests, transatlantic security, and the world.

Meanwhile, the nuclear activities of regional adversaries continue to threaten U.S. interests. North Korea continues to diversify and improve its nuclear and missile capabilities—short- and long-range ballistic, cruise, and potentially hypersonic. These activities present a growing danger to the U.S. homeland and to our allies and partners in the Indo-Pacific. And Iran's continued nuclear progress, in conjunction with its growing arsenal of missiles and other advanced conventional weapons, is another major concern.

Far from being a relic of the Cold War, nuclear weapons remain salient and relevant to international security. China and Russia's continued emphasis on nuclear weapons require the United States to sustain and strengthen deterrence while adapting to the new challenges of deterring two major nuclear powers at the same time. As a result of these dynamics, the United States must do everything it can do mitigate the risk of confrontation with or among nuclear powers.

Adapting U.S. Defense Strategy and Posture to a Changing Security Environment

The concept of integrated deterrence is a cornerstone of the NDS, providing a blueprint for how the Defense Department will sustain and strengthen deterrence across the board, with the PRC as the pacing challenge.

Three Approaches to Deterrence

Within the broad framework of integrated deterrence, the NDS identifies three basic approaches, all of which will be familiar to practitioners and scholars of deterrence.

First, the United States will deter by denial, especially where potential adversaries could act quickly to change facts on the ground in critical regions.

Second, the United States will deter by bolstering resilience, particularly to disrupt adversary strategies premised on early escalation in key domains, especially space and cyberspace. Both approaches reflect an understanding that U.S. competitors' and adversaries' theories of victory hinge on the ability to frustrate the informational and other networks that undergird the American way of war. An emphasis on denial and resilience can frustrate that theory by demonstrating that the United States cannot be blinded, deafened, or delayed in supporting our own interests and mounting a forward defense of our allies and partners.

Third, the NDS makes clear that the United States will deter by cost imposition, both directly and collectively. Direct cost imposition refers to the ability and willingness of the United States to unilaterally impose costs in excess of whatever benefits an adversary may perceive that it could gain from aggression. Collective cost imposition refers to our ability to marshal others to join us in coalitions—military, political, and economic—to shape an adversary's decision calculus. A clear example of collective cost imposition is the massive global coalition formed in support of Ukraine, which has provided security assistance to Ukraine while imposing devastating economic sanctions and export controls on Russia.

Understanding the Role of Nuclear Weapons

Because our nuclear capabilities do not exist in a vacuum, the NDS was fully integrated with the NPR and the Missile Defense Review. The result was a comprehensive, integrated approach to current security challenges.

All three reviews provide an assessment of the threat environment and the roles that different military capabilities play in potential adversaries' military doctrines and strategies and in our own strategy. For the NPR this meant developing a clear understanding of the role that nuclear weapons continue to play in our competitors' and adversaries' theories of victory. The NPR process highlighted the anticipated significant growth of China's nuclear forces and the increasing prominence that nuclear weapons might have in the PRC's overall strategy. Our reviews similarly recognized how Russia uses nuclear weapons and nuclear threats in its strategy for coercion and warfighting something that has been put on disturbing display as Russia has engaged in nuclear saber rattling in the Ukraine conflict. And the NPR acknowledged the continued role of nuclear weapons in North Korea's strategy and the need to remain vigilant against the prospect that Iran could seek nuclear weapons.

This hard look at the security environment clarified the appropriate role of nuclear weapons in our own theory of victory. The NDS and NPR process did not look at U.S. nuclear weapons in isolation, but instead considered American nuclear posture in the context of broader military capabilities and posture across all domains and across the spectrum of conflict.

The NPR underscores that nuclear weapons can impose unique costs on an adversary that cannot be replicated by any other instrument of national power. Given their unique effects, the NPR concluded that the fundamental role of nuclear weapons is to deter nuclear attack. But the review also affirmed a broader set of roles for nuclear weapons: nuclear weapons deter *all* forms of strategic attack, including nuclear employment of any kind as well as conventional attacks of high consequence that would have similarly devastating effects, while also assuring allies and partners and achieving U.S. objectives if deterrence fails.

Like other elements of American deterrence, U.S. nuclear strategy is rooted in credibly threatening to impose costs that far exceed any possible benefits of aggression. As Secretary Austin has observed, nuclear deterrence is the ultimate backstop to deter attacks on the homeland and our allies and partners who rely on U.S. extended deterrence commitments.

An Integrated Approach

At the same time, the NDS and NPR acknowledge that non-nuclear capabilities, including non-military capabilities, can also help the United States impose costs on adversaries and competitors, which complements the deterrent effects of nuclear weapons. For instance, our successful work to marshal the international community to impose political and economic costs on Russia—in addition to military ones—for its aggression in Ukraine show how the United States can build and sustain multilateral coalitions capable of holding accountable those who violate international norms. It seems clear that leaders in Beijing will consider the economic and political costs—in addition to the military costs—in deciding whether to attempt aggression across the Taiwan Strait, in the East China Sea, or the South China Sea.

In addition to actions taken directly by the United States, the NDS recognizes that collective responses could also present an adversary with significant costs and add complexity to their military planning, which can complement the deterrent effects of nuclear weapons. Strengthened interoperability with our closest allies and partners, for example, can contribute to deterrence by denial, resilience, and cost imposition through non-nuclear means. Working alongside the international community to define and enforce norms also contributes to cost imposition. The existence of clearly defined norms provides important focal points for generating cooperation and imposing collective costs when countries violate these shared principles. This is particularly true in the nuclear domain, where longstanding norms of responsible behavior work

alongside deterrence to prevent nuclear use. In other domains, such as cyberspace and outer space, norms are more nascent, but they will grow in importance in the years to come.

In summary, the NDS and NPR took a hard look at the role of nuclear weapons in the theories of victory of America's adversaries and competitors. The clear conclusion was that nuclear deterrence can and should play an important role in our own theory of victory, but must be utilized alongside the full range of our military and non-military capabilities and those of our allies and partners.

Strengthening Nuclear Deterrence

The Department of Defense is acting with urgency to strengthen deterrence and strategic stability in an environment defined by two major nuclear competitors, as well as other challengers pursuing nuclear capabilities.

We are reinforcing the longstanding tenets of U.S. nuclear strategy. This includes the recognition that, for the foreseeable future, nuclear weapons will continue to provide unique deterrent effects that no other element of U.S. military power can replicate. The NPR also acknowledges the need for flexibility in our deterrence strategy, noting as the security environment continues to evolve, changes in U.S. strategy and force posture may be necessary.

We are also maintaining and investing in flexible and credible nuclear capabilities that account for changes in the security environment. These capabilities are tailored to the threats, capabilities, and decision calculi of potential adversaries, thereby supporting the country-specific deterrence strategies identified in the NPR.

- China: The United States remains committed to a flexible deterrence strategy and posture that continues to clearly convey that the PRC's nuclear capabilities will not deter the United States from defending our allies and partners and cannot coerce us into terminating a conflict on unacceptable terms.
- Russia: We will deter both large-scale and limited attacks through a modern and resilient nuclear triad and flexible, tailorable capabilities that ensure Russia's leaders do not misunderstand the consequences of nuclear use on any scale against the United States or our allies.
- *North Korea:* Any nuclear use by the Kim regime would be unacceptable and would result in the end of that regime.
- Iran: Iran does not possess nuclear weapons. However, Iran's ongoing nuclear activities, which were previously constrained by the Joint Comprehensive Plan of Action (JCPOA), are deeply concerning because they could be applied to a future nuclear weapons program. It is U.S. policy that Iran will not be allowed to obtain a nuclear weapon. The United States relies on non-nuclear overmatch to deter regional aggression by Iran as long as Iran does not possess nuclear weapons,

and the Joint Force retains the ability to deny Iran a nuclear weapon.

To meet these nuclear threats, the president's budget calls for sustaining our current nuclear triad and the forces needed to provide flexibility and strengthen regional nuclear deterrence, while the NPR calls for full funding for the modernization and recapitalization of the nuclear triad. Our modernization program will recapitalize the three legs of the triad, but it will do much more than put a new coat of paint on old systems. We are investing in flexible, credible, and modern capabilities. These investments will give us confidence that we are fielding a safe, secure, and effective nuclear deterrent and strong extended deterrence well into the middle of this century.

First, to upgrade our ground-based deterrent, the Department of Defense is developing the Sentinel intercontinental ballistic missile (ICBM). Sentinel will replace the entire force of Minuteman III missiles, which are aging out and have been life-extended multiple times since their initial deployment in 1970. Sentinel will have increased capability, enhanced security, improved reliability, and lower sustainment costs compared to Minuteman III. These improvements will ensure that the ground leg of the triad has the adaptability and flexibility to address the changing environment through the 2070s.

Second, the Department is procuring the Columbia-class nuclear-powered ballistic missile submarine (SSBN), which will replace the current fleet of Ohio-class SSBNs as the most survivable leg of the triad. In keeping with the NPR, the Department is also funding the life extension of the Trident II submarine-launched ballistic missile (SLBM) to keep Trident in service alongside the Columbia-class submarine through the 2080s. The life extension work for Trident is also consistent with the department's commitment to support the United Kingdom's independent deterrent. We are also funding the Navy's development of the W93 warhead and the Mark 7 reentry system, which will similarly support the UK's warhead modernization efforts.

Third, to ensure the continued credibility of the air-based leg of the triad, the Department is sustaining the B-2 and B-52 bombers while funding development of the B-21 and the Long Range Stand Off cruise missile (LRSO), which will be equipped with the W80-4 warhead. The LRSO is needed to replace the air-launched cruise missile (ALCM) and to ensure that bombers can maintain a stand-off capability after the ALCM is retired. LRSO will also eventually be deliverable by the B-21. These programs will provide the president with flexible response options for deterrence and assurance. We are also working towards timely nuclear certification of the F-35, in support of NATO's nuclear deterrent.

Meanwhile, the Department strongly supports the efforts of the Department of Energy's National Nuclear Security Administration (NNSA) to develop a balanced, flexible stockpile capable of pacing threats, responding to uncertainty, and maintaining effectiveness. We strongly support NNSA's efforts to reestablish, repair, and modernize our production infrastructure and ensure that it has the capabilities and capacity to build and maintain modern nuclear weapons in a timely manner. As we work to modernize our nuclear enterprise, we are also reinvigorating our alliances and partnerships to continue to deepen extended deterrence. This includes assuring allies that they can rely on the U.S. nuclear umbrella for their defense, rather than potentially pursue their own nuclear capabilities, while also helping to enhance their conventional capabilities. The United States has stepped up the pace and depth of engagement with our both European and Indo-Pacific allies, engaging in frank discussions on how we will individually and collectively strengthen nuclear and conventional deterrence.

In the Indo-Pacific, we are building on the extended deterrence dialogues established over the last decade with the Republic of Korea (ROK), Japan, and Australia. Across the region, we are emphasizing the importance of integrating technological developments into alliance capabilities, which will support efforts to maintain our technological edge in critical and emerging technologies, such as high-power microwaves, autonomous systems, and counter-hypersonics. We are also expanding joint and shared use of facilities and maintaining flexible use of air and seaports to ensure the resiliency of defense assets and their operational effectiveness in a contingency. We are deepening cooperation on space capabilities to increase our resiliency, strengthen mission assurance, interoperability, operational cooperation, and domain awareness. And we will continue to pursue realistic training and exercises.

The Washington Declaration between the United States and the ROK, issued by Presidents Biden and Yoon in April 2023, deepens our two countries' extended deterrence relationship. The declaration sends "a firm message to the international community that the United States and the ROK will stand together in the face of any and all threats to their shared security, and continue their close consultations on further steps to strengthen extended deterrence." To reinforce these commitments, the United States is making its military assets more visible on the Korean Peninsula, including the first visit of a U.S. nuclear ballistic missile submarine to the ROK in over 40 years. We have also committed to deepening and expanding coordination between our militaries.

The Washington Declaration also describes our efforts to further strengthen our standing consultative bodies on extended deterrence, including the Extended Deterrence Strategy and Consultation Group, to bolster joint planning and improve our responses to potential attacks. The new Nuclear Consultative Group will further elevate our dialogue with the ROK on extended deterrence by coordinating joint exercises, posture, and planning.

Meanwhile, we are working with our Japanese allies to enhance our combined regional deterrence. We welcomed Tokyo's recent commitment to both double defense spending and develop counterstrike capabilities. And we are bolstering our conventional deterrent posture, including the recently announced deployment of a new Marine littoral regiment—our most capable Marine unit—on Okinawa. The increasing pace of trilateral U.S.-Japan-ROK activities in response to North Korean provocations further strengthens our shared commitment to deterring aggression.

We have also made historic progress in the U.S.-Australia alliance. In addition

to supporting major force posture initiatives in Australia, we recently announced, in partnership with our UK allies, our plan for Australia's acquisition of a conventionallyarmed, nuclear-powered submarine through the Australia-UK-U.S. security partnership (AUKUS). Australia's acquisition of conventionally-armed, nuclear-powered submarines is being done in a manner that sets the highest nonproliferation standard and strengthens the nuclear nonproliferation regime. From the beginning, we have worked closely with the International Atomic Energy Agency (IAEA) to develop an appropriate, robust suite of measures to provide confidence that Australia is upholding its nonproliferation obligations. In fact, AUKUS is only possible because of Australia's longstanding and demonstrated commitment to nuclear nonproliferation.

In Europe, we're working to ensure that NATO's deterrent capabilities remain adequate to meet evolving challenges, particularly the acute challenge posed by Russia. NATO's new Strategic Concept commits allies to taking all steps to ensure the credibility, effectiveness, safety, and security of NATO's nuclear deterrent. Accordingly, the United States is proceeding with the timely nuclear certification of the F-35, while NNSA is well into production of the B61-12 gravity bomb that the F-35 will carry in support of our NATO allies. We have also reenergized formal policy dialogues on nuclear issues, such as the NATO High Level Group (HLG), the senior advisory body to the Alliance Nuclear Planning Group (NPG). We welcome the increased pace of engagement and discussion within the NPG.

Finally, beyond our regional efforts, the Department is furthering integrated deterrence by honing new operational concepts, deploying cutting edge technologies, and investing in the capabilities required to make integrated deterrence real. The Fiscal Year 2024 presidential budget requests the Department's largest ever procurement and research and development budgets ever to help meet the pacing challenge presented by the PRC and the acute threat from Russia.

Conclusion

The security environment taking shape today is potentially as dangerous as it was in the early days of the Cold War. In the early 1950s, we faced a challenger with uncertain intentions and a growing nuclear arsenal. At that time, our allies looked to the United States for responsible leadership built on the twin pillars of a strong deterrent paired with an openness to dialogue.

Of course, there are also notable differences with the Cold War period. Today we face not one, but two, major nuclear powers—the PRC and Russia—as well as North Korea and other regional nuclear aspirants dissatisfied with the status quo and increasingly willing to challenge global security. In this emerging landscape, we must act urgently to sustain and strengthen our deterrent.

President Biden entered office with a goal of taking a smart and disciplined approach to national security. That is why we have embarked on a generational effort to modernize the U.S. nuclear triad and strengthen extended deterrence. It is also why we will continue to look for opportunities to enhance strategic stability through hard-nosed diplomacy, arms control, and other steps to reduce the risks of nuclear war, wherever feasible.

But these efforts cannot stop with the nuclear domain. Strengthening deterrence requires us to integrate the unique role played by nuclear weapons alongside cutting edge non-nuclear capabilities, our potent non-military toolkit, and the actions and investments made by our vast network of allies and partners. That is the vision embraced by our National Security Strategy and National Defense Strategy—and we must now turn to making that vision a reality.

From the "Unipolar Moment" to Multipolar Rivalry: Implications for the U.S. Nuclear Enterprise

Brad Roberts

Secretary Austin's call for a rejection of business as usual at the Department of Defense and for urgent measures to sustain and strengthen deterrence leaves open the question of what parallel efforts might be required of the Department of Energy. The answer begins with an understanding of how changes in the security environment are driving changes in the requirements of U.S. nuclear strategy. Toward that end, this chapter proceeds as follows. It begins with a review of the journey from 1991 to 2023 and of how changes in the security environment led to changes in the role of the enterprise. It then turns to a description of the key attributes of the new era in international affairs bearing on the missions of the enterprise. With this as a baseline, the chapter then identifies specific implications of each attribute.

The Journey from 1991 to 2023

Over the last three and a half decades, the security environment has evolved in many ways, with significant implications for the U.S. nuclear enterprise.³ On December 25, 1991, the Soviet Union dissolved and one chapter in international history came to a sharp and decisive close—and along with it a chapter in U.S. nuclear history. The next chapter came to be known as the "unipolar moment…..where world power resides in one reasonably coherent, serenely dominant, entity: the Western alliance, unchallenged."⁴ American power was unrivaled, established orders in Europe and Asia were uncontested, major powers were neither rivals nor potential adversaries, and global mechanisms were robust and growing. In this context, the Clinton administration pursued a national security strategy of "enlargement and engagement" and a nuclear strategy of "lead but hedge" (that is, lead in reducing nuclear dangers but hedge against a return of major power rivalry).

But there was also unwelcome counter-currents in this period. One was the rising specter of "rogue states" armed with nuclear, chemical, and/or biological weapons and the means to deliver them at long ranges, as epitomized by Saddam Hussein's Iraq. Another was the growth in the 1990s of movements of violent extremists willing to resort to mass casualty terrorism and interested in weapons of mass destruction, as epitomized by al Qaeda. Following the 9/11 attacks, the George W. Bush administration pursued a national security strategy of confrontation with the "axis of evil" (Iraq, Iran, North Korea) and with "the nexus of tyranny and technology" while adopting a "new strategic framework" that embraced Russia and China as powers with whom the

³ This summary is drawn from Chapter 1, "The Evolution of U.S. Nuclear Policy and Posture Since the End of the Cold War," in Brad Roberts, *The Case for U.S. Nuclear Weapons in the 21st Century* (Stanford, CA: Stanford University Press, 2016), pp11-50.

⁴ Charles Krauthammer, "The Unipolar Moment," The Washington Post (July 20, 1990).

United States shared responsibilities and interests. Its deterrence strategy centered on developing a "new triad" of capabilities (offense, defense, and infrastructure) to strengthen non-nuclear means. It also decided that the United States would no longer size its nuclear arsenal in relation to that of Russia.

The policy and posture reviews conducted by the Obama administration in 2009 brought home the challenges of a "changed and changing" security environment with its mix of negative and positive trends. Although the administration was cautiously optimistic at its start about the long-term trends with Russia and China, that optimism quickly waned as "re-set" with Russia failed to take hold and China turned to outright confrontation in the South China Sea. Moreover, the administration judged that while the risks of major nuclear attack on the United States had sharply declined, the risk of terrorist attack or attack by a proliferator had increased.

Then came President Putin's military-backed annexation of Crimea in 2014 and increased Chinese military and diplomatic assertiveness under President Xi Jinping. Then-Secretary of Defense Ashton Carter called for "a new playbook on Russia" and for a "third offset" to deal with China's rising military power. The need to modernize the nuclear force became inescapable. The program of record defined by the Obama administration was then carried forward under the Trump and Biden administrations largely unchanged—and with bipartisan congressional support.

In 2023, the signs of an accelerating erosion of the security environment are numerous.⁵ Major power rivalry and competition have given way to war in Europe and a rising expectation of war in Asia. The war in Ukraine grinds along with rising expectations of a widening or intensification of conflict, driven in part by a rising chorus of Russian voices calling for nuclear escalation. North Korea is making rapid and accelerating progress in developing and deploying a substantial arsenal of nuclear weapons and the missiles to deliver them at long ranges. Iran inches ever close to the nuclear threshold. The Global South prefers not to take sides. Institutions for crisis and conflict management are being undermined and growing weaker. Long-standing norms are being violated for the shock effect. The arms control treaty regime is collapsing. The United States and its allies have committed to strengthening deterrence but are struggling to do so at the speed of relevance.

Throughout this journey, the expectations falling on the U.S. nuclear enterprise have shifted significantly. In the 1990s and 2000s, the enterprise was asked to cease modernization, downsize, help clean up and secure Soviet legacies, and steward the residual arsenal without underground explosive nuclear testing. Given substantial budget reductions, it sacrificed its production infrastructure to enable stockpile stewardship. In the 2010s, downsizing and cleanup came to an end while the enterprise was asked to begin modernization-by-life-extension and to support a global nuclear materials security campaign. Under the Trump and Biden administrations, the modernization program has accelerated and proven much more complex and challenging

^{5 2023} Annual Threat Assessment of the U.S. Intelligence Community, Office of the Director of National Intelligence (March 8, 2023).

than judged to be the case a decade ago. Expectations have also formed in Washington D.C. that the enterprise can be more helpful in meeting the challenges of emerging and disruptive technologies, including by deriving disruptive benefits for the United States and its allies and partners, and of strategic stability in an era of renewed rivalry and diminished arms control.⁶

Key Attributes of the New Era Bearing on the U.S. Nuclear Enterprise

In this new era of eroding order and deterrence, the missions of the U.S. nuclear enterprise are touched on in myriad ways. These include the following:

First, the United States now faces a more multipolar nuclear world than before. Rather than focus on a single peer competitor as it did in the Cold War, it must now tailor for three nuclear-armed adversaries and the potential for more to appear. China is emerging as a nuclear peer to the United States as it moves toward a deployed force roughly comparable in size and structure.⁷ North Korea is emerging as a revisionist power with a substantial emerging force. The arsenals of both China and North Korea are growing and diversifying more rapidly than projected just a few years ago. Iran inches over closer to its own nuclear threshold. All have developed new ways of war that have in common the elements of crisis generation, nuclear-backed blackmail and brinkmanship, and multi-domain escalation if necessary. Simultaneous crises and possibly war are real possibilities in this more multipolar context.

Second, with the Ukraine war as context, Russia has been revealed to be a much more challenging object of U.S. deterrence strategy than widely assumed before 2021. President Putin's tolerance for military risk appears to be high. His capacity for significant miscalculation has been vividly demonstrated. And his dependence on nuclear weapons to enable his geopolitical strategy and on nuclear threats as part of that strategy is now indisputable. His professed commitment to "new rules or no rules" has led to a set of behaviors aimed at demonstrating his contempt for existing international norms; his willingness to violate so many norms raises an obvious question about whether and why he might view the nuclear taboo as a norm that must not be violated.

Third, the rivalries with Russia and China are centered on the regional orders in Europe and East Asia that the United States and its allies built in the Cold War and have preserved into the 21st century. They see these alliances as part of a U.S. strategy to encircle and contain them and to gain the freedom of maneuver to coerce them and to perpetrate "color revolutions." North Korea has a similar if narrower agenda for regional change. All also object to the rules-based global order, on the argument that the rules were foisted upon them in their moments of weakness.

⁶ Nuclear Posture Review 2022, pp23-24.

⁷ For more on this topic, see *China's Emergence as a Second Nuclear Peer: Implications for U.S. Nuclear Deterrence Strategy* (Livermore, CA: Center for Global Security Research, 2023).

Fourth, in these contests over regional order, the prize is the future political alignment of countries now allied with the United States. Will they remain allied with the United States or choose appeasement of Russia, China, or North Korea instead? Living as they are in the nuclear cross-hairs, these allies are necessarily anxious about the credibility of U.S. extended nuclear deterrence. They are also anxious about the possibility that a United States whose homeland is newly vulnerable to large-scale nuclear attack may choose not to defend them in time of war.

Fifth, these nuclear-armed rivals have a long head start over the United States and its allies and partners in adapting their policies and postures to the new context. Russia, China, and North Korea all became focused on the potential for armed conflict with the United States in the 1990s and at that time began to set out concepts and theories of victory for such conflict. They followed with the development of new military doctrine and of the capabilities necessary to enable the doctrine.⁸ What we're seeing now are the results of three decades of preparation. In contrast, the United States only began to turn to this new challenge with the annexation of Crimea in 2014 and was only able to focus on it upon exiting the long wars in Iraq and Afghanistan.

Sixth, the legacy arms control regime is collapsing. At the end of the Cold War, the bilateral U.S.-Russian arms control framework was robust and multi-faceted; today, the only remaining item is the quasi-suspended New START agreement. The arms control framework that helped to stabilize Cold War competition and consolidate the post-Cold War peace has collapsed. More accurately, these agreements were undermined by Russian non-compliance, in fulfillment of President Putin's ambition to free Russia from agreements he deemed instruments of Western dominance. The collapse of these arrangements and Moscow's antipathy to existing regimes has also undermined the global treaty regimes and the effectiveness of the United Nations Security Council in ensuring compliance with treaties.

Seventh, the global nuclear order appears increasingly fragile. In the absence of an effective treaty and compliance regime, and given the pressures for nuclear proliferation in many sub-regions of the world, there appears to be a rising possibility of reaching a tipping point, followed by a cascade of proliferation. One such tipping point could be the decision of a U.S. ally to acquire nuclear weapons of its own in response or a loss of confidence in the U.S. nuclear umbrella, catalyzing wider concerns and nuclearization by others.

Eighth, the potential remains for a revolutionary actor to acquire and use nuclear weapons. Heretofore, nuclear weapons have generally been acquired by states looking to safeguard their interests in security and stability. As argued above, the United States and its allies and partners today face nuclear-armed states with revisionist political agendas. A revolutionary actor such as the Caliphate or the Islamic State might seek, acquire, and employ nuclear weapons for terrorist purposes—or simply, as some have argued, to change the course of history.

⁸ Roberts, The Case for U.S. Nuclear Weapons in the 21st Century, chapters 2, 4-5.

Ninth, there are more substantial doubts than before about the political will and political capacity of the United States to stay the course as the leader of the liberal international world. Those doubts arise from the changing character of U.S. domestic politics and from recent experience of a president whose approach to alliances was somewhat contemptuous and entirely transactional. They also arise from the new vulnerability of the U.S. homeland to nuclear attack in a context other than Cold Warstyle vintage global nuclear confrontation.

Tenth and finally, this is an era with significant potential for strategic surprise. As argued above, the geopolitical order is in flux and confrontational. The technological context is extremely dynamic. The old rules are fading and the new rules haven't been written.

Implications for the U.S. Nuclear Enterprise

Each of the preceding factors has important implications for the U.S. nuclear enterprise. In response to the more multipolar nuclear world, the enterprise must be able to:

- Ensure the long-term viability of the triad, as the flexibility it offers is even more valuable in a multipolar security order
- Ensure the near-term viability of the triad, which will come into question if there
 is any gap in standing capabilities during the transition from legacy systems to
 modern replacements
- Enable the tailoring of the U.S. nuclear posture to the specific requirements associated with the different value structures of different adversaries

In response to the growing Russia challenge, the U.S. nuclear enterprise must be able to:

- Credibly demonstrate that the United States has the will and capacity to maintain an effective nuclear deterrent
- Credibly demonstrate that there is no condition under which Russia can seize and hold a long-term strategic advantage over the United States and its allies

In response to the revisionist regional agendas of Russia and China, the U.S. nuclear enterprise must be able to:

- Sustain extended deterrence by completing the modernization of the bomb associated with NATO's nuclear sharing arrangements
- Strengthen extended deterrence by nuclear and non-nuclear means and by

enabling its adaptation to new military and geopolitical circumstances

In response to the growing assurance requirements of U.S. allies, the U.S. nuclear enterprise must be able to:

- Sustain and strengthen extended deterrence, as above
- Contribute to the ability of the United States and its allies to defend themselves against missile attacks
- Credibly signal the resolve of the United States to compete to defend its allies and partners

In response to the head start on adaptation enjoyed by U.S. adversaries, the U.S. nuclear enterprise must be able to:

- Respond at "the speed of relevance" to new requirements resulting from geopolitical or technical surprise so that adversary leaders see no possibility of gaining, holding, and exploiting new strategic advantages
- Contribute meaningfully to broader U.S. government efforts to recover ground lost to U.S. adversaries over the past 2-3 decades

In response to the collapsing legacy arms control regime, the U.S. nuclear enterprise must be able to:

- Study the new strategic landscape, anticipate needed new capabilities, and prepare them
- Study the landscape, identify new opportunities to reinforce the stability of deterrence with reciprocal restraint, and develop technology solutions to emerging challenges

In response to an increasingly fragile global nuclear order, the U.S. nuclear enterprise must be able to:

- Monitor foreign developments to assess the degree to which states have developed and are improving their latent nuclear potential and substitute means in extremis
- Deepen cooperation with allies and partners to ensure continued shared international leadership

In the response to the potential for a revolutionary actor to acquire and use nuclear

weapons, the U.S. nuclear enterprise must be able to:

- Support U.S. and international monitoring efforts
- Enable effective suppression of detected capabilities
- Respond in crisis
- Support remedial humanitarian assistance

In response to growing doubts about U.S. nuclear resolve, the contribution of the U.S. nuclear enterprise is indirect but not inconsequential. It must be able to:

• Serve as an affirmation of the political resolve of leaders of the executive and legislative branches of government to fulfill U.S. commitments to its allies and partners and any other with which it shares interests and/or values

In response to the risk of strategic surprise, the U.S. nuclear enterprise must be able to:

 Respond in a timely and effective manner to future nuclear requirements of whatever degree of urgency technical complexity; it need not be best in class but it must be second to none

Conclusion

The changes in the security environment over the last two decades have wide-ranging implications for the U.S. nuclear enterprise. Sustaining and strengthening deterrence will indeed require many changes to business as usual.

The Effects of the War in Ukraine on NNSA Missions

William Tobey

Strategic Context

While the challenge from a risen and revisionist China may prove greater and more enduring, Russia's war on Ukraine profoundly changes the strategic context, importance, and requirements of the National Nuclear Security Administration's (NNSA) missions. The world changed as much in February of 2022 as it did in November of 1989 or December of 1991, when the Berlin Wall fell and the Soviet Union fell apart. These changes will not likely be ephemeral. Russia is preparing for a long war and a prolonged period of isolation from and hostility toward the West.

Although Russia has many political, economic, and military weaknesses, it retains the world's largest arsenal of nuclear weapons. Russia is therefore central to deterrence, arms control, nonproliferation, and nuclear security issues. Furthermore, Moscow's permanent membership of the United Nations Security Council affords it a veto potentially affecting all these issues.

Russia is a personalized autocracy. Abundant evidence reveals that much of the Russian military remained ignorant of the impending invasion of Ukraine until the last moments before troops plunged across the border. The United States and the International Criminal Court (ICC) have reinforced Putin's personal responsibility for Russia's war on Ukraine. President Biden called him a "butcher" and a "war criminal." The ICC issued an arrest warrant for him, ultimately precluding his attendance at a 2023 BRICS summit meeting in South Africa. War criminals are not typically invited to the White House. Thus, for at least as long as President Biden and Putin hold their offices, U.S.-Russian relations will be impaired.

Russia's United Nations Security Council veto also matters. The Security Council is charged with maintaining international peace and security. It is the backstop for the International Atomic Energy Agency (IAEA), whose statute requires that Safeguards and Nonproliferation Treaty violations be reported to the Security Council. From 1945 to 1992, the Security Council passed 725 resolutions; from 1992 to 2022, the Security Council passed nearly three times as many resolutions, in two thirds the time. The difference can be explained by the end of the Soviet Union. Soviet opposition, backed by a veto, often stymied effective Security Council action. Now that Russian revisionism is rampant, the Security Council will likely revert to its Soviet-era record.

More broadly, Russia is disengaging from or attacking a wide range of international initiatives and organizations, including the Global Initiative to Combat Nuclear Terrorism, IAEA, and the Organization for the Prevention of Chemical Weapons. At the very last moment, Russia blocked a consensus report at the 2022 Nonproliferation Treaty Review Conference. In the words of one observer, Russia is not only violating the rules-based

international order; it is vandalizing it.

It is also important to note that Russia's war in Ukraine is not over and we do not know how it will end. It will undoubtedly affect all the realms discussed below, and one can begin to see the nature of those effects, but no one can be certain of the final result. The luxury of certainty is, however, not possible. Events demand decisions, as even deferral is a form of determination.

Deterrence

Adjacent work importantly describes the new challenges posed by deterring two nuclear peer-adversaries. There is no need to duplicate that analysis. Here, the issue is: What changes to nuclear deterrence result directly from Russia's war on Ukraine? They are manifold:

- First, Moscow likely believes that its nuclear threats have prevented direct intervention by U.S. or NATO forces in defense of Ukraine, reinforcing the salience of Russia's concept of nuclear deterrence.
- Second, in making those threats, Putin and those around him advance the argument that Russia's nuclear arsenal underwrites Russia's great power status, again strengthening Russian geopolitical predilections.
- Third, Russia's disastrous prosecution of a conventional war against a smaller and nominally less capable power means that Moscow will rely more heavily on nuclear weapons—both for deterrence and, if necessary, warfighting.
- Fourth, the combined weight of these lessons may impel Russia to pursue additional novel weapons, in the same vein as Moscow's nuclear-armed, nuclear-powered, long-range cruise missile and torpedo. For example, if deployed, weapons such as fractional-orbital bombardment systems could undermine deterrence and strategic stability.

Arms Control

Even before Russia's war on Ukraine, prospects for ratifying a follow-on to the New START Treaty were dim. Russia's violations of the New START and Intermediate Nuclear Forces Treaties, the Chemical Weapons Convention, the Conventional Forces in Europe Treaty, and a host of other international treaties and agreements, have left both policyand law-makers wary. The closely divided U.S. Senate makes assembling the two-thirds majority required for treaty ratification difficult. Many Republicans are traditionally suspicious of Russian security policy; after 2016, many Democrats are resentful of Moscow's interference in U.S. elections. Russia's war on Ukraine makes negotiation—let alone agreement and ratification—of a new strategic arms control treaty improbable. The New START agreement will expire in February of 2026. Thus, it is highly likely that for the first time in half a century no legal limits on the number of U.S. and Russian strategic offensive weapons will remain in force.

Nonproliferation

The nonproliferation effects of Russia's war on Ukraine swirl in different streams:

- First, Russia's violation of the Budapest Memorandum—in which Ukraine forsook retention of Soviet nuclear weapons in return for, inter alia, security guarantees from Russia, the United States, and Great Britain—carries stark lessons. Russia cannot be trusted. Security assurances without alliances are undependable. The difference between an ally, like Poland, and a partner, like Ukraine, can literally be the difference between life and death.
- Second, those nations without a nuclear-armed ally will be tempted to increase their nuclear weapons latency. Officials in Saudi Arabia and Turkey have each discussed the possibility of advancing toward a nuclear weapons program.
- Third, even those nations with nuclear-armed allies will seek greater assurance; for example, public calls in both Poland and South Korea for the basing of American nuclear weapons on their territories.
- Fourth, Russia's reported dependencies on Iran for drones and North Korea for rockets and artillery shells likely create powerful incentives for Moscow to block any effective actions at IAEA or the United Nations Security Council to halt or reverse the Iranian or North Korean nuclear programs. Indeed, it is possible that in the context of increasing great power competition, Russia and China might one day conclude that Iranian and North Korean nuclear weapons would advance their respective security interests.
- Fifth, the Nonaligned Movement will likely heighten its criticism of nuclear weapons states for failing to make arms control progress. This would make the 2026 Nonproliferation Treaty more contentious and might give impetus to the Treaty on the Prohibition of Nuclear Weapons.

Nuclear Security

The cooperative threat reduction programs pursued with Russia and other former Soviet states from the 1990s to the 2010s were built on two assumptions: first, the primary, if not the only, threat to nuclear and radiological security came from nonstate actors; second, the recipients most in need of cooperation were former adversaries. Current events challenge both assumptions. In Ukraine, Russia has attacked nuclear power reactors, spent fuel storage facilities, and the people who operate them. The state-based threat to nuclear and radiological security, however, is not limited to Russia in Ukraine. In 2020, Azerbaijan threatened an Armenian nuclear power reactor. In the Middle East, where nuclear power reactors are being planned, built, and operated, missiles and drones attacked critical Saudi Arabia's infrastructure with great precision and very nearly devastating consequences in 2019. The dozens of nuclear power reactors operating in Japan and South Korea all fall within range of North Korea's missile forces—which were tested more than once a week in 2022.

Drone and cyberattacks are becoming more frequent and sophisticated. They can be targeted very precisely and can transcend borders and even oceans. Thus, no state's nuclear and radiological facilities can be considered immune from external attack.

In August of 2022, former Russian President (and current vice chair of Russia's security council) Dmitry Medvedev threatened, "Don't forget that there are nuclear sites in the European Union too. And incidents are possible there as well." While Medvedev may be full of bluster, his threat cannot prudently be ignored.

An element of integrated deterrence is deterrence by denial, taking steps to cause an adversary's attack to fail. It would follow then, that hardening U.S., allied, and partner nuclear and radiological facilities against attacks by state actors—whether cyber or physical—would advance integrated deterrence.

A collateral effect of Putin's war on Ukraine—political instability within Russia—also raises the threat to nuclear security posed by nonstate actors. Reuters asked U.S. National Security Council spokesman Adam Hodge about the proximity of Wagner Group forces enroute to Moscow during the coup attempt to a Russian nuclear weapons storage facility. He responded, "We had no indication at any point that nuclear weapons or materials were at risk." Nonetheless, had the coup proved successful, or had Wagner troops attacked a nuclear weapons storage site, as they did the military headquarters in Rostov-on-Don, the danger to nuclear security would have been real.

Conclusion

The effects of Russia's war on Ukraine are profound and long-lasting. Because of the size of Russia's nuclear arsenal and its possession of a United Nations Security Council veto, the war will affect most realms of international relations, but none more so than the nuclear domains. The United States is likely returning to uncharted territory, with two nuclear peer-competitors, no numerical limits on strategic offensive arms, increased pressures on non-nuclear weapons states to proliferate, and novel threats to nuclear and radiological security posed by state actors. U.S. deterrence, arms control, nonproliferation, and nuclear security policies and programs were developed mostly in the 1990s, before these threats were evident. The new problems or novel manifestations of old ones will require innovative policies, hard choices, and most of all, urgent action.

The New Era of Nuclear Responsiveness

Jill Hruby

As President Biden has argued, "Our world is at an inflection point. How we respond to the tremendous challenges and the unprecedented opportunities we face today will determine the direction of our world and impact the security and prosperity of the American people for decades to come."⁹ His urgent call to action is a call that we at the National Nuclear Security Administration (NNSA) have heard clearly. My purpose today is to explain how NNSA is responding.¹⁰

The challenges have only grown over the last year. When we convened in spring 2022, we spoke about the changing geopolitical landscape and the new policies of the Biden administration. Russia's invasion of Ukraine had occurred a few months before and we were worried about fighting in and around nuclear zones. We were also concerned about North Korea's cadence of missile testing and the possibility they would conduct a seventh underground nuclear test, and still hopeful we could restore the Iran Joint Comprehensive Plan of Action. Brief unclassified summaries of the Nuclear Posture Review had been released with the debate underway on a few key issues including SLCM-N. We were in the early phases of the presidential-directed AUKUS consultation with Australia and the United Kingdom in response to the growing concerns in the Indo-Pacific.

Unfortunately, the geopolitical environment is worse now than it was then. The war in Ukraine continues along with a growing list of nuclear norm-breaking behavior by Russia that includes not only an unprovoked invasion of a non-nuclear weapon state and takeover of a Ukrainian nuclear power plant, but also suspension of the only treaty that limits the number of nuclear weapons and the announced intent to move nuclear weapons into Belarus. The analysis of China's nuclear program suggests they could achieve peer status within a decade. The pace of North Korea's missile testing is mindboggling, and negotiation with Iran seems impossible with uranium being enriched there to a higher level and at a faster pace than ever before. Each of these behaviors is destabilizing. Together, they represent a new, more dangerous nuclear landscape. There is no doubt we are at a nuclear inflection point.

However, it's not all bad news. North Korea has not conducted the expected seventh nuclear test. The AUKUS consultation period ended with a practical agreement to move forward together including a strong commitment to nonproliferation and responsible behaviors. The Zaporizhzhia nuclear power plant in Ukraine has been operated in standby mode for long enough to lower the potential for a large-scale radiological release. Due to great work by your DOE and NNSA enterprises, we have better equipped

⁹ National Security Strategy (October 2022), citation from the presidential cover letter.

¹⁰ This essay is based on remarks delivered to the 17th annual Strategic Weapons in the 21st Century Symposium co-convened by Lawrence Livermore and Los Alamos National Laboratories, April 27, 2023.

the Ukrainians to prevent, monitor, and respond to nuclear emergencies. We have supplied portable diesel generators and extra fuel for protection from the continuous Russian attacks on the power grid and the loss of cooling capacity at nuclear power plants. There are IAEA [International Atomic Energy Agency] inspectors at all the Ukrainian power plants to help with understanding the safety and security status and to deter additional aggression.

At NNSA, we have continued to modernize our weapons and infrastructure. Two weapon programs are in full-scale production, delivering on time. Three other weapon programs are advancing with one more weapon slated for full-scale production in the 2020s and two weapons, set to go into production in the early- to mid-2030s. We have made over 40 developmental plutonium pits at Los Alamos, the Uranium Processing Facility has completed nearly all its procurements and is moving toward construction completion, and there are infrastructure upgrades across the entire complex. We successfully established a domestic producer of Moly-99, an isotope used in over 40,000 medical procedures each day, without using highly enriched uranium, and we successfully removed the highly enriched uranium from the Yayoi research reactor in Japan. Our hiring is strong, and our workforce is growing. The NNSA enterprise made history by being the first to achieve fusion ignition in a laboratory, and we will bring the first exascale computer for national security online this year.

I am extremely proud of our successes. However, I want to be clear, against the complex international nuclear landscape, the nuclear security enterprise must increase our responsiveness. We need to take advantage of the good in our culture and the appreciate the things we did right in the past, but we must also look for every opportunity to accelerate progress and modernize approaches. There is room to improve design, production, construction, technology deployment, and science. The last several decades of searching for flaws and seeking complete understanding of an aging stockpile needs to transition to problem solving and timely deployment of a new stockpile. This is a big shift in mindset and a change in focus, but the work will be rewarding, and the outcomes are needed.

We need to do this while further extending our improvements on integrated safety, security, and environmental stewardship. We were lucky to have had time to improve our operations and simultaneously improve data quality and products, and now the concepts must be embedded in the way we do business. We have no intention of cutting corners as we accelerate; rather, we must find efficiencies and eliminate non-value-added work.

In short, this is the time to combine the 1960–1990 era of stockpile development with the recent era of stockpile stewardship and operational improvement to produce the era of the present—maybe we should call it the "era of responsiveness."

Investments made over the last 30 years have readied us for this. We have the resources and political support we need. We must create a responsive enterprise that is flexible and resilient characterized by the ability to scale operations up or down, move faster, take appropriate risks, decrease burdensome processes, understand tradeoffs, keep the long game in mind, and deliver in the here and now.

There is another opportunity for NNSA right now, and it is to integrate more fully across our weapons activities and our nonproliferation, counterterrorism, and emergency response activities to create a sustained, holistic deterrence model with appropriate dependencies. Our Naval Reactors program is also more integrated with NNSA than ever before as we increase our strategic thinking about nuclear materials, nuclear capabilities, nonproliferation, and integrated deterrence. This is the other inflection point to realize: the true value of integration. NNSA should be a subset of the type of integration needed throughout the defense community in this country.

With the introduction of responsiveness and integration as key inflection points for the NNSA enterprise, let me turn to providing an update on the three elements in the Nuclear Posture Review that are front and center for NNSA—nuclear deterrent risk management, production-based resilience, and the science and innovation initiative.

Nuclear Deterrent Risk Management Strategy

First, the nuclear deterrent risk management strategy. As you know, there is a new level of coordination and risk management needed between NNSA and DOD as we modernize all three legs of the nuclear triad with both new delivery systems and refurbished or new warheads. In addition, we are simultaneously recapitalizing the NNSA's captive production complex and the U.S. defense industrial base. To align resources, schedules, goals, and efforts, the Nuclear Weapons Council in dialogue with other relevant stakeholders is developing a Deterrent Risk Management Strategy. The overarching purpose of the Strategy is to make sure our nuclear deterrent is always safe, secure, reliable, and effective.

The Nuclear Weapons Council Requirements and Capacity Working Group has developed detailed requirements and associated planning documents to manage the current triad sustainment and modernization that focus on avoiding future deterrence gaps. To do this successfully, the future of deterrence must be conceptualized. As a wider array of adversaries advance capabilities, as technologies emerge, and as the geostrategic realities change, building more weapons cannot be the only answer and could be the wrong answer. Integrated deterrence, net assessments, and disruptive technologies are being examined to maintain a U.S. advantage over our adversaries. As a result of this thinking, NNSA is initiating two Phase One studies, and looking at ways to streamline warhead modernization in a world where we expect requirements to be less linear. Ideas such as warhead modularity, shorter weapon lifetimes, advanced technologies, and a clean sheet review of the phase X process are being considered.

Production-based Resilience

The second pillar is production-based resilience. The idea for production-based resilience was developed to reimagine the enterprise for the world going forward. In the 1990s, the NNSA envisioned, and took concrete steps to realize, an enterprise that was less expensive and expansive. We closed some production facilities, consolidated production activities, idled many facilities, and rebuilt parts of the complex for a much smaller capacity. Today, 30 years later, we are again envisioning a new enterprise. This

enterprise is meant to be flexible and scale more readily. It is meant to be more resilient to outages and failures. And it is meant to have modern capabilities to attract the best talent, to be efficient, and to deliver the highest quality products.

At this point, we are exclusively using existing sites for the enterprise we envision. This adds some complexity due to things like adding and improving basic utilities such as power and water and tearing down old buildings. It is also merging labs and plants on a more substantial scale than has been done before. And, we would also like to have a smaller carbon footprint and be a model for Department of Energy deployment projects. Our responsive approaches already include production facility and research facility co-existence that can shift the balance of work as needed, and we will likely continue to do more of this as needed for resilience and flexibility.

Most importantly for production-based resilience, we must take advantage of the revolutions in manufacturing, metrology, information technology, engineering, physics, chemistry, biology, and more in the last three decades to incorporate new technologies and processes into our production complex. We must re-build the Enterprise's capacity to produce plutonium pits and secondaries. We must expand our capacity for non-nuclear components. And we must be prepared for the next challenges. We are already anticipating explosives and enriched uranium needs for the needs in the 2040s and beyond. We will work closely with the DOD on explosives capabilities and closely with the private sector on uranium enrichment. New technologies should also improve the safety, security, and survivability of the nuclear stockpile, stockpile management, hedging, and risk mitigation without overreliance on a single type of warhead or the maintenance of a large stockpile reserve.

I would like to use some of our current activities as real-world examples of production-based resilience. Let's start with plutonium pit production. The ability to produce additional pits was lost when the Rock Flats facility was closed in 1992. Because we have made significant strides in understanding pit aging through our Stockpile Stewardship Program, we recognized that pits don't last forever, and we needed to re-establish a production capability. Congress mandated NNSA produce no fewer than 80 pits per year by 2030. Although we will not meet that target, the infrastructure to produce 80 pits as close to 2030 as possible is our highest construction priority. We are fully committed to a two-site pit production strategy at Los Alamos National Laboratory and the Savannah River Site. The two-site pit production strategy has built-in resilience in the event of something that halts production at either site. The baseline plan is to produce 30 pits per year at Los Alamos and at least 50 pits per year at Savannah River. The Los Alamos facility is designed to allow other plutonium research and operations in the same facility. If we need fewer than 80 pits per year, Los Alamos could expand research activities. At Savannah River, we have included "white space" in the design to allow for the incorporation of future technologies or a second production line. This two-site solution eliminates a single point of failure, allows for flexible production scaling to match mission need, commits to long-term research in plutonium, and provides capacity margin beyond the present mandate. The commitment

to this strategy has resulted in the announced transition of the Savannah River Site from [U.S. Department of Energy's Office of] Environmental Management stewardship to NNSA stewardship beginning in 2025.

Now, as an example of technologies and approaches, I would like to provide an example from the Uranium Processing Facility, UPF, at Y-12. UPF is one of our largest infrastructure projects in decades and is meant to reduce mission dependency on Building 9212 at Y-12, which is over 75 years old. It will provide for the long-term viability and security of processing uranium that has already been enriched. One key technological change at UPF is the incorporation of electrorefining to provide purified uranium metal. This replaces a high-hazard chemical process and improves worker safety and environmental stewardship. To manage mission risk during the transition process, NNSA has executed a service contract with a private company, Nuclear Fuel Services, for converting uranium oxide to metal. In this way we can incorporate new technologies and mitigate mission risk while confronting the issues currently facing large-scale construction projects around the nation like supply chain bottlenecks and labor shortages.

There are other examples as well and the list will grow as we continue modernizing. That brings me to my final point on infrastructure, the need to accelerate construction. After coming out of Covid, we realized we had new construction challenges. Supply chain delays, inflation, worker productivity, and especially worker shortages were being realized even without the Covid pandemic restrictions. One focus has been on finding high productivity craft workers. We have expanded nationwide recruiting with labor unions and provided pay, transportation, and housing incentives as needed by geographic area. We also established new pipeline programs for technicians and skilled craft trades like the pipelines we have been building for our STEM workforce and the first awards for this program were distributed in February 2023. Along with these actions, we have reevaluated our current construction portfolio and chosen to delay three planned projects to focus personnel and resources on our most pressing needs. While these delays are disappointing, we intentionally decided not to compete with ourselves and to prioritize completion of projects on-schedule and on-budget.

Finally, we must not let our science infrastructure and capability degrade while we rebuild our production enterprise. It is hard to overstate the success of our science-based Stockpile Stewardship program. Over the past 30 years, we have maintained confidence in the safety, security, reliability, and effectiveness of our weapons and our people through use of world-class modeling on specially designed high-performance computers, specially designed new experimental capabilities highly diagnosed like NIF, and specialized high-fidelity lab- and flight-experiments. We have not conducted an underground explosive test and our plan is to never do so again. The core facilities must be sustained as world class, and we must invest in select leapfrog capabilities to stay ahead.

Science and Technology Innovation Initiative

This leads to our third pillar, the Science and Technology Innovation Initiative, focused on integrating science and technology throughout the design and production

phases of the nuclear weapon lifecycle where it is needed most. This initiative will also accelerate technology maturation.

The technological shifts of the last decade have been astonishing not only for their breadth but for their rapid pace. We must continue to make concrete, meaningful investments in our science programs if we want to take advantage of the changes and stay competitive in the technologies of tomorrow. It is important that we embrace the technical challenges we have, not the solution we have. Emerging and disruptive technologies such as the bioeconomy, AI, quantum computing, nanotechnology, and advanced semiconductors are the industries that will power and lead the world into tomorrow. I want to make sure NNSA is at the forefront of these efforts. It is clear there is a virtuous cycle in recruiting, training, and retaining personnel and sustaining, recapitalizing, and upgrading our scientific infrastructure. Doing this right must always be a high priority.

Nonproliferation, Counterterrorism, and Arms Control

Before concluding, I want to come back to the inflection point of integration. Although many levels of integration are needed, we must start with meaningful integration of our NNSA programs and priorities to provide more holistic deterrence.

We will continue to evolve our responsibilities in the technical and policy elements of nonproliferation, counterterrorism, and arms control. Without highly effective programs in this area, even with a modernized and effective deterrent, we will not obtain strategic stability. And the goal of integration of nonproliferation with weapons activities is to unlock new ideas more likely to be successful in the future.

Our nonproliferation and counterterrorism efforts in the United States and around the world remain active and focused on eliminating or minimizing the most dangerous nuclear and radiological materials, detecting the movement of radiological materials, responding to and attributing any nuclear incidents, and working with the IAEA on effective safeguards and security for peaceful nuclear uses. We recognize the need to improve the safeguards and security of large-scale nuclear power plants because of Russia's actions in Ukraine, and we also recognize the need to work with industry and the international community on effective safeguards and security programs for new technologies such as small modular reactors and new fuel technologies. In the interest of staying ahead, we will develop, steward, and advance bio capabilities for national security.

We have started two activities in our defense nuclear nonproliferation portfolio with direct overlap with weapon activities. One is the use of the Pantex plant for an arms control testbed. We want to use realistic facilities and real people who work in them to get new ideas and to engage in evaluation. The other is the use of the Nevada Nuclear Security Site for conducting chemical explosive experiments aimed at improving geological models used to detect and analyze underground tests in other countries. The use of our Nevada site for this work keeps our capabilities sharp and takes advantage of its location and capabilities.

Finally, because of the complexity in nuclear construction, we need to think at least

30 years ahead to plan for capabilities. We will never be done with modernizing the enterprise. If there is one thing we have learned over the last five to 10 years, it is that restarting capabilities is much harder than not stopping them. New capabilities such as uranium enrichment are being integrated across Defense Programs, Nonproliferation, Naval Reactors, Nuclear Energy, and the industrial sector.

Conclusion

NNSA has not been idle at this critical moment. We see the challenges clearly. We are working hard to seize the opportunities. Our agenda inflection points are responsiveness and integration. We must take advantage of this difficult moment to create new ideas for a secure world. I am confident we can meet the challenges by working as an energized enterprise.

The Nuclear Security Enterprise at the Inflection Point

Kimberly S. Budil, Thom Mason, and James Peery

The 2022 National Security Strategy describes a rapidly changing international security environment. At this "inflection point" in world history, the United States faces two primary challenges—a major power competition to shape the world order and the need for cooperation between nations to tackle a wide range of issues including climate change, food and energy insecurity, disease, terrorism, and more. This view of a rapidly changing security environment is not new, having been highlighted in the prior administration's strategic documents as well. Russia's war of aggression against Ukraine has brought nuclear security issues to the fore, with their flouting of international rules and norms and alarming rhetoric about nuclear use. China poses a fundamentally different challenge. It has declared its intent to lead in strategic areas of science and technology and demonstrated its willingness to make significant investments to achieve these aims. It has also undertaken a significant and rapid expansion of its nuclear capabilities, seeking to establish itself as a leader on the world stage. How the United States responds during this "decisive decade" will have significant implications for the international order.

Today the nuclear security enterprise (NSE) finds itself at a similar inflection point. A significant program is underway to modernize every aspect of the U.S. nuclear deterrent, re-establish U.S. nuclear weapons production for both nuclear and non-nuclear components, and return to Cold War project execution speed while maintaining the much lower overall size of the stockpile. New delivery systems are being developed for all three legs of the triad and four major stockpile modernization programs are at various stages of completion with a fifth in the early stages of planning. After decades of neglect, the entire production enterprise is being recapitalized with new facilities under construction and new manufacturing capabilities being deployed. We have a unique opportunity to transform both the stockpile and the enterprise to create the agile and responsive U.S. nuclear deterrent enterprise needed for the coming decades. There is real urgency to drive this program forward but there are many challenges still to address.

Most of the era since the United States ceased nuclear testing in 1992 has been characterized by drawdowns in stockpile numbers and carefully and cautiously extending the life of existing systems. While the Stockpile Stewardship Program (SSP) was building the facilities and capabilities to ensure the safety, security, and reliability of the nuclear weapons stockpile without additional nuclear explosive testing, this caution was warranted. Over the ensuing decades, new capabilities were developed including increasingly powerful supercomputers and high-fidelity modeling and simulation tools along with advanced experimental capabilities like the Dual Axis Radiographic Hydrotest facility (DARHT), National Ignition Facility (NIF), and Microsystems Engineering, Science and Applications (MESA), dramatically expanding our understanding of weapon physics and engineering. Taken together with the large body of legacy nuclear test data, this effort provided an increasingly capable toolkit to a new generation of stockpile stewards.

More than a decade ago, the anticipated workload of the nuclear security enterprise was projected to be approximately 1 - 1.5 life extension programs underway at any time. Coupled with the decision to outsource much of the component supply chain, facilities for non-nuclear component production were downsized and very limited modernization of production technologies and approaches was envisioned. By the 2020s, it was clear that these projections vastly underestimated the amount of work that would be required or the large cost and complexity of revitalizing or replacing aging facilities and bringing legacy processes back online. Nuclear facility construction in particular has posed immense challenges due to increased safety and regulatory requirements and was further complicated by the supply chain issues and worker shortages caused by the COVID-19 pandemic that are not unique to the National Nuclear Security Administration (NNSA). Although a great deal of progress has been made, most projects will cost significantly more than estimated and will be completed later than expected—and, in some cases, will be late to the need for ongoing modernization projects.

During the era when the modern stockpile was being developed, the NSE typically had several systems in development and could deliver new capabilities routinely in well less than a decade in response to emerging requirements. Today we have more detailed knowledge and vastly better scientific tools and capabilities, but our ability to respond and deliver new capabilities has atrophied. Current life extension programs take more than a decade to complete and the modernized systems under development today will take even longer to be realized. Part of these long timescales is due to the simultaneous effort to construct new facilities and reactivate manufacturing tools that have not been exercised in years. But it is increasingly clear that a significant driver of these timelines is our reliance on legacy processes and approaches, coupled with a risk averse, highly regulated work environment built for an era when there was less urgency to deliver and minimization—or elimination—of risks was paramount. The NSE must embrace a new way forward to meet the challenge of this decisive decade.

There are three fundamental focal points for change:

- shifting from a risk elimination to a risk management culture,
- embracing modern manufacturing technologies and digital tools, and
- creating new types of partnerships and approaches to speed the development to deployment cycle

All of these are underpinned by the extensive science and technology (S&T) toolkit that the SSP has developed and advanced. Realizing these opportunities will position the nuclear security enterprise to provide the agile, adaptable, and responsive capabilities

the nation needs in this rapidly evolving security environment.

Toward a Risk Management Culture

The decades between the launch of the SSP and the consensus around the current stockpile modernization program were dominated by a series of very conservative life extension programs focused on keeping stockpiled weapons in a configuration as close as possible to their originally fielded configuration. The tools of stewardship were still under development and sustaining confidence was predicated on minimizing change. Budgets were highly constrained, making cost containment a top priority. Furthermore, there was a tendency to increase the rules and oversight in a culture of risk minimization—or even more ideally, elimination—with oversight being undertaken at ever more granular levels without obvious benefits to safety and security. Taken in isolation, each new rule or regulation added some incremental benefit, but there was little attention paid to the aggregate effect of these additional requirements and oversight mechanisms. Individual employees were effectively incentivized to focus on strict compliance so that if a risk was realized they would not be directly accountable. More formal approaches to project management were introduced and each challenge resulted in new layers of controls and oversight. Oddly, this approach has led to increasing risk since scientists and engineers spend much less time on innovation and refining their designs. Instead they spend more time responding to excessive reporting and reviewing requirements. The initial introduction of industry best practices resulted in dramatic safety improvements, but more recent experience suggests diminishing returns.

Today the nuclear security enterprise is focused on streamlining our approach to ensure timely delivery of needed capabilities. Through the Enhanced Mission Delivery Initiative, NNSA and NSE leadership are working in partnership to establish appropriate roles, responsibilities, authorities, and accountability for technical decisionmaking, focus oversight on high risk or high consequence decisions and interfaces, adopt graded approaches to project management, and assess the work processes and procedures at the labs, plants, and sites to ensure they are appropriately enabling of mission delivery. Culture change is a major part of this initiative, seeking to focus teams on the importance of delivering on time and making risk-informed decisions along the way to enable this.

NNSA and the labs, plants, and sites of the NSE have undertaken a number of efforts to accelerate progress on stockpile and enterprise modernization and improve mission outcomes. A number of pilot efforts have begun to identify the most promising approaches. One pilot is focused on streamlining the management of mid-scale commercial-like construction projects and applying industry standards such as OSHA regulations for safety to speed delivery. In another example, sites across the NSE are working together to expand use of digital engineering by implementing common software and file types where practical to improve handoffs of information. Other efforts are focused on building stronger partnerships across sites to improve technical

decisionmaking and risk management.

Toward a Modern Nuclear Security Enterprise

Adoption of modern manufacturing approaches and technologies is one of the key opportunities as the production enterprise is recapitalized. Three decades of stockpile stewardship advances have greatly expanded knowledge of the science and engineering of nuclear weapons and the tools to allow assessment of new materials and new manufacturing technologies with an increased focus on designing for manufacturability. This will improve the ability to meet military requirements, eliminate materials that are difficult to produce or hazardous to workers, and minimize waste during manufacture. Similarly, integration of digital engineering techniques can improve information flow between the design and production sites, allow for design optimization and consideration of manufacturability during design, and provide a digital thread for a warhead that runs through design, engineering, and production.

There are numerous opportunities being pursued from use of additive and other advanced manufacturing technologies to more agile approaches to the design to production cycle. One significant bottleneck is the inspection and qualification of components. New automated on-machine inspection processes hold promises for speeding this process and significant efforts to expand the supply chain for important components and materials are underway. Tools like machine learning and artificial intelligence are allowing for enhancement of models using data from highfidelity experiments and rapid iteration of designs to optimize manufacturability and performance. These enhanced simulation tools together with new exascale highperformance computers will allow for more targeted experimentation and testing, which should speed progress. There have been some early modernization program successes in this arena but there is much more work to be done across the labs, plants, and sites in partnership with NNSA.

Over the next several years, introduction of additional advanced manufacturing approaches, enhanced use of artificial intelligence and machine learning tools to improve the entire warhead lifecycle, and use of agile approaches promise to continue this important modernization of the enterprise. Given the age of the stockpile, the risk balance is shifting from placing a premium on minimizing change (in order to stay as close as possible to still-robust legacy systems) to having to incorporate new approaches to facilitate replacement of systems that are moving well beyond their original design life.

Toward Enhanced Partnerships

More than a decade focused on conservative life extension programs (which have focused on replicating previous specifications) has meant that the traditional give and take between designers and production staff was not exercised extensively. Even more significantly, the past decade of significant program growth coupled with the natural pace of retirements of experienced staff has led to a demographic shift in the NSE workforce. At most sites, about half of the workforce has less than five years of experience. While this is an opportunity for new ideas and fresh perspectives, it also requires a substantial increase in mentoring and management support to help new staff learn quickly and effectively. As today's modernization programs introduce new technologies, materials, and approaches, it is imperative that strong partnerships and collaborations are built between the labs, plants, and sites to facilitate rapid and effective technical decisionmaking.

A number of initiatives are underway to build these partnerships, including exchange of staff between design and production sites, regular management engagement across sites to speed decisionmaking and problem solving, and highly integrated product realization teams dedicated to technical problem solving.

Conclusion

The rapidly evolving nuclear security environment demands that the U.S. nuclear security enterprise be able to deliver needed capabilities more rapidly. Today the NSE is focused on recapitalization of legacy capabilities and facilities to meet the demands of the current program of record. It has become increasingly obvious that more dramatic change will be required to meet the needs of the deterrent today and into the future. This will require a shift away from highly conservative technical decisionmaking to a risk-informed approach, the adoption of modern manufacturing technologies and approaches and embrace of digital tools, and the creation of an enterprise that is much more highly integrated than at any time during the SSP era. While work is underway to begin this transformation, bold actions will be required to build an NSE that can meet the challenge of the coming decades.

Nuclear Security Priorities for an Uncertain Future

Brad Wallin

The world is at an inflection point. Aggressive advances in nuclear weapons development by Russia, China, and North Korea are concerning and have exposed a lack of investment by the United States in fundamental nuclear capabilities since the end of the Cold War. In the pages that follow, I will outline the principal problems that have slowed down U.S. modernization programs, highlight areas of optimism, and lay out four key areas where U.S. nuclear programs should focus in the future to maintain a competitive edge against our adversaries.

A Deteriorating Security Environment and an Aging Enterprise and Stockpile

Russia has been aggressively modernizing its nuclear arsenal for over a decade and has thousands of non-strategic, non-treaty accountable nuclear weapons. Vladimir Putin has threatened nuclear use multiple times in his war on Ukraine. As Ukraine appears to gain the upper hand in the conflict, Russia could feel the need to counter perceptions of weakness through use of low-yield nuclear weapons. China has moved dramatically from a stated policy of wanting only enough weapons to defend itself to an apparent desire to be a peer with Russia and the United States in the 2030s. They have spoken of explicit reunification of Taiwan by military means if necessary. More dangerous is China's enormous investments in science, technology, and engineering (ST&E) that can underpin sustained competition with the United States in almost every domain, including economic, that can change the balance of world power in the coming decades. North Korea continues aggressive missile testing and threatens further nuclear tests. It is a credible regional threat, and its continued belligerence puts into focus the U.S.' commitments to extended deterrence in Asia.

The above examples are an ominous backdrop to the substantial work the United States is putting into modernizing its nuclear arsenal and capabilities. Since the end of the Cold War, the United States has refurbished or is refurbishing the W87, W76, B61, and W88. In addition, we are life extending the W80, putting the new variant on the new long range stand-off cruise missile, and replacing the W78 and the Minuteman III intercontinental ballistic missile (ICBM) with the W87-1 and Sentinel ICBM to improve mission assurance, safety, and security. Finally, we are adding a new warhead to the submarine launched ballistic missile (SLBM) fleet, the W93.

These programs come with a concomitant need to modernize our production complex. The United States stopped key production capabilities at the end of the Cold War; bringing these capabilities back is proving time consuming and expensive, albeit absolutely necessary. Plutonium, uranium, lithium, tritium, non-nuclear components, and high explosives all require new facilities and substantial investment to be able to support the program of record, which will still see several weapons systems deployed for beyond 40 years.

Fortunately, the country recognizes the above needs; stockpile and production modernization programs have largely bipartisan support. However, these efforts are experiencing significant challenges. Every system that has been modernized by the United States has seen delays in getting to first production unit, rate production, and deployment. The large construction projects required to reconstitute the production complex have all been significantly delayed due to supply chain and planning upsets. The National Nuclear Security Administration (NNSA) sites have been able to successfully hire top talent, but the overall demographics show we have a very early career workforce tasked with delivering our deterrent, and the post-pandemic work environment suggest they are susceptible to better offers from the private sector. Weapons systems that went from requirements to first production unit (FPU) in 6 -7 years historically are taking 10 -15 years to modernize. The nuclear security enterprise (NSE) has accumulated many cumbersome processes that have slowed delivery and not avoided the mistakes they were put in place to eliminate.

Priorities for U.S. Modernization Efforts

The international challenges as well as the modernization challenges make for a bleak picture of our current state, but there are several positive attributes of the current environment we should recognize and reinforce.

There is significant investment in the delivery system, warhead, and production modernization efforts. These will likely continue to see delays as we realize the full effects of the pandemic and its impact on supply chains and the workforce. We must persist in seeing these major efforts to completion. The leadership at the federal level in the NNSA and the DOD have a common view of the challenges and a shared desire to change negative trends in delivery. Similarly, the labs, plants, and sites have leadership that is working in a more collaborative way than ever before. The NNSA has identified several recommendations for improving execution, documented in the Enhanced Mission Delivery Initiative (EMDI).

There is an increased recognition that the workforce is the key to our collective success. Workforce experiences are the forefront of leaders' minds and incentives are being devised to be more competitive with the private sector to retain and continuously challenge the stockpile stewards we are hiring today.

Finally, the ST&E tools the United States invested in after the Cold War, most notably in the science-based stockpile stewardship program (SSP), have closed key gaps in knowledge of nuclear weapon science and engineering. These tools have enabled design options for the stockpile that do not require a return to nuclear testing and furthermore have provided us fundamental understanding in design space—meaning we likely will not need to return to testing unless a foundationally new need emerges. In addition, these tools have helped in restarting production by enabling new materials, new manufacturing techniques, reduced tolerances, and new inspection techniques that can increase production yield. It might be tempting in a limited budget environment to reduce funding in ST&E to fund facilities, but that would be shortsighted.

Given the above, below are the most essential things we need to do as a country to reverse the troubling trends we currently see.

Reduce Times to Deliver on the Program of Record

We must work with Congress and NNSA to improve oversight and efficiency of delivery. This can come about by leveraging the improved collaboration between sites and show that by partnering more effectively, sites can solve problems that previously required federal intervention. In exchange, NNSA can improve oversight by holding sites accountable for the behavior above and identifying only the most essential things that need to be monitored to keep projects on track. The EMDI report and associated pilot projects are a great place to demonstrate these changes, try them out in limited ways, and incorporate them as best practices for the future. Similarly, there needs to be an improved relationship between NNSA and key congressional stakeholders. Punitive requests for reports have not led to improved execution. More transparency and trust are needed.

Implement New Technologies and Approaches to Production

With the significant investments being made to once again establish production capabilities for nuclear weapon components, we need to ensure we do not merely rebuild the past. The commercial manufacturing world has seen revolutionary changes due to additive and other advanced manufacturing techniques. Our ST&E tools are sufficient to allow us to confidently change manufacturing processes and understand our requirements systematically, allowing us to understand the trade space of tolerances needed to balance meeting requirements for performance and safety with ease of production and reduce time to delivery.

Prepare for an Uncertain Future

We are modernizing the key elements of our triad in ways that are essential and will take some time. In addition to warhead modernization, the submarines, airplanes, and missile systems themselves are all overdue for significant upgrades which will take time to deliver. We must not waver from our commitment to make these improvements. The international environment is changing quickly. We may need some new capabilities on shorter timescales than the above will allow. The history of nuclear weapons development is replete with examples where designers had to design around challenges in production. We can identify options to reuse some components, existing delivery systems, and leverage untapped capacity in non-standard facilities within NNSA to deliver novel capabilities that can improve our deterrent. The ST&E tools of stewardship give us confidence that we can pursue new designs without a need to return to nuclear testing. We must couple this with capabilities that evaluate deterrence options in the near and long term with a variety of different threat projections. A more systematic look at these options will likely identify opportunities we are not pursuing that can enhance

deterrence and assurance.

Attract and Retain an Expert Workforce

The NSE has seen significant growth in the past decade and most sites are understaffed to meet their full commitments doing business the way we currently do it. Most sites have been able to hire top talent to join the mission, but the post-pandemic environment has been challenging for retention as technical experts can find higher pay and more flexible work from home opportunities in other fields. Several options can lead to an improved ability to satisfy the NSE workforce needs. We can compete with external companies that may offer more salary and benefits by emphasizing the overall experience we can offer employees, including opportunities to work on the national security mission and pre-eminent ST&E tools. We must invest in basic infrastructure of our sites (offices, labs, power, and roads, for example) for our must-be-onsite workforce, use accurate benchmarks to decrease salary and benefit differentials with commercial industry, and make our culture more inclusive and welcoming for the diverse perspectives we need to solve our national security challenges.

In closing, the international environment is ominous, and we have not done all we can to efficiently deliver deterrent capabilities to the policymaker or warfighter. We must take the opportunities we have to reverse current trends and reduce delivery times, modernize production, prepare for an uncertain future, and attract and retain the experts who are the real deterrent. The underlying foundation that is essential to the above goals is a pre-eminent ST&E base that must continually be sustained and modernized. It is from this that we can certify without testing, qualify more efficient methods of production, anticipate adversary advances, and compete for the talented workforce that will make up the backbone of our deterrent of today and the future.

Fit for Purpose? The Enterprise in an Era of Strategic Competition

Charlie Nakhleh

The international conflict in the summer of 1914 consisted of two wars, not one. Both were started deliberately...The wars were about power...Both Germany and Austria believed themselves to be on the way down. Each started a war to stay where it was...Although soldiers in the trenches for the four long years beginning in 1914 came to believe that the war was pointless, that was not so. It was about the most important issue in politics: who should rule the world."

In 1992, unlike in 1914, the "most important issue in politics" appeared to have been decided decisively: the liberal democratic West, led by the United States, was to rule the world. The abrupt collapse of its most powerful ideological, political, and military rival after almost five decades of tension and episodic terror was unexpected. Expected or not, the inevitability of the West's triumph was soon rationalized and then just as quickly assumed to be permanent. Now, some 30 years later, that most fundamental of questions is being asked again and new answers are being offered and debated in myriad ways.

In 2023, unlike 1914, the great powers striving to attain or undermine dominance are doing so under the considerable shadow cast by nuclear weapons. Both the bipolar strategic competition of the Cold War and the unipolar moment of the post-Cold War era are now in the past. Many recent discussions have noted that the current and coming era is, from the perspective of the United States, a two near-peer or two-peer era. From a more detached perspective, the analogy of the famous (and chaotic) threebody problem of orbital mechanics is now frequently used to describe the emerged and emerging strategic situation.

In addition to the continuing presence of the first major land war in Europe since 1945—a war that has seen the latent possibility of, and official worry over, nuclear employment by one of the combatants—the last two years have also revealed a Chinese nuclear buildup of notable scale and ambition.¹² The end state of this expansion remains unclear, as do its underlying motivations. No satisfactory answers to these questions can be given, certainly not by outsiders and perhaps not even by those directing the expansion. In a sense, the answers themselves aren't of overwhelming

¹¹ David Fromkin, Europe's Last Summer (New York: Vintage Books, 2004), pp295-296.

¹² The Chinese "modernization, diversification, and expansion of its nuclear forces" has been discussed thoroughly in the Department of Defense's Annual Reports to Congress on the *Military and Security Developments Involving the People's Republic of China*. The quote here is taken from the preface of the 2022 report, which can be found at https://www.defense.gov/CMPR/ (accessed July 21, 2023). This report exhaustively documents the relevant military developments in East Asia in both the nuclear and nonnuclear spheres.

practical significance. What is important to have in hand are clear answers to two different questions: What should be done in response? And how should we set about that task?

One plausible response to the worsening situations in both Europe and in East Asia as well as the changing global strategic nuclear balance answer is to stay the present course of modernization and recapitalization, as outlined in the unclassified 2022 Nuclear Posture Review (henceforth, the NPR), with relatively little adjustment.¹³ The degree of continuity of the current NPR with the two previous posture reviews, carried out in 2010 and 2018 by widely different administrations, is itself remarkable when one considers the dramatic changes in the strategic environment between 2010 and 2022.

Of course, such a choice would not be without consequences, and there remain debates over the likelihood and implications of those consequences. For example, some analysts fear that simply staying the course without adjustment could lead to a general weakening in the belief on the part of adversaries and allies alike in the capability or willingness of the United States to extend deterrence to its allies and partners who, by geographic necessity, are located far from America's shores.¹⁴ An alternative answer, one that an unscientific survey of regular off-the-record conversations would indicate appears to enjoy wide support, is that the emerging situation is sufficiently novel that meeting it successfully requires significant adjustments to the current course of action. Many possible adjustments to the current path have been proposed and debated, in both conference dialogues and print, but I would like to put the specifics of those proposals and debates to one side for now and take a more strategic view.

Let us assume that we have decided to respond to a more complex and darker security environment with a course of action for the nuclear deterrent that departs from the present one. The question that will concern me for the balance of this brief comment is not *what* the specifics of that course of action should be, but *how* we should undertake that course of action. We could also frame this as an issue of competitive *fitness* and ask ourselves what we, as a Nuclear Security Enterprise (NSE),¹⁵ must do to ensure that we are sufficiently fit to prevail in the coming competition?

The first, and most important, thing to do is also the simplest: Acknowledge, indeed emphasize, the importance of the nuclear deterrence mission. Decide that it is important, say so, and stop accepting the unacceptable as we execute that mission. These are psychological and verbal actions, and their importance is fundamental. The NSE needs to challenge and change the modes of thought that have colonized its collective brain over the last 30 years and then communicate those changes until

¹³ The NPR, together with the National Defense Strategy (NDS) and Missile Defense Review (MDR) can be found at https://www. defense.gov/National-Defense-Strategy/. Accessed July 21, 2023.

¹⁴ See, e.g., pp47-48 of the report of a study group convened at Lawrence Livermore National Laboratory, *China's Emergence as a Second Nuclear Peer* (Livermore, CA: Center for Global Security Research, 2023), which can be found at https://cgsr.llnl.gov/research/ occasional-papers. Accessed July 21, 2023.

¹⁵ I interpret the term NSE broadly to include all elements and organizations that support the nuclear deterrence mission under the auspices of both the Departments of Energy and Defense.

something like a shared awareness about the importance of the mission is broadly disseminated throughout all aspects of the NSE.

At first blush, it seems that the appropriate response to this recommendation is a puzzled glance. After all, isn't the importance of the mission obvious? Didn't we all get the memo? To get a sense of the muddle the surrounds the message, it's worth quoting at length a passage from the conclusion of the NPR:

We fully recognize the enduring importance of a nuclear policy that balances the evolving demands of deterrence with our goal of taking steps to reduce the role of nuclear weapons in our national security strategy, and thereby reducing the salience of nuclear weapons globally. We will work with a sense of urgency to reduce the danger of nuclear war, which would have catastrophic consequences for the United States and the world. Developments in the security environment make these goals more challenging and more pressing to pursue. However, we can only make progress in these respects if we are confident in the ability of our nuclear posture to deter aggression and protect our Allies and partners. Thus, for the foreseeable future, nuclear weapons will continue to provide unique deterrence effects that no other element of U.S. military power can replace.¹⁶

This statement reflects competing interests: a strong desire to get away from nuclear weapons altogether, a desire rooted in an understandable fear about the possible consequences of nuclear war and a clear recognition that nuclear weapons play an important, indeed irreplaceable, role in U.S. national security strategy. It is not until the end of several involved sentences outlining the benefits of disarmament that the reader comes upon a rather grudging acknowledgment of the importance of nuclear deterrence. The policy is at its root confused and reflects deep tensions between different schools of thought in the policy debate. Such tensions are not new. There are many discordant voices both inside and outside government struggling to have their views reflected in nuclear policymaking. The strong tendency in policy formulation is to "balance" these views, as the quote suggests. Unfortunately, "balance" often means a simple juxtaposition of nearly incompatible statements. A confused and garbled message is the inevitable result.

The shared awareness of the importance of nuclear deterrence that I have argued is essential to the new era will require relentless repetition of clear and ungarbled messages about the importance of nuclear deterrence from the top to the bottom of the enterprise. A choice will have to be made; and the first essential step is realizing that a choice is upon you.

The second thing that the NSE needs to change is its modes of behavior. The recent *Evolving the Nuclear Security Enterprise* report, known commonly as the Enhanced Mission Delivery Initiative or EMDI report, notes that "an emphasis on compliance"

¹⁶ Ibid., p25.

has led to "risk aversion at multiple levels" within the NSE.¹⁷ Plainly put, there is an enormous amount of negative-value-added administrative work that is currently tolerated—indeed required—in all aspects of the NSE's endeavors. This problem occurs at all scales in the enterprise—it is, to borrow another analogy, a fractal problem—and the NSE would do well to map out in detail the oft-hidden sources of these obstacles and then set out a goal of reducing them by an order of magnitude at least.

It is important not to underestimate the difficulty of addressing this problem. The U.S. government, considered together with all the organizations private and public that support its efforts, is a siloed organization in general and the NSE is no exception. There are no simple high-level fixes to the problems of risk aversion and exponential growth in bureaucratic busy work. Some roadblocks only emerge at remarkably low levels within the enterprise. Many examples can be given from all aspects of the business. If it were simply a question of fixing one or two or 10 high-level impediments, it would have been done long ago. In short, we are facing a system-level problem.

Fortunately, there are some approaches available to help a siloed NSE respond effectively to the increasingly dynamic environment it confronts. Small, empowered cross-functional teams drawn from all elements of the NSE should be established to achieve specific mission goals. These teams, sometimes called "fusion cells" or "teams of teams" in the literature, would have to be empowered to identify obstacles to accomplishing the mission and then solve, and not merely admire, the problems they identify. To ensure that they are so empowered, these teams would have to report out at a very high level in the enterprise so that their actions can be pushed down against the objections of key elements in an uncomprehending, and perhaps unwilling, enterprise. The teams would have to be co-located, by some combination of physical and virtual means, to ensure that they develop the bonds and trust needed to identify and overcome obstacles to mission success. They would also have to be networked together so that information and successful solutions can be shared quickly. Experience with successful fusion cells has shown that the members of such teams must be selected carefully. Importantly, however, the team's members do not have to change their organizational affiliation-indeed they must be trusted representatives of their home organizations, able to speak both authoritatively for, and candidly to, those organizations.¹⁸ Setting up such teams does not require wholesale reorganization of the government. Once the specific mission of a team has been achieved, the team can be disbanded, and its members sent back to their home organizations to work on other problems and other teams. Fusion cells can be done well or badly, but when done well, they offer the hope of helping a siloed organization effectively confront a dynamic and

¹⁷ While not as comprehensive in its aims as might have been wished, the EMDI report is concise, clear, and contains six major findings and 18 recommendations that merit careful consideration. See L.Y. Barela, S. Ho, C.L. Kittock, P.D. Rodrick, J.A. Tilden, and K.C. Wallace, *Evolving the Nuclear Security Enterprise: A Report of the Enhanced Mission Delivery Initiative*, National Nuclear Security Administration (September 2022). The quoted phrase is on p4.

¹⁸ Such cross-functional teaming approaches have been recommended and implemented in various contexts, e.g., the Goldwater-Nichols legislation of 1986, the 9/11 Commission Report and subsequent reforms, and many others.

decentralized foe.

Such methods will be bureaucratically difficult to implement and sustain. Nor would they be necessary if the security environment now were as benign as was hoped it would be in the early days of euphoria after the fall of the Berlin Wall and collapse of the Soviet Union. It's important to remember that those heady days are now as far away from us as the occupation of Czechoslovakia by Hitler was from the Tet Offensive. They are now a part of the historical record. We no longer live in the early 1990s; we live in the present and will live in the future. We have evolved and inherited collective modes of thought and behavior that are suited to the problems of the past. But it is the problems of now and tomorrow that are ours to solve.

Sustaining and Strengthening Nuclear Deterrence through the Inflection Point

Drew Walter

Introduction

Due to a confluence of programmatic, geopolitical, and technical factors, the U.S. nuclear deterrent has reached a critical juncture. After decades of deferral, the United States has now embarked upon an across-the-board, just-in-time effort to modernize and replace the capabilities and systems that comprise our nuclear deterrent. Platforms, delivery systems, and warheads in each of the three legs of the nuclear triad are well beyond their original design life, as are foundational parts of the nuclear enterprise's production infrastructure and nuclear command and control system-and nearly all of these elements are in urgent need of replacement. These activities, which were first planned more than a decade ago in a decidedly different geopolitical environment, are required to simply maintain today's posture against today's threats. At the same time, the strategic threats posed by China and Russia are increasing both quantitatively and qualitatively, raising questions about whether the planned nuclear modernization Program of Record will be sufficient to pace the threats of tomorrow. The Department of Defense (DOD) has long committed to nuclear deterrence as its top-priority mission. That commitment must be backed by focus, urgency, and integrated decisionmaking if the United States is to sustain and strengthen nuclear deterrence through and beyond the inflection point.

U.S. Nuclear Forces in Transition

For over a decade, DOD and the Department of Energy's National Nuclear Security Administration (NNSA) have predicted a nuclear modernization mountain—where simultaneous recapitalization across the nuclear enterprise would require major increases in activity, budgets, and workforce. Having made initial progress in the transition from an enterprise in "sustain-and-repair" mode to one with the capabilities and capacities necessary to support broad modernization, DOD and NNSA are now more than halfway up that mountain. But finishing the task—in other words, fielding a modern deterrent before legacy systems age out while also rebuilding the enterprise itself—will be an enormous challenge.

While the current U.S. arsenal is safe, secure, and effective, nearly all nuclear deterrent systems are operating well beyond their original design life: Both the Minuteman III, first fielded in 1970, and the AGM-86B Air-Launched Cruise Missile (ALCM), first fielded in 1982, were designed to last 10 years; OHIO-class ballistic missile submarines are scheduled to serve for 42 years before they are retired, well beyond their original 30-year design life; and B-52 bombers, first fielded in 1961, are likely to continue to be a workhorse of the air leg of the nuclear triad until they

are nearly 100 years old. Although many decades of heroic sustainment efforts have allowed the United States to maintain a viable and credible nuclear deterrent based on these Cold War-era systems, sustainment alone cannot ensure that these capabilities continue to deter indefinitely. Life extensions are no longer an option.

Consequently, nearly all DOD nuclear delivery systems and platforms are being replaced. Six major nuclear modernization programs, at various stages in the acquisition process, are proceeding simultaneously: the Sentinel intercontinental ballistic missile (ICBM), the COLUMBIA-class ballistic missile submarine, modernized Trident D5 submarine-launched ballistic missiles (SLBM), the B-21 bomber, the Long-Range Standoff (LRSO) cruise missile, and the F-35A Dual Capable Aircraft. DOD is also updating and replacing hundreds of capabilities that make up the nuclear command, control, and communications system. While these modernization programs push full steam ahead, an oversubscribed defense industrial base, supply chain and workforce challenges, as well as sheer programmatic complexity mean these programs may be challenged to deliver on time. And with the nuclear enterprise under pressure to sustain legacy capabilities so that aging systems such as Minuteman and OHIO remain fully capable until the day they are replaced by their modern counterparts, all margin has disappeared between the end-of-life of existing systems and the fielding of their replacements.

Ultimately, programmatic risks in nuclear acquisition and sustainment programs, if realized, flow back to U.S. Strategic Command and endanger its ability to meet deterrence and assurance objectives laid out by the president and the secretary of defense. To prevent this, DOD is carefully examining and acting on both risks and opportunities during the transition from currently fielded capabilities to their modernized replacements. Decisions related to B-21 production and end-of-life-margin in OHIO submarines and Minuteman III missiles have sought to mitigate and manage transition risk. But these and other recent actions were, in some ways, the low-hanging fruit—leaving only more difficult choices ahead.

NNSA is also racing to recapitalize its capabilities in time to field needed replacements for aging nuclear bombs and warheads. Following the Cold War, the NNSA development and production enterprise was downsized and scaled to execute life extension programs in a sequential manner, resulting in an enterprise inherently lacking resilience, robustness, and flexibility. NNSA is correcting this course, funding both large and small infrastructure modernization efforts that will eventually create the capacity and resilience needed.

While this long-term effort is underway, NNSA is still capable of agility and resilience if requirements are appropriately scoped and opportunities are recognized. Take, for example, NNSA's recent success to quickly produce and field the W76-2 lower-yield SLBM warhead. With a leadership imperative, narrow requirements, and an open production line, the enterprise moved swiftly to field the W76-2 and filled a need identified by the 2018 Nuclear Posture Review (NPR). Following this effort, NNSA proceeded to produce the B61-12 bomb and the W88 ALT 370 SLBM warhead. Next, the

warhead program will shift to the W80-4 that will arm LRSO, followed by the W87-1 ICBM warhead and the W93 SLBM warhead. Each successive program will be increasingly complex and more difficult than the previous, with the decisions made on an individual program likely to have repercussions for programs further down the line.

In particular, the W87-1 and the W93 represent two important lodestars for the nuclear enterprise. The W87-1 is driving the reinvigoration of the NNSA production enterprise and key parts of the DOD industrial base, which were deprioritized and allowed to atrophy for decades. The W93 is the first new nuclear warhead program the United States has pursued since the end of the Cold War, marking the end of the era of refurbishment. When fielded, W93 will provide the balance, flexibility, and adaptability for the sea leg of the triad directed by the 2022 NPR.

More Threatening International Security Environment

The threat environment has changed dramatically since the current U.S. modernization plan was established in the early-2010s, with both Russia and China presenting increasing risks to the United States, our Allies and partners, and international stability. Russia has clearly demonstrated it will leverage nuclear weapons to achieve its revanchist and revisionist geopolitical objectives—most blatantly in its illegal and unprovoked invasion of Ukraine, which has been backed by repeated and dangerous nuclear threats to keep the West from direct engagement. More recently, Moscow unlawfully suspended its involvement in the New START Treaty, the last remaining limit on its nuclear forces. Russia continues to develop unique, never-before-seen nuclear capabilities—including a high-speed, nuclear-powered, nuclear-armed autonomous underwater weapon and a nuclear-powered, nuclear-armed cruise missile. Russia also fields the most diverse nuclear force in the world, with dozens of different types of strategic and non-strategic nuclear weapons including nuclear landmines, undersea mines, torpedoes, artillery shells, cruise missiles, ballistic missiles of all ranges, and nuclear-armed ballistic missile interceptors.

China, for its part, has also dramatically altered its nuclear posture since 2010. China is now in the process of rapidly expanding its nuclear arsenal; its longstanding "minimum deterrent" arsenal of a few hundred warheads is projected to grow to 1,500 by 2035, including many new capabilities for theater and regional nuclear strikes. China now fields a full nuclear triad and is rapidly expanding both the quantitative and qualitative aspects of its nuclear arsenal. The pace of China's expansion of its ICBM fields in central and western China indicates the priority and seriousness of this effort to Chinese Communist Party leadership. China's growth is being enabled, in part, by highly enriched uranium (HEU) that Russia is providing to fuel China's CFR-600 breeder reactors. While supposedly for civilian purposes, this Russian HEU in Chinese breeder reactors will almost certainly be used to produce plutonium to enable the rapid expansion of China's nuclear weapons stockpile. Worryingly, this may also portend additional future cooperation between Moscow and Beijing on nuclear issues that would increase the nuclear threat to the United States and our Allies and partners.

The current U.S. modernization plan was essentially established by the 2010

NPR and was shaped by and for the security environment of that time. With minor adjustments, including the W76-2 and the natural follow-on of the W93, DOD and NNSA are executing a Program of Record set out over a decade ago. Unfortunately, the international security environment has deteriorated through the 2010, 2018, and 2022 NPRs—and continues to deteriorate. The Program of Record that the United States is currently executing is clearly more necessary than ever, but it is also no longer sufficient to address the worsening international security environment.

The Promise of a Responsive Nuclear Infrastructure

The combination of a triad in transition and a worsening security environment leaves the United States in a challenging position. Successive NPRs have given DOD and NNSA the direction to build a responsive nuclear infrastructure and enterprise to ensure the United States is able to quickly address emerging threats and meet new requirements. However, the unfortunate reality is that while infrastructure modernization plans are in place and being executed, today's nuclear enterprise and industrial base do not yet have the capabilities, capacity, resiliency, or agility needed to meet the needs of an increasingly complex security environment.

In the early nuclear era, the ever-present threat of nuclear annihilation posed by the Soviet Union sparked an incredible breadth and pace of innovation. New facilities and manufacturing processes were established at breathtaking pace, leading to the rapid development and fielding of nuclear capabilities. When new threats and requirements emerged, the U.S. defense industrial base and nuclear complex were able to rapidly provide the Nation with the capabilities necessary to solidify deterrence. In the post-Cold War years, with nuclear threats thankfully much less pronounced, national imperatives shifted to other priorities and the innovation and production agility supporting the nuclear deterrent waned. The United States moved to rely on legacy capabilities, including a reserve of nondeployed warheads, to hedge against technical and geopolitical uncertainty—and the core responsiveness that the United States retained was the ability to upload additional warheads. Successive NPRs have recognized the need to supplement this upload hedge by building an infrastructure capable of responding to new needs in a timely fashion.

While the United States has made some progress in reconstituting an agile nuclear enterprise, significant shortcomings remain and realization of a truly responsive DOD-NNSA enterprise remains a goal. The enterprise is prioritizing and pursuing this challenge, but it will undoubtedly take many years to recover because so much was lost. There are risks in: (1) the defense industrial base's capacity to produce key components and subsystems, (2) the current and future workforce, (3) securing the supply chain, and (4) protecting against cyber threats, among other areas. For instance, DOD spent 30 years downsizing its test infrastructure to accommodate planned programs and nothing more. As a result, the Department now faces challenges fulfilling demand for flight testing and testing radiation-hardened microelectronics.

NNSA also faces significant production capability and capacity challenges. NNSA's post-Cold War enterprise lost much of its manufacturing base, with key production

capabilities simply gone and remaining capacity sized only for occasional life extension and refurbishment. While plutonium pits are incredibly important and NNSA's ability to produce them gets lots of rightful attention and needed funding, pits are also the bright and shiny object—easy to see and understand. Other key production lines of effort that NNSA needs to produce the Nation's nuclear warheads get less attention and likely carry similar risk. NNSA's plans to recapitalize production facilities related to enriched uranium and lithium are two important examples.

Beyond the production base, the enterprise also lacks the muscle memory and process memory necessary to execute programs and deliver on new requirements quickly. We are now out of time to perform the herculean tasks needed to reestablish capabilities and capacities that are essential to producing a modern nuclear deterrent. While no one pines for the days of the Cold War and the very real threat of nuclear annihilation that hung over the world, our nuclear enterprise must regain just a fraction of its past agility and capability if we are to sustain and strengthen nuclear deterrence for the long term.

Managing Risk During the Transition and Beyond

To facilitate the transition from a legacy deterrent to a modern one, and to adapt to the changing security environment, DOD has begun to actively manage risk and seek opportunities through the Nuclear Weapons Council (NWC). While historically the NWC's responsibilities and enabling statute largely focused on the nuclear stockpile, recent leaders across administrations and in Congress have entrusted this body with additional responsibilities to take a more holistic, broad, and integrated view of the deterrent. This includes recent and mutually-reinforcing responsibilities assigned by the secretary of defense, the 2022 NPR, and the National Defense Authorization Act for Fiscal Year 2023, which empowered the NWC to more proactively identify, assess, and manage risks and opportunities across the nuclear deterrent and enterprise and advise the deputy secretary of defense through semi-annual meetings of the Nuclear Deputy's Management Action Group (N-DMAG).

To support this and its broader decisionmaking responsibilities, the NWC has developed and implemented a strategic framework founded on identifying and ranking its priorities to understand and make integrated and risk-informed choices and tradeoffs. Aspects of this framework include pacing the threat, production and resiliency, operational objectives, Allies and partners, schedule, geopolitical environment and hedge, affordability, and surety. This framework has made clear that the NWC can no longer make individual decisions related to individual programs and, instead, must trade and balance risk across the entire nuclear enterprise with the objective of making decisions that prioritize what is best for the nuclear deterrent as a whole.

The NWC will always need to address nearer-term issues that arise with sustainment and modernization programs. For example, the NWC recently decided to adjust the schedule for W80-4 production due to unforeseen schedule impacts and technical issues. The NWC was keenly interested in how this shift would not only affect the planned initial operational capability date for LRSO but also whether a schedule decision on W80-4 would negatively impact W87-1, W93, or other future warhead programs.

While addressing these kinds of vital, nearer term stockpile management decisions, the NWC simultaneously, proactively, and intentionally seeks to plan for the long term. As part of this effort, the NWC has updated its requirements and planning process and is actively engaged, within the policy framework provided by the 2022 NPR, in various studies related to future requirements and capabilities. Key study topics include force size, resource requirements, risk mitigation opportunities, technology insertion opportunities, opportunities to accelerate programs, pacing the threat, contingency planning, and concept studies for two future warheads—funding for which is included in the president's Fiscal Year 2024 budget request.

The NWC has engaged in robust discussion on what choices are available to improve the United States' ability to pace the threat, in addition to crystallizing what "pace the threat" even means. The NWC and N-DMAG are seeking long-term solutions for capabilities of the future, but are also looking for what DOD and NNSA can do in the near term with what they already have or can quickly produce. While the U.S. nuclear deterrent presents a serious challenge to any potential adversary, that challenge has been largely static for the past 40 years. Given developments in Russia and China's nuclear capabilities, activities, and ambitions in the past decade, the United States must be prepared to reinforce deterrence by fielding capabilities in the short term that can present Moscow and Beijing with new, different, and unanticipated challenges. Further, DOD and NNSA must continue to think creatively and explore options and opportunities to do this without significantly upending the existing and essential Program of Record. NWC leaders have encouraged creative thinking on how to achieve this objective and contribute to deterrence in the near term, while preserving decision space for senior leaders to determine whether those creative ideas should progress beyond concepts and into development.

Conclusion

Implementing the direction of the 2022 NPR to field "a balanced, flexible stockpile capable of pacing threats, responding to uncertainty, and maintaining effectiveness" requires a coordinated, integrated, and urgent effort across all nuclear enterprise stakeholders. While DOD and NNSA are steadfastly climbing the mountain of activity required to modernize our nuclear force while maintaining fielded capabilities, it is now clear that the mountain is more of a plateau. A tremendous amount of sustained, focused, and long-term effort will be required to meet the Nation's future deterrence and assurance objectives. It is also clear that a key assumption for the past 10+ years as we began to climb the mountain was that this modernization plan was fixed and sufficient. Unfortunately, increasing threats from China and Russia lay bare this assumption—the adversary gets a vote and has voted, and U.S. plans must change accordingly.

The U.S. nuclear enterprise is still rebuilding to meet this challenge, but now must execute programs while simultaneously recapitalizing production capabilities. Plans

are in place and strong leadership and significant resources have the trendline on a positive trajectory, but the slope may be too incremental—step function change may be required. Collectively, DOD and NNSA must find innovative ways to go faster, streamline processes, make better and more integrated decisions, simplify requirements, and incorporate modern technology. While the challenges will become increasingly complex, the opportunities are immense. It is an exciting time to be a part of the U.S. nuclear enterprise at this historic inflection point.

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Against the complex international nuclear landscape, the nuclear security enterprise must increase its responsiveness. We need to take advantage of the good in our culture and to appreciate the things we did right in the past, but we must also look for every opportunity to accelerate progress and modernize approaches. There is room to improve design, production, construction, technology deployment, and science. The last several decades of searching for flaws and seeking complete understanding of an aging stockpile needs to transition to problem solving and timely deployment of a new stockpile. This is a big shift in mindset and a change in focus, but the work will be rewarding, and the outcomes are needed.

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