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A NEW STRATEGIC REVIEW FOR A NEW AGE

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A New Strategic Review for a New Age

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Preface

Contemporary U.S. plans for the modernization of nuclear forces are an approximately 15-year-old legacy of the Obama Administration. They were not established in anticipation of the dramatic changes in the security environment since 2010—when it was assumed that a one-for-one replacement for the legacy nuclear delivery systems and the New START Treaty limit on nuclear weapon numbers would be more than adequate. Rather, the existing nuclear modernization program was established at a time when many U.S. officials continued to believe that U.S. relations with Russia and China were relatively benign and would remain so, or improve further. How the contemporary nuclear program, largely inherited from the Obama Administration, fares over the next few years, and how the new presidential administration entering office in 2025 decides to adapt the U.S. nuclear posture for the much more dynamic and dangerous contemporary threat environment will affect the US strategic and non-strategic nuclear posture for decades, and, correspondingly, U.S. deterrence strategies and options.

The goal of this study and report is to provide analyses and recommendations that help to inform the direction of the new administration's nuclear policy. The study examines several key issues: developments in the international threat environment; U.S. deterrence goals in that contemporary threat environment; needed adjustments in U.S. deterrence strategies and force posture, and for the assurance of allies; and, near-term initiatives and decisions needed to enable the United States to move toward a force posture that is fit to address contemporary threats. Unfortunately, given the past four decades of deep U.S. strategic and non-strategic force reductions and the

atrophying of the U.S. nuclear production infrastructure, the United States has a limited near-term capacity to strengthen its nuclear force posture in response to an unprecedentedly threatening security environment. Given contemporary threats, whatever may be the preferred nuclear force posture and characteristics for deterrence and allied assurance purposes, the reality is that U.S. options for adjustment are largely limited through the early 2030s by available nuclear systems and warheads.

Consequently, important issues of this study include: understanding the difference between the desired force posture and what is likely to be practicable in the near term; and, identifying near-term actions and decisions that could help adjust the posture to the extent feasible in coming years. In particular, it is important to identify decisions and actions regarding the nuclear force posture and infrastructure that could/should be made now to help put the United States in an improved deterrence position. In addition, the potential value of strategic missile defense warrants a new look given looming threat conditions and the Trump Administration's new strategic missile defense initiative, i.e., "Golden Dome."

Finally, in the contemporary threat context, most U.S. allies highly value the U.S. extended deterrent. Unfortunately, the current U.S. nuclear replacement program may be insufficient to assure at least some allies confronting tough security conditions. Even though U.S. allies rarely publicly comment on U.S. programmatic decisions, some allies openly expressed concerns in 2010 about the retirement of the Tomahawk Land Attack Missile-Nuclear and more recently about the Biden Administration's efforts to terminate the replacement SLCM-N. Allied concerns about the continuing credibility of the U.S. extended nuclear deterrent have led some to openly discuss the option of acquiring independent nuclear capabilities.

As long as allies are a critical element of U.S. security – which is likely to be the case for the foreseeable future – the analysis of, and recommendations for U.S. nuclear policy and forces must take into account requirements for extended deterrence and the assurance of allies, which is a key to alliance cohesion. This study is conducted in full recognition of this reality and seeks to offer recommendations that help to correct emerging problems in this regard.

Great appreciation is due to each of this report's co-authors, whose diligence is evident throughout its pages. Many thanks also are due to the Senior Reviewers, who generously provided their time, suggestions and guidance; their immense combined expertise and experience were critical to the study's outcome and value. Finally, Amy Joseph, once again, deserves great thanks for producing a complicated final report, and a series of earlier spin-off articles with her usual extraordinary skill and patience.

Fairfax, Virginia

Dr. Keith B. Payne

Chapter 1

Tailored Deterrence and Low-Cost Nuclear Weapons Upload

Executive Summary

Introduction

Before the end of its tenure, the Biden Administration pointed publicly to the Russian, Chinese and North Korean nuclear force buildups and the potential need to strengthen U.S. nuclear capabilities in response to these threats. These assessments came in the context of Russia's ongoing horrific campaign against Ukraine and Chinese President Xi Jinping's order that China be prepared to invade Taiwan by 2027.

Particularly troubling, the United States may have significantly underestimated Russian and Chinese nuclear capabilities. For example, the extent to which Russia may have uploaded its strategic nuclear forces is uncertain. Moscow had been in violation of the New START Treaty for two years when it illegally "suspended" the entire Treaty. Russia has had sufficient time to upload its strategic force since the last inspection in March 2020.

Contemporary U.S. plans for the modernization of nuclear forces are an approximately 15-year-old legacy of the Obama Administration and they are moving slowly. They were established at a time when many U.S. officials believed that U.S. relations with Russia and China were relatively benign and would remain so, or improve further. Now, there is an emerging Sino-Russian entente, a Russo-North Korean alliance, and extensive Russo-Iranian-North Korean cooperation in a major war against Ukraine, a Western partner. These marriages of convenience are

organizing around the clear common intent to overthrow the post-World War II liberal international order.

History has proceeded in a decidedly different direction than expected. There is potential for multiple, simultaneous geopolitical crises and conflicts, and the prospect for deterrence failure is very real. Prudence now demands strengthening U.S. deterrence and extended deterrence strategies.

Given the diversity of U.S. opponents and related variability in their decision making, the need to “tailor” U.S. deterrence strategies to diverse opponents has become a well-accepted principle of U.S. deterrence policy. This mandates deterrence strategies adapted to the range of threat requirements needed for multiple opponents and contexts—which, in turn, demands deterrence force flexibility and diversity.

While the basic U.S. approach to nuclear deterrence has not significantly changed for decades, Washington’s ability to implement it has drastically declined due to the combination of deep U.S. nuclear weapons reductions and the expansion of opponents’ nuclear and other military forces. The prospect for opportunistic or coordinated Russian, Chinese, and North Korean aggression makes this a particularly urgent concern. Given the looming threats posed by the unprecedentedly dangerous contemporary geopolitical context, and the associated expansion of Russian, Chinese, and North Korean nuclear capabilities, the United States must now consider how to strengthen its nuclear capabilities to preserve deterrence.

Today, the United States reportedly has ~1,660 deployed strategic nuclear weapons. With this level of capability, even with planned U.S. force modernization, the United States likely cannot fully hold at risk Russian and Chinese targets related to deterrence, particularly given Beijing’s new nuclear force expansion and construction of underground facilities.

Nuclear force upload is an advantageous and timely option for deterrence purposes. It is a particularly important option to sustain deterrence in the near term. The potential upload, even under the limits of New START, would provide ~2,200 warheads. The Trident SLBM force reportedly could be uploaded in months and the Minuteman ICBM force in about three to four years. The follow-on systems can extend the upload of these legacy systems. *Upload is not a substitute for the modernization program* as the existing Triad is aging out rapidly, but it may be critical for deterrence in the near term.

The New START Treaty and Upload

Significant U.S. upload now requires prompt U.S. withdrawal from the expiring (in February 2026) New START Treaty. Russia has ceased observing New START, violated its verification provisions, and may be in violation of its warhead limits. Consequently, the United States certainly has the legal right to terminate the Treaty and the strategic need to do so.

Upload is largely limited by the available number of delivery vehicles, i.e., missiles and bombers. The 2002 Moscow Treaty intentionally did not limit delivery vehicles in order to facilitate a prompt U.S. response to negative security developments. The 2001 *Nuclear Posture Review* (NPR) similarly emphasized retaining upload potential (called the “responsive force”) as a hedge against an uncertain future, and stated that U.S. forces could be uploaded in “weeks, months and years.” Unfortunately, the 2010 New START Treaty did the opposite. Given New START’s limit on *accountable*, deployed warheads (1,550), the United States can upload its strategic missile force by only 131 warheads. The ~2,200 potential upload under New START is possible because of the Treaty’s very lenient counting rules that apply to bomber weapons.

If the United States continues observation of New START limits despite Russian violations (and China's dramatic nuclear buildup), the only way to substantially increase the number of deployed U.S. nuclear weapons would be to procure many more nuclear-capable bombers and cruise missiles. Yet, more cruise missiles are not feasible until the Long-Range Stand-Off (LRSO) missile is operational (2030). Until then, a small number of B-21 bombers (with a probable *nuclear-capable* IOC in the late 2020s) can likely carry eight nuclear bombs each, based upon the reported size and payload of the B-21 bomber.

The Scope of Possible U.S. Warhead Upload

If not constrained by New START, with uploading, the Trident SLBM force reportedly could increase from ~960 to ~1,626 deployed warheads and the Minuteman ICBM force could increase from about 400 to ~1,000 deployed warheads, for a deployed strategic ballistic missile force of ~2,626 warheads. The number of warheads could be somewhat higher or lower than these estimates depending upon decisions related to necessary missile range and the required number of single warhead missiles. Additionally, there will be several hundred bomber weapons which could be somewhat increased via uploading.

In the past, the bomber force could be uploaded in a matter of weeks. However, a 2007 decision eliminated all but 528 nuclear ALCMs (now reduced by almost 20 years of testing) and all Advanced Cruise Missiles, thereby eliminating much of what otherwise would be the *most rapid* U.S. upload potential. Nevertheless, the bomber upload, with or without New START, would likely now permit ~716-~784 bomber warheads.

Table 1 below compares routine strategic force loading with the upload potential at low cost. Table 2 summarizes the potential U.S. upload, also at low cost, with and without

New START. (See Appendix A for Tables 1 and 2 references.) The number of warheads could be higher or lower than these estimates depending upon decisions related to necessary missile range, targeting flexibility, and warhead footprint considerations.

Table 1: Routine Strategic Force Loading and Upload Potential at Low Cost

Delivery Vehicle	Routine Force Loading Under New START			Potential Uploading		
	Number of Delivery Vehicles	Weapons Per Delivery Vehicle	Total Weapons	Weapons Capacity Per Delivery Vehicle	Total Weapons Capacity	Potential Warhead Increase Beyond Current Routine
Trident D5 SLBM	240	~4 W76 or W88	~960	8 W76 or W88	1,920 (~1,626) ^(e)	960 (658) ^(e)
Minuteman III ICBM	400	1 W78 or W87	400	1 W87 or 3 W78	~1,000 ^(b)	~600 ^(d)
B-52H Bomber	44	20 ALCM w/ W80 ^(a)	0 (~300) ^(a)	20 ALCM w/ W80	528 (~460) ^(c)	528 (~460)
B-2 Bomber	19 (16) ^(a)	16 B61 or B83 ^(e)		16 B61 or B83	256	256
Total Weapons	~1,360 warheads + ~300 Bombs and ALCMs = ~1,660 total				~3,342 to ~3,704	~1,974 to ~2,344

Notes

- (a) Sixteen B-2 bombers are combat coded which means they are maintained in a combat ready status for nuclear and conventional strikes. On a day-to-day basis, deployed bombers are not loaded with nuclear gravity bombs or cruise missiles, although these weapons are kept in storage facilities in or near bomber air bases. Reportedly, there are ~300 nuclear weapons deployed at the three nuclear-capable bomber bases. There are no bombers maintained exclusively for the nuclear mission. In light of the conventional role of the B-2s, diverting all combat coded B-2s to the nuclear deterrence mission is unlikely.
- (b) Three hundred Minuteman III ICBMs could carry up to three W-78/Mark 12A warheads each. Each remaining missile can carry only a single W87/Mark 21 warhead.
- (c) Each B-52H can carry up to 20 nuclear ALCMs. A 2007 decision resulted in the retention of 528 ALCMs but these have been reduced as a result of 18 years of testing. The number will continue to decline until LRSOs are deployed in the early 2030s. To deploy 460 nuclear ALCMs would require about 24 B-52s. This leaves 20 combat coded B-52s for conventional missions.
- (d) In addition to the 400 deployed Minuteman III silos and their deployed missiles, 50 silos will be retained in a non-deployed but “warm” status, with their non-deployed missiles kept in storage. If the missiles were returned to the silos, and each missile was armed with one warhead, the upload potential of the Minuteman III force would increase by 50 weapons.
- (e) The maximum upload capability is 1920; 1,626 assumes that the number of W88/Mark 5 warheads is reduced to give missiles with both warhead configurations about the same range.

Table 2: Prompt and Low-Cost Upload Potential of the Deployed U.S. Strategic Nuclear Force With and Without New START Constraints

Delivery Vehicle	Routine Force Loading Under New START			Uploading		
	Number of Delivery Vehicles	Weapons Per Delivery Vehicle	Total Weapons	Weapons Per Delivery Vehicle	Upload With New START	Upload Without New START
Trident D5 SLBM	240	~4 W76 or W88	~960	8 W76 or W88	~1,086 ^(b)	~1,920 (~1,626) ^(d)
Minuteman III ICBM	400	1 W78 or W87	400	1 W87 or 3 W78	400 ^(b)	~1,000 ^(e)
B-52H Bomber	44	20 ALCM w/ W80 ^(e)	0 (~300) ^(a)	20 ALCM w/ W80	528 (~460) ^(c)	528 (~460)
B-2 Bomber	19 (16) ^(a)	16 B61 or B83 ^(a)		16 B61 or B83	256	256
Total Weapons	~1,360 warheads + ~300 Bombs and ALCMs = ~1,660 total				~2,202	~3,342 to ~3,704

Notes

- (a) Sixteen B-2 bombers are combat coded which means they are maintained in a combat ready status for nuclear and conventional strikes. On a day-to-day basis, deployed bombers are not loaded with nuclear gravity bombs or cruise missiles, although these weapons are kept in storage facilities in or near bomber air bases. Reportedly, there are ~300 nuclear weapons deployed at the three nuclear-capable bomber bases. Bombs at bomber bases can be uploaded in days. There are no bombers maintained exclusively for the nuclear mission. In light of the conventional role of the B-2s, diverting all combat coded B-2s to the nuclear deterrence mission is unlikely.
- (b) Assumes all uploaded warheads are added to Trident SLBMs because this is faster, cheaper and more survivable.
- (c) Each B-52H can carry up to 20 nuclear ALCMs. A 2007 decision resulted in the retention of 528 ALCMs but these have been reduced as a result of 18 years of testing. The number will continue to decline until LR5Os are deployed in the early 2030s.
- (d) The maximum upload capability is 1920. The number 1,626 assumes that the number of W88/Mark 5 warheads is reduced to give missiles with both warhead configurations about the same range.
- (e) In addition to the 400 deployed Minuteman III silos and their deployed missiles, 50 silos will be retained in a non-deployed but "warm" status, with their non-deployed missiles kept in storage. If the missiles were returned to the silos, and each missile was armed with one warhead, the upload potential of the Minuteman III force would increase by 50 weapons.

These numbers are not necessarily the largest possible loadings, but they are reasonable maximums when the necessary range and the impact of range reduction on submarine survivability are taken into account. For example, while each Trident missile reportedly can carry 14 warheads, this may not be the case in practice because of the possible decrease in missile range.

The Costs of Upload

The cost of upload would be quite modest—largely transportation and warhead installation. An August 2020 report of the Congressional Budget Office (CBO) concluded that: 1) expanding nuclear forces to the Moscow Treaty limit (2,200) warheads “would not increase the Department of Defense’s (DoD’s) costs relative to its current plans....”; and 2) “Increasing warhead loadings to reach the START II limits [3,500 warheads] would incur about \$100 million in onetime costs for DoD.” Moreover, the \$100 million would be spent over a period of several years. The CBO indicated there were some long-term sustainment costs, but they would be in the 2040s. It should be noted that during the Biden Administration there was high inflation that was not anticipated in the 2020 cost estimates.

The U.S. Nuclear Modernization Program and Upload

U.S. strategic nuclear forces could be fully uploaded before the first element of the planned modernization program becomes operational, which is not being pursued with urgency. With limited exceptions, that program will not provide significant new capabilities; rather it will largely provide more of the same. The planned 12 Columbia-class submarines will carry fewer missiles and are “...the absolute minimum required to meet [the] strategic guidance.” As General Anthony Cotton observed, the modernization program is the product of the Obama Administration’s 2010 *Nuclear Posture Review Report* (NPR) which assumed, as did previous NPRs, benign great power relations.

Bomber Weapons

To preserve deterrence credibility, the 2018 *Nuclear Posture Review* directed the Defense Department “to prioritize its nuclear hedge planning” to (among other things) retain “the ability to penetrate adversary defenses...” To do so at relatively low cost, and in near term pending the fielding of LRSO and SLCM-N, the United States must explore mating an existing cruise missile frame with an existing nuclear weapon. To support deterrence now, placing a portion of the bombers on alert also is important to increase U.S. force survivability and resilience, i.e., a portion of U.S. bombers must be put on a sustainable alert.

In this context, it may be important to note that near-term ICBM and SLBM upload would provide expanded missile capabilities to suppress opponents’ air/missile defenses, and thereby help mitigate opponents’ questions about the U.S. capability to deliver weapons against advanced defenses-questions that could otherwise undermine deterrence.

Hard and Deeply Buried Targets (HDBTs)

The nuclear-armed authoritarian leaders depend upon Hard and Deeply Buried Targets (HDBTs) to assure their survival. China, for example, has thousands of advanced underground facilities (UGFs) and constructs more each year. According to the Pentagon, these UGFs are central to China’s counter intervention and power projection efforts, enabling the PLA to protect valuable assets from the threat of missile strikes and conceal military operations.

Increasing the U.S. capacity to hold UGFs at risk in the near term is another reason upload can contribute to deterrence. HDBTs are important targets to hold at risk in this regard because they may protect what some adversaries value most. Any expectation that they can serve as reliable

sanctuaries is very likely to degrade the effectiveness of U.S. deterrence strategies. The weapons that may have held HDBTs at risk during the Cold War—the Peacekeeper ICBM, the Advanced Cruise Missile and the multi-megaton B53—are no longer available to upload. Nevertheless, Minuteman and subsequently Sentinel uploading can provide expanded coverage against the number of UGFs that can be held at risk via attack by one or more weapons.

Yield Diversity

To deter adversaries that are increasingly deploying nuclear forces geared for warfighting, the United States needs diverse capabilities, including variable yield systems. A variety of yields enhances flexibility and adaptability, thereby facilitating the potential for tailoring deterrence. Variable yields can also reduce collateral damage—potentially strengthening the credibility of U.S. deterrence strategies.

Upload can increase yield diversity somewhat by permitting more low-yield Trident warheads. It is critical for increasing U.S. low-yield capabilities in a timely way. Retention of the B83 and W88 would help. More significant would be, at low cost, to give the new W93 and the W87-1 warheads variable yields, but they are likely a decade or more away. The new nuclear sea-launched cruise missile (SLCM-N) will provide much-needed low-yield nuclear capability. However, the new SLCM-N may not be deployed until 2034. While only a small number of low-yield W76-2s were produced, with termination of New START, upload could rapidly increase severalfold the number of survivable low-yield weapons: more W76-2s could be produced and modified W76-1s could become low-yield weapons.

High Delivery Accuracy

High delivery accuracy also increases deterrence strategy adaptability and targeting flexibility. Enhancing the accuracy of the ballistic missile force would likely strengthen the U.S. nuclear deterrent by increasing damage expectancy against many types of hard targets; in combination with lower-yield weapons, it could also increase the credibility of U.S. deterrence strategies by reducing collateral damage. The B61-12 and B61-13 are now the only U.S. precision nuclear weapons. The new Sentinel ICBM and warhead package reportedly will be considerably more accurate than the 1970-vintage Minuteman III; if so, Sentinel uploading would provide additional weapons with greater accuracy. Uploading ICBM and SLBMs would expand U.S. capabilities with accuracy and additional numbers could help compensate for inadequate accuracy via two-on-one targeting in some scenarios.

Dealing with the Non-Strategic Nuclear Threat

Russia has a “vast arsenal of non-strategic nuclear weapons.” Most estimates range from 2,000 (the official number) to 10,000 – 10 to 50 times the reported U.S. number. In February 2024, General Cotton said China “...has approximately 1,000 medium- and intermediate-range dual-capable...ballistic missiles....” China may also possess nuclear-capable cruise missiles, short-range ballistic missiles, and gravity bombs. These capabilities would allow Russia and/or China to launch many types of attacks against U.S. allies – to which Washington would likely not be able to respond promptly or effectively with non-strategic systems. That reality poses a threat to deterrence, particularly extended deterrence, given the likely need for

low-yield, regional U.S. nuclear options for credible deterrence in regional contingencies.

Given Russian, Chinese and North Korean theater nuclear escalation options, the United States needs more non-strategic nuclear capability for credible extended deterrence purposes. The nuclear SLCM-N program may be accelerated if the existing TLAM Block 5 SLCM is given a nuclear capability. This is a very important possible step, as is providing a stealthy stand-off nuclear capability for NATO's Dual-Capable Aircraft (DCA). However, strategic force upload may be a helpful, near-term – albeit partial – means to strengthen extended deterrence. That is, uploading Trident could provide additional low-yield targeting capabilities much more quickly than other possible options. Doing so would likely contribute significantly to extended deterrence credibility as future U.S. regional options mature.

Extended Deterrence in the Indo-Pacific

There are no U.S. nuclear weapons deployed in the Indo-Pacific region and there is a serious question of whether the United States has *any real* capability for *timely* deployment of capabilities to the theater. This gives Russia, China and North Korea dangerous coercive leverage as they expand, diversify and improve their nuclear capabilities. The Congressional Strategic Posture Commission rightly concluded that there is an “urgent need” for U.S. theater nuclear forces to be “deployed or based in the Asia-Pacific theater.”

None of the U.S. INF-range ballistic, cruise or hypersonic missile programs are nuclear capable. The way the United States is doing business today, there is likely no possibility of giving any of them nuclear capability by the possible 2027 timeline for a Chinese invasion of Taiwan, and the current strategic modernization program is unlikely to

provide any new capability in 2027 other than the new versions of the B61 bomb.

In the near term, inexpensive warhead upload may be the only available option to help sustain nuclear deterrence in this theater. If the United States starts soon, all of the Trident force and almost half of the Minuteman force likely could be uploaded by mid-2027. While not sufficient, this could help to enhance extended deterrence in the near term and reduce the prospect of nuclear proliferation by desperate allies.

Conclusion

A prudent deterrence response to an unprecedented threat context involving the potential for opportunistic or coordinated aggression and the long-standing Russian and Chinese nuclear buildups includes nuclear weapons upload of legacy and future forces. This is a near-term option to redress the looming nuclear imbalance and threats to deterrence. It likely is impossible, for example, to hold at risk the increasingly large number of Chinese and Russian deterrence-related assets, including nuclear weapons and facilities, with a New START Treaty-limited force. The United States must proceed with the planned nuclear modernization program. But, it likely will be too slow and ultimately too limited for confident deterrence in a rapidly worsening threat environment. At this point, nuclear upload is likely the only way America can adequately enhance the force size and flexibility needed to tailor deterrence in the near term for the prevention of great power conflict, including major aggression against U.S. allies. And, absent upload, the United States will realize only about half of the potential benefit from the planned modernization program in terms of warhead numbers.

Introduction

Before the end of its tenure, the Biden Administration pointed publicly to Russian, Chinese and North Korean nuclear force buildups and the potential need to strengthen U.S. nuclear capabilities in response. In 2024, for example, Pranay Vaddi, then-Special Assistant to then-President Biden, stated that, “Russia, the PRC and North Korea are all expanding and diversifying their nuclear arsenals at a breakneck pace—showing little or no interest in arms control.”¹ In August 2024, Acting Assistant Secretary of Defense for Space Policy Vipin Narang observed that, “We have begun exploring options to increase future launcher capacity or additional deployed warheads—on the land, sea, and air legs—that could offer national leadership increased flexibility if executed.”² The November 2024 Biden Administration nuclear weapons employment guidance report stated “...it may be necessary to adapt current U.S. force capability, posture, composition, or size in order to be able to fulfill the three stated roles of nuclear weapons.”³ These assessments came in the context of Russia’s on going horrific campaign against Ukraine and

¹ Pranay Vaddi, “Adapting the U.S. Approach to Arms Control and Nonproliferation to a New Era,” Arms Control Association, June 7, 2024, available at <https://www.armscontrol.org/2024AnnualMeeting/Pranay-Vaddi-remarks>.

² “Nuclear Threats and the Role of Allies’: Remarks by Acting Assistant Secretary of Defense for Space Policy Dr. Vipin Narang at CSIS,” August 1, 2024, available at <https://www.defense.gov/News/Speeches/Speech/Article/3858311/nuclear-threats-and-the-role-of-allies-remarks-by-acting-assistant-secretary-of/>.

³ U.S. Department of Defense, “Report on the Nuclear Employment Strategy of the United States,” November 2024, p. 4, available at <https://media.defense.gov/2024/Nov/15/2003584623/-1/-1/1/REPORT-ON-THE-NUCLEAR-EMPLOYMENT-STRATEGY-OF-THE-UNITED-STATES.PDF>.

China's President Xi Jinping's order that China be prepared to invade Taiwan by 2027.⁴ Nevertheless, the Biden Administration left taking actions in this regard to the Trump Administration.⁵

As ominous as these assessments are, the United States may significantly underestimate Russian and Chinese nuclear capabilities. There is precedent for underestimation: at the end of the Cold War, when Russia revealed the size of the Soviet nuclear arsenal, it became clear that Washington had underestimated it by 17,000 warheads.⁶ Today, Russia and China may each have twice as many nuclear warheads as reported by the Department of Defense (DoD) and the Federation of American Scientists, respectively.⁷ Russia is well ahead of the United States in nuclear weapons and China is rapidly closing the gap.⁸ The DoD's estimate of 600+ Chinese nuclear weapons in mid-

⁴ Olivia Victoria Gazis, "CIA Director William Burns: 'I wouldn't underestimate' Xi's ambitions for Taiwan," *CBS News*, February 23, 2023, available at <https://www.cbsnews.com/news/cia-director-william-burns-i-wouldnt-underestimate-xis-ambitions-for-taiwan/>.

⁵ Michael R. Gordon, "U.S. Must Be Prepared to Expand Nuclear-Weapons Force, Biden Officials Say," *The Wall Street Journal*, November 15, 2024, available at <https://www.wsj.com/politics/national-security/u-s-must-be-prepared-to-expand-nuclear-weapons-force-biden-officials-say-3f317fc9>.

⁶ Houston T. Hawkins, *Rethinking the Unthinkable* (Los Alamos, NM: Los Alamos National Laboratory, July 23, 2014), p. 8, available at <https://www.osti.gov/biblio/1148302>.

⁷ Mark B. Schneider, "The Chinese Nuclear Arsenal: More DoD Nuclear Threat Minimization," *RealClearDefense*, March 1, 2025, available at https://www.realcleardefense.com/articles/2025/03/01/the_chinese_nuclear_arsenal_more_dod_nuclear_threat_minimization_1094753.html; and Mark B. Schneider, *How Many Nuclear Weapons Does Russia Have? The Size and Characteristics of the Russian Nuclear Stockpile* (Fairfax, VA: National Institute Press, 2023), available at <https://nipp.org/wp-content/uploads/2023/09/Vol.-3-No.-8.pdf>.

⁸ *Ibid.*

2024 is already a year out of date.⁹ A straight-line projection of its estimates of Chinese nuclear warheads growth over the last several years (~100 a year) would result in 900+ Chinese nuclear warheads in mid-2027. Since the United States cannot commit all of its nuclear weapons to deterring China only, this is a dangerous development.

More concerning still, the extent to which Russia may have uploaded its strategic nuclear forces is uncertain. Russia had been in violation of the New START Treaty for two years when it illegally “suspended” the entire Treaty,¹⁰ including on-site inspections which actually ended in March 2020.¹¹ This has created a large uncertainty concerning the number of deployed Russian nuclear warheads. This reality is a reflection of the fact that Russian arms control violations have been all too common. The 2023 bipartisan Congressional Strategic Posture Commission report summarized this: “Over the past 20 years, Russia has either violated or has failed to comply with nearly every

⁹ U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China*, December 2024, p. IX, available at <https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF>.

¹⁰ U.S. Department of State, Office of the Spokesperson, “Russian Noncompliance with and Invalid Suspension of the New START Treaty,” Fact Sheet, June 1, 2023, available at <https://2021-2025.state.gov/russian-noncompliance-with-and-invalid-suspension-of-the-new-start-treaty/>.

¹¹ U.S. Department of State, “Report to Congress on Implementation of the New START Treaty Pursuant to paragraph (a)(10) of the Senate’s Resolution of Advice and Consent to Ratification of the New START Treaty (Treaty Doc. 111-5) NEW START TREATY ANNUAL IMPLEMENTATION REPORT,” January 20, 2023, p. 8, available at <https://www.state.gov/wp-content/uploads/2023/01/2022-New-START-Implementation-Report.pdf>.

major arms control treaty or agreement to which the United States is or was a party.”¹²

The Biden State Department argued that the United States could adequately monitor the number of deployed Russian warheads without on-site inspections and that Russia was complying with the deployed warhead limit. This claim began to unravel openly in November 2024 when a Defense Intelligence Agency (DIA) report stated that Russia “...maintains about 1,550 deployed strategic nuclear warheads on ICBMs and submarine-launched ballistic missiles (SLBMs), as well as a force of heavy bombers which are capable of carrying long-range air-launched cruise missiles (ALCMs).”¹³ Since 1,550 is the New START limit on all accountable deployed weapons, the DIA’s assessment indicates Russia is violating the Treaty limit. In early 2025, TASS revealed that Russia had operational SS-19 ICBMs,¹⁴ which would put Russia further above the Treaty limit.

In January 2025, the Biden State Department, apparently in anticipation of the Trump Administration, issued a report that grudgingly acknowledged that Russia “...may have exceeded the deployed warhead limit by a small number

¹² Madelyn Creedon and Jon Kyl, et al., Congressional Commission on the Strategic Posture of the United States, *America’s Strategic Posture, The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Alexandria, VA: Institute for Defense Analysis, 2023), p. 84, available at <https://www.ida.org/-/media/feature/publications/a/am/americas-strategic-posture/strategic-posture-commission-report.ashx>.

¹³ Defense Intelligence Agency, “Nuclear Challenges – The Growing Capabilities of Strategic Competitors and Regional Rivals,” November 2024, p. IX, available at https://www.dia.mil/Portals/110/Images/News/Military_Powers_Publications/Nuclear_Challenges_2024.pdf.

¹⁴ Pavel Podvig, “Old UR-100NUTTH may still be in service,” *Russian Forces.org*, February 6, 2025, available at https://russianforces.org/blog/2025/02/old_ur-100nutth_may_still_be_i.shtml.

during portions of 2024....”¹⁵ Yet, it also stated that, “The United States assesses with high confidence that Russia did not engage in any large-scale activity above the Treaty limits in 2024....” That “high confidence” claim is not credible given the collapse of the New START Treaty’s verification regime – which, even when in effect, left room for uncertainty. In 2010, then-Senator Christopher Bond (R-MO) stated that, “As the vice chairman of this committee [the Senate Select Committee on Intelligence], I have reviewed the key intelligence on our ability to monitor this treaty [New START] and heard from our intelligence professionals. There is no doubt in my mind that the United States cannot reliably verify the treaty’s 1,550 limit on deployed warheads.”¹⁶ In 2020, former Under Secretary of State and chief New START Treaty negotiator Rose Gottemoeller said “...we discarded the counting rules in favor of confirming declared warheads on the front of missiles through reciprocal inspections; in fact, we did not need telemetry measures to confirm compliance with the warhead limits in the new treaty.”¹⁷ Gottemoeller estimated Russia could otherwise covertly add several hundred to 1,000 warheads through upload.¹⁸ Substantially higher

¹⁵ U.S. Department of State, “2024 Report to Congress on Implementation of the New START Treaty,” January 17, 2025, available at <https://2021-2025.state.gov/2024-report-to-congress-on-implementation-of-the-new-start-treaty/>.

¹⁶ Christopher Bond, “The New START Treaty,” *The Congressional Record*, November 18, 2010, available at <https://www.congress.gov/111/crec/2010/11/18/CREC-2010-11-18-pt1-PgS8093.pdf>.

¹⁷ Rose Gottemoeller, “The New START Verification Regime: How Good Is It?,” *Bulletin of the Atomic Scientists*, May 21, 2020, available at <https://thebulletin.org/2020/05/the-new-startverification-regime-how-good-is-it/>.

¹⁸ Rose Gottemoeller, U.S. Congress, *The Importance of the New START Treaty* (Washington, D.C.: House Committee on Foreign Affairs, December 4, 2019), p. 61, available at

numbers actually appear possible.¹⁹ With no New START Treaty on-site inspections since March 2020, Russia could have uploaded much of its strategic nuclear force.²⁰

Contemporary U.S. plans for the modernization of nuclear forces are an approximately 15-year-old legacy of the Obama Administration and are moving slowly. They were established at a time when many U.S. officials believed that U.S. relations with Russia and China were relatively benign and would remain so, or improve further. However, in contrast to the United States, Moscow and Beijing have been expanding their nuclear arsenals for over a decade and appear to view nuclear weapons as coercive tools for expansion.²¹ China appears intent on taking Taiwan by force, if necessary.²² Moscow frequently issues audacious nuclear threats and Russia's doctrinal statements emphasize a steady lowering of the threshold for nuclear employment.²³ This will likely also be true with regard to

<https://www.congress.gov/116/meeting/house/110302/documents/CHRG-116hrg38543.pdf>.

¹⁹ Schneider, *How Many Nuclear Weapons Does Russia Have?*, op. cit., pp. xiii, 86, 91, 132, 133, 135-147.

²⁰ Mark B. Schneider, "Red Flag: State Department Report on Russian New START Treaty Compliance," *RealClearDefense*, February 3, 2025, available at

https://www.realcleardefense.com/articles/2025/02/04/red_flag_state_department_report_on_russian_new_start_treaty_compliance_1089158.html.

²¹ See the discussion in Keith B. Payne and David Trachtenberg, *Deterrence in the Emerging Threat Environment: What is New and What is Different*, *Occasional Paper*, Vol. 2, No. 8, (Fairfax, VA: National Institute Press, August 2022) available at <https://nipp.org/papers/deterrence-in-the-emerging-threat-environment-what-is-different-and-why-it-matters/>.

²² "Xi says no one can stop China's 'reunification' with Taiwan," *Reuters*, December 31, 2024, available at

<https://www.reuters.com/world/china/xi-says-no-one-can-stop-chinas-reunification-with-taiwan-2024-12-31/>.

²³ Mark B. Schneider, "The Implications of Russia's New Nuclear Doctrine," *Information Series*, No. 615 (Fairfax, VA: National Institute

China if there is a crisis/conflict over Taiwan. There is an emerging Sino-Russian entente, a Russo-North Korean alliance, and extensive Russo-Iranian-North Korean cooperation in a major war against Ukraine, a Western partner. These marriages of convenience are organizing around the clear common intent to overthrow the post-World War II liberal international order.²⁴ As two former Biden senior national security officials have recently concluded, “The United States now faces a Category 5 hurricane of nuclear threats.”²⁵

Because history has proceeded decidedly differently than expected, U.S. deterrence strategies are now problematic and the prospect for significant failure is very real. There is potential for multiple, simultaneous geopolitical crises and conflicts; prudence now demands strengthening U.S. deterrence and extended deterrence strategies. Prior to departure, the Biden Administration essentially reached the same conclusion.²⁶

Press, February 5, 2025), available at https://nipp.org/information_series/mark-b-schneider-the-implications-of-russias-new-nuclear-doctrine-no-615-february-5-2025/.

²⁴ See Keith B. Payne, “Deterrence and Arms Control: Ending the Deceptive ‘Holiday from History,’” *Information Series*, No. 616 (Fairfax, VA: National Institute Press, February 10, 2025), available at https://nipp.org/information_series/keith-b-payne-deterrence-and-arms-control-ending-the-deceptive-holiday-from-history-no-616-february-10-2025/.

²⁵ Vipin Narang and Pranay Vaddi, “How to Survive the New Nuclear Age,” *Foreign Affairs* (July/August 2025), available at <https://www.foreignaffairs.com/united-states/how-survive-new-nuclear-age-narang-vaddi>.

²⁶ See, Department of Defense, “Report on the Nuclear Employment Strategy of the United States,” November 2024, op. cit., p. 4. “In an evolving security environment with multiple adversaries who are making nuclear weapons more central to their national security strategies, it may be necessary to adapt current U.S. force capability, posture, composition, or size in order to be able to fulfill the three stated roles of nuclear weapons.”

Expanding Nuclear Deterrence Requirements

The basic U.S. approach to nuclear deterrence has not significantly changed for decades.²⁷ In 2012, former STRATCOM Commander Admiral Richard Mies (Ret.), wrote that U.S. targeting doctrine was "...designed to hold at risk our potential adversaries' military forces, war-supporting industry, command and control capabilities, and military and while minimizing to the maximum extent collateral damage to population and civilian infrastructure."²⁸ In 2013, the Obama Administration's nuclear weapons employment policy stated, "The new guidance requires the United States to maintain significant counterforce capabilities against potential adversaries."²⁹ The 2024 Biden Administration's nuclear employment guidance said, "The Guidance continues to emphasize the need to, first and foremost, hold at risk what adversaries value most. It also reiterates the need to maintain counterforce capabilities to reduce potential adversaries' ability to employ nuclear weapons against the United States and its allies and partners, and does not rely on a counter-value or minimum-deterrence approach."³⁰

While this basic U.S. approach to deterrence has not changed much over many years, Washington's ability to

²⁷ See the excellent review in, Franklin Miller, "Counterforce and Countervalue in U.S. targeting: A Historical Review," in *Counterforce in Contemporary U.S. Nuclear Strategy*, Brad Roberts, ed. (Livermore, CA: Lawrence Livermore National Laboratory, 2025), pp. 21-37.

²⁸ Admiral Richard Mies, USN (Ret.), "Strategic Deterrence in the 21st Century," *Undersea Warfare*, Spring 2012, p. 15, available at https://issuu.com/julianne.m.johnson/docs/usw_spring_2012.

²⁹ U.S. Department of Defense, "Report on the Nuclear Employment Strategy of the United States Specified in Section 491 of 10 U.S.C.," 2013, p. 4, available at <https://man.fas.org/eprint/employ.pdf>.

³⁰ Department of Defense, "Report on the Nuclear Employment Strategy of the United States," November 2024, op. cit., p. 3.

implement it has drastically declined due to the combination of deep U.S. nuclear weapons reductions and the expansion of opponents' nuclear and other military forces. A 2012 report concluded that the United States needed approximately 2,700-3,000 deployed strategic nuclear warheads because of the requirement to hold at risk adversary "hardened and mobile targets with high confidence...."³¹ This assessment, if even only approximately correct at the time, undercounts contemporary requirements as it occurred well before contemporary geopolitical hostilities, the Sino-Russian entente, and the large Chinese nuclear buildup—and the new deterrence requirements they generate.

For example, it may be impossible for U.S. strategic nuclear forces, if they are modernized on a replacement basis, to cover these new targets in a timely way. The existing Minuteman force likely was fully committed for decades before the new Chinese silos were discovered. Even when the Minuteman is entirely replaced by Sentinel (well into the 2030s), it would likely have to be upgraded (i.e., MIRVed) to cover the numerous new Chinese ICBMs and some of the underground facilities. Four hundred single warhead Sentinels would have a higher damage expectancy against up to 400 targets, but without upload they could not threaten 401 targets much less another 370 Chinese silos and other underground facilities that may be considerably hardened.

Given the looming threats posed by the unprecedented contemporary geopolitical context, and the associated expansion of Russian, Chinese, and North Korean nuclear capabilities, the United States must now consider how to strengthen its nuclear capabilities to preserve deterrence.

³¹ Rebecca Heinrichs and Baker Spring, "Deterrence and Nuclear Targeting in the 21st Century," (Washington, D.C.: The Heritage Foundation, November 30, 2012), available at <https://www.heritage.org/node/12067/print-display>.

Thomas Schelling's classic principle that deterrence can be based on a "threat that leaves something to chance,"³² i.e., that deterrence threats need *not* be logically credible to be effective, has been reflected in U.S. extended deterrence strategies for decades. However, when powerful opponents are cooperating, driven by the common goal of reordering the global order, and willing to use force despite the risks, deterrence likely needs to be more credible than a "threat that leaves something to chance."

The bipartisan Strategic Posture Commission's 2023 report rightly concluded that the existing 15-year-old modernization program of record is "necessary but not sufficient,"³³ and that the United States needs both to upload its strategic nuclear missiles and enhance its nuclear modernization program. It recommended:

First, the Commission recommends that the Air Force and Navy exercise uploading ICBM and SLBM warheads [and], Prepare to upload some or all of the nation's hedge warheads.

The current modernization program should be supplemented to ensure U.S. nuclear strategy remains effective in a two-nuclear-peer environment.

To avoid additional risk and meet emerging challenges, the United States must act now to pursue additional measures and programs. Additional measures beyond the planned modernization of strategic delivery vehicles and warheads may include either or both qualitative and

³² See, Thomas Schelling, *The Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960), pp. 187-188.

³³ Creedon and Kyl, et al., Congressional Commission on the Strategic Posture of the United States, *America's Strategic Posture, The Final Report of the Congressional Commission on the Strategic Posture of the United States*, op. cit., p. 84.

quantitative adjustments in the U.S. strategic posture.

The U.S. strategic nuclear force posture should be modified to: Address the larger number of targets due to the growing Chinese nuclear threat.

[T]he current POR [Program of Record] is not a like-for-like transition in capacity, and may demand more SSBNs [nuclear ballistic missile submarines] if the United States chooses to deploy additional missiles and nuclear warheads.

Increase the planned production of Columbia SSBNs and their Trident ballistic missile systems, and accelerate development and deployment of D5LE2 [Trident D-5 Life Extension Program II].

Increase the planned number of B-21 bombers [beyond the program number of 100] and the tankers an expanded force would require.

Initiate planning and preparations for a portion of the future bomber fleet to be on continuous alert status, in time for the B-21 Full Operational Capability (FOC) date.

Plan to deploy the Sentinel ICBM in a MIRVed configuration.

Increase the planned number of deployed Long-Range Standoff Weapons [LRSOs].

Address the need for U.S. theater nuclear forces deployed or based in the Asia-Pacific theater.

Finally, the U.S. theater nuclear force posture should be modified in order to provide the President a range of militarily effective response options to

deter or counter Russian or Chinese limited nuclear use in theater.³⁴

U.S. Strategic Command Commander General Anthony Cotton favors 145 B-21s, more LRSO nuclear cruise missiles, deploying the B-52J faster and more Columbia-class nuclear missile submarines.³⁵ He noted that the number of LRSOs was set in 2010 before China embarked on an aggressive campaign of building strategic weapons and developing new hypersonic missiles. Some of these recommendations, including those in the Congressional Strategic Posture Commission report, might be reduced or complemented by warhead upload, particularly if they are based on an assumption of existing New START constraints which force more expensive and slower options than upload.

Tailoring Deterrence and Its Requirements

Given the diversity of U.S. opponents and related variability in their decision making, the need to “tailor” U.S. deterrence strategies to diverse opponents has become a well-accepted principle of U.S. deterrence policy on a bipartisan basis.³⁶ Recent tabletop exercises confirm the criticality of tailoring deterrence to different opponents and different contexts.³⁷

³⁴ Ibid., pp. viii, 34, 35, 43, 45, 46, 48.

³⁵ John A. Tirpak, “STRATCOM Chief: Air Force Needs 145 B-21s and More New Strategic Systems,” *Air and Space Forces.com*, March 18, 2025, available at <https://www.airandspaceforces.com/stratcom-chief-b-21s-lrso-strategic-systems/>.

³⁶ See for example, Creedon and Kyl, et al., *The Final Report of the Congressional Commission on the Strategic Posture of the United States*, op. cit., pp. 27, 33.

³⁷ Markus Garlauskas, Lauren Gilbert, and Kyoko Imal, *A rising nuclear double-threat in east Asia : Insights from our Guardian Tiger I and II tabletop exercises*, Atlantic Council, May 2025, available at <https://www.atlanticcouncil.org/wp-content/uploads/2025/05/A->

Tailoring deterrence mandates strategies that can adapt to the range of threat requirements needed for multiple opponents and contexts—which, in turn, demands deterrence force flexibility and diversity.³⁸ The Biden Administration rightly concluded that, “The requirement to develop and maintain a tailored deterrence strategy in support of both deliberate and adaptive nuclear planning in a dynamic security environment requires nuclear capabilities that are highly flexible and that can support a wide range of employment options.”³⁹ Enhancing force flexibility and planning adaptability to support tailored deterrence against multiple opponents, in turn, demands diverse forces with resilience, accuracy, and various yields; these capabilities are critically dependent on the planned modernization. However, that modernization program will not bear much fruit until the early-to-mid 2030s—well past, for example, the 2027 date China’s President Xi Jinping’s has identified for absorbing Taiwan.⁴⁰

rising-nuclear-double-threat-in-East-Asia-Insights-from-our-Guardian-Tiger-I-and-II-tabletop-exercises.pdf.

³⁸ For the initial post-Cold War discussions of the need for “tailoring deterrence” and its requirements, see, Keith B. Payne, “Deterring Emerging Nuclear Actors?,” Presentation at the Strategic Options Assessment Conference, sponsored by U.S. Strategic Command, Dougherty Conference Center, Offutt Air Force Base, July 7, 1993; and Keith B. Payne, *Deterrence in the Second Nuclear Age* (Lexington, KY: University Press of Kentucky, 1996), pp. 123-129. See also, Department of Defense, *Deterrence Operations: Joint Operating Concept (DO JOC)*, Version 2.0 (August 2006), p. 3, available at https://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/joc_deterrence.pdf. For a later discussion see, M. Elain Bunn, “Can Deterrence be Tailored?,” *Strategic Forum*, National Defense University, No. 225 (January 2007), pp. 1-8.

³⁹ Department of Defense, “Report on the Nuclear Employment Strategy of the United States,” November 2024, op. cit., p. 4.

⁴⁰ Gazis, “CIA Director William Burns: ‘I wouldn’t underestimate’ Xi’s ambitions for Taiwan,” op. cit.

The United States reportedly has ~1,660 deployed strategic nuclear weapons (~1,360 missile warheads and ~300 bomber weapons.)⁴¹ As concluded by the Strategic Posture Commission, one avenue to help increase needed U.S. deterrence capabilities in the near term is uploading existing and follow-on missiles and bombers. Upload is limited in this regard: two of the most capable Cold War counterforce capable missiles—the Peacekeeper ICBM and the Advanced Cruise Missile—were eliminated and are now unavailable for upload.

Nevertheless, upload is an advantageous and timely option. For example, it can considerably enhance U.S. targeting capabilities against China and Russia (including the 370 new Chinese ICBM silos⁴² and some portion of the thousands of new underground facilities) well before realization of significant nuclear improvements from the modernization program. Indeed, the U.S. upload potential can serve multiple purposes associated with sustaining an effective U.S. deterrence strategy. It can help to: 1) hedge against the possible breakout of Russian and Chinese forces and related extant or future intelligence failures; 2) increase the U.S. capability and flexibility to hold diverse targets at risk for deterrence purposes; 3) increase the survivability and resilience of nuclear weapons; 4) increase damage expectancy against diverse target sets; 5) enhance counterforce capability, particularly against hard and deeply buried targets (HDBTs); 6) enhance defense

⁴¹ See Table 1 below. See also Hans M. Kristensen, Matt Korda, Eliana Johns and Mackenzie Knight, “United States nuclear weapons 2025,” *Bulletin of the Atomic Scientists*, March 2025, Vol. 81, No. 1, p. 53, available at <https://doi.org/10.1080/00963402.2024.2441624>.

⁴² U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China*, 2024, p. 101, available at <https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF>.

suppression potential; and 7) help preserve the credibility of U.S. extended deterrence commitments.⁴³

What upload cannot do is change the nature of the U.S. strategic forces, modernize them or make them more diverse to deal with the spectrum of new threats. Upload is not a substitute for modernization. But, it is a near-term avenue to increase U.S. nuclear deterrence capabilities relatively quickly and at modest cost. Other recommendations tend to be longer term and more expensive than upload.

The New START Treaty and Upload

Upload is largely limited by the available number of delivery vehicles, i.e., missiles and bombers. The 2002 Moscow Treaty did not limit delivery vehicles, facilitating the potential for a prompt U.S. response to negative security developments.⁴⁴ In line with the Moscow Treaty, the 2001 *Nuclear Posture Review* (NPR) cut by two-thirds U.S. deployed strategic nuclear weapons, but emphasized retaining upload potential (called the “responsive force”) as a hedge against an uncertain future, and stated that U.S. forces could be uploaded in “weeks, months and years.”⁴⁵

⁴³ Mark B. Schneider, “The October 2023 Strategic Commission Report and U.S. Nuclear Weapons Requirements,” *Information Series*, No. 568 (Fairfax, VA: National Institute Press, December 1, 2023), available at https://nipp.org/information_series/mark-b-schneider-the-october-2023-strategic-commission-report-and-u-s-nuclear-weapons-requirements-no-568-december-1-2023/.

⁴⁴ U.S. Department of State, “Comparison of the START Treaty, Moscow Treaty, and New START Treaty,” Fact Sheet. Bureau of Verification, Compliance, and Implementation, April 8, 2010, available at <https://2009-2017.state.gov/t/avc/rls/139901.htm>.

⁴⁵ Donald H. Rumsfeld, *Annual Report to the President and the Congress* (Washington, D.C.: Department of Defense, 2002), p. 90, available at https://history.defense.gov/Portals/70/Documents/annual_reports/2002_DoD_AR.pdf?ver=2014-06-24-153732-117.

Unfortunately, the New START Treaty did the opposite, reducing the potential U.S. “responsive force.” The only reductions in *operational* forces that existed when New START entered into force in 2011 were made solely by the United States. This included four launchers on each Trident missile submarine. Russia already was below the New START Treaty limit on accountable, deployed weapons (1,550) and deployed delivery vehicle limits (700) when the Treaty entered into force.⁴⁶ All Russia had to eliminate were 65 non-deployed weapons that already were inoperable. This, sadly, was considered a negotiating success by much of Washington’s establishment.

Significant U.S. upload now requires prompt withdrawal from the expiring (in February 2026) New START Treaty, which, as noted above, Russia has ceased observing, has violated its verification provisions, and may be in violation of its weapons limits—giving the United States the clear legal right to terminate it. Based on the last available official data concerning the number of U.S. deployed strategic nuclear warheads (from 2023),⁴⁷ the United States can upload its strategic missile force by only 131 warheads given New START’s limit on accountable, deployed weapons (1,550). If the United States were to continue observation of New START limits despite Russian violations (and China’s dramatic nuclear buildup), the only way to substantially increase the number of deployed U.S.

⁴⁶ U.S. Department of State, “New START Treaty Aggregate Numbers of Strategic Offensive Arms,” Fact Sheet, Bureau of Arms Control, Verification, and Compliance, June 1, 2011, available at <https://2009-2017.state.gov/t/avc/rls/164722.htm>.

⁴⁷ U.S. Department of State, “Report to Congress on Implementation of the New START Treaty Pursuant to paragraph (a)(10) of the Senate’s Resolution of Advice and Consent to Ratification of the New START Treaty (Treaty Doc. 111-5) NEW START TREATY ANNUAL IMPLEMENTATION REPORT,” January 31, 2024. p. 4, available at <https://www.state.gov/wp-content/uploads/2024/01/2023-New-START-Treaty-Implementation-Report.pdf>.

nuclear weapons would be to procure many more nuclear-capable bombers and cruise missiles. However, it appears that more cruise missiles are not feasible until the LRSO is operational (2030).⁴⁸ Until then, a small number of B-21 bombers (with a probable *nuclear-capable* IOC in the late 2020s) can likely carry eight nuclear bombs each, based upon the reported size and payload of the B-21 bomber.⁴⁹

The modernization program is critical to preserving the long-term viability of the U.S. deterrent, which, at this point, is rapidly aging out, but it provides little near-term increased capability—a problem that upload can help address at modest cost.

The Scope of Possible U.S. Warhead Upload

If not constrained by New START, with uploading, the Trident SLBM force reportedly could increase from ~968 to ~1,626 deployed warheads and the Minuteman ICBM force could increase from about 400 to ~1,000 deployed warheads, for a deployed strategic ballistic missile force of ~2,626 warheads.⁵⁰ The Trident force reportedly could be

⁴⁸ General Anthony J. Cotton, Testimony before the Subcommittee on Strategic Forces, Senate Armed Services Committee, March 26, 2025, p. 13, available at https://www.armed-services.senate.gov/imo/media/doc/testimony_of_general_anthony_jcotton2.pdf.

⁴⁹ Christian Orr, “B-21 Raider: Why the Air Force Needs This 6th-Gen Bomber Now,” *1945.com*, December 17, 2024, available at <https://www.19fortyfive.com/2024/12/b-21-raider-why-the-air-force-needs-this-6th-gen-bomber-now/>.

⁵⁰ Keith B. Payne and Mark B. Schneider, “U.S. Nuclear Deterrence: What Went Wrong and What Can Be Done?,” *Information Series*, No. 601 (Fairfax, VA: National Institute Press, October 7, 2024), available at https://nipp.org/information_series/keith-b-payne-and-mark-b-schneider-u-s-nuclear-deterrence-what-went-wrong-and-what-can-be-done-no-601-october-7-2024/.

uploaded in months and the Minuteman force in about three to four years.⁵¹ It is important to emphasize that the number of warheads could be higher or lower than these estimates depending upon decisions related to necessary missile range, targeting flexibility, and warhead footprint considerations, and the required number of single warhead missiles. Additionally, there will be several hundred bomber weapons which could be somewhat increased via uploading.

It is possible to reconstitute some U.S. nuclear capability (e.g., Trident missile launchers), eliminated under the New START Treaty. The reconciliation version of the House and Senate Armed Services Committee's FY2026 authorization bill provides "\$62,000,000 to convert Ohio-class submarine tubes to accept additional missiles."⁵² This would add 56 deployed Trident missiles, when available, with ~448 warheads to the ~2,606 mentioned above.

These calculations are based upon unclassified, agreed START and START II Treaty missile warhead accountability numbers. The numbers are not necessarily the largest possible loadings, but they are reasonable maximums when the necessary range and the impact of range reduction on submarine survivability are taken into account. For example, while each Trident missile reportedly can carry 14 warheads,⁵³ this may not be the case in practice because of the possible decrease in missile range. Another driving

⁵¹ As reported in, Peter Huessy, "Arms Control Challenges: Past & Present," *Warrior Maven*, June 8, 2023, available at <https://warriormaven.com/global-security/arms-control-nuclear-deterrence>.

⁵² "Amendment in the Nature of a Substitute to the Committee Print Offered by Mr. Rogers of Alabama," 2025, p. 28, available at https://armedservices.house.gov/UploadedFiles/Bill_Text.pdf.

⁵³ Brett Tingley, "First Improved W88 Nuclear Warhead For Navy's Trident Missiles Rolls Off The Assembly Line," *The War Zone*, July 14, 2021, available at <https://www.twz.com/41531/first-improved-w88-nuclear-warhead-for-navys-trident-missiles-rolls-off-the-assembly-line>.

factor in the above-referenced analysis was limitation of additional costs.

In the past, the bomber force could be uploaded in a matter of weeks.⁵⁴ However, a 2007 decision eliminated all but 528 nuclear ALCMs (now reduced by almost 20 years of testing) and all Advanced Cruise Missiles, eliminating much of what otherwise would be the *most rapid* U.S. upload potential.⁵⁵ Moreover, only a part of the bomber force likely can be devoted to the nuclear mission because of its important conventional role. The prompt and inexpensive upload for the strategic bomber force, with or without New START, would likely provide ~716~784 bomber weapons.

The current bomber modernization program involves 100 planned B-21s (replacing the B-1s and B-2s) and the 46 nuclear-capable B-52Js. The B-52H and the future B-52J modification can carry 20 nuclear cruise missiles. As noted above, each B-21 probably can carry eight nuclear bombs. The Air Force reportedly plans to make only 20 percent of the 100 planned B-21s immediately nuclear capable.⁵⁶ More

⁵⁴ "Gen. John A. Gordon, USAF (Ret.), Administrator, National Nuclear Security Administration, written response for the record, in Senate Armed Services Committee, Department of Defense Authorization for Appropriations for Fiscal Year 2003, Part 1, S. Hrg. 107-696, Pt. 1, 107th Cong., 2nd session," (Washington, D.C.: GPO, 2003), p. 378; and J.D. Crouch II, Assistant Secretary of Defense for International Security Policy, "Challenges of a New Capability-Based Defense Strategy: 'Transforming US Strategic Forces,'" briefing, National Defense Industrial Association 2003 Science & Engineering Technology Conference, March 5, 2003, slide 21, available at <http://www.dtic.mil/ndia/2003science/crouch.pdf>.

⁵⁵ Senate Armed Services Committee, Statement of Major General Roger Burg, March 28, 2007. p. 8, available at <https://www.airandspaceforces.com/PDF/testimony/Documents/2007/March%202007/032807Burg.pdf>.

⁵⁶ Peter Huessy, *ICBM EAR Christmas and New Year's Edition*, Week of December 27th, 2024, *ICBM Ear*, December 27, 2024, available at <https://geostrategicanalysis.substack.com/p/icbm-ear-report-week-of-december>.

B-21s probably will have to be made nuclear capable at relatively modest costs. The nuclear capability of another 30 B-52s eliminated under New START reportedly can be restored.⁵⁷

In 2023, the Biden Administration revealed that the U.S. nuclear stockpile, defined as “active” and “inactive” weapons, was 3,748.⁵⁸ The report states, “Active warheads include strategic and non-strategic weapons maintained in an operational, ready-for-use configuration, warheads that must be ready for possible deployment within a short timeframe, and logistics spares. They have tritium bottles and other Limited Life Components installed. Inactive warheads are maintained at a depot in a non-operational status and have their tritium bottles removed.” This represents a *de facto* limit on *rapid and inexpensive* U.S. upload. (Some of the 2,000 U.S. nuclear weapons awaiting dismantlement may be usable but this would require technical analysis of the state of the weapons.)

Table 1 below compares routine strategic force loading with the upload potential at low cost. Table 2 illustrates the potential U.S. upload, also at low cost, with and without New START. (See Appendix A for Tables 1 and 2 references.) The number of warheads could be higher or lower than these estimates depending upon decisions related to necessary missile range, targeting flexibility, and warhead footprint considerations.

⁵⁷ Bryant Harris and Stephen Losey, “Congress wants to restore nukes on conventional B-52 bombers,” *Defense News*, June 18, 2024, available at <https://www.defensenews.com/air/2024/06/18/congress-wants-to-restore-nukes-on-conventional-b-52-bombers/>.

⁵⁸ National Nuclear Security Administration, “Transparency in the U.S. Nuclear Weapons Stockpile,” July 2024, available at <https://www.energy.gov/nnsa/transparency-us-nuclear-weapons-stockpile>.

Table 1: Routine Strategic Force Loading and Upload Potential at Low Cost

Delivery Vehicle	Routine Force Loading Under New START			Potential Uploading		
	Number of Delivery Vehicles	Weapons Per Delivery Vehicle	Total Weapons	Weapons Capacity Per Delivery Vehicle	Total Weapons Capacity	Potential Warhead Increase Beyond Current Routine
Trident D5 SLBM	240	~4 W76 or W88	~960	8 W76 or W88	1,920 (~1,626) ^(e)	960 (658) ^(e)
Minuteman III ICBM	400	1 W78 or W87	400	1 W87 or 3 W78	~1,000 ^(b)	~600 ^(d)
B-52H Bomber	44	20 ALCM w/ W80 ^(a)	0 (~300) ^(a)	20 ALCM w/ W80	528 (~460) ^(c)	528 (~460)
B-2 Bomber	19 (16) ^(a)	16 B61 or B83 ^(a)		16 B61 or B83	256	256
Total Weapons	~1,360 warheads + ~300 Bombs and ALCMs = ~1,660 total				~3,342 to ~3,704	~1,974 to ~2,344

Notes

- (a) Sixteen B-2 bombers are combat coded which means they are maintained in a combat ready status for nuclear and conventional strikes. On a day-to-day basis, deployed bombers are not loaded with nuclear gravity bombs or cruise missiles, although these weapons are kept in storage facilities in or near bomber air bases. Reportedly, there are ~300 nuclear weapons deployed at the three nuclear-capable bomber bases. There are no bombers maintained exclusively for the nuclear mission. In light of the conventional role of the B-2s, diverting all combat coded B-2s to the nuclear deterrence mission is unlikely.
- (b) Three hundred Minuteman III ICBMs could carry up to three W-78/Mark 12A warheads each. Each remaining missile can carry only a single W87/Mark 21 warhead.
- (c) Each B-52H can carry up to 20 nuclear ALCMs. A 2007 decision resulted in the retention of 528 ALCMs but these have been reduced as a result of 18 years of testing. The number will continue to decline until LR5Os are deployed in the early 2030s. To deploy 460 nuclear ALCMs would require about 24 B-52s. This leaves 20 combat coded B-52s for conventional missions.
- (d) In addition to the 400 deployed Minuteman III silos and their deployed missiles, 50 silos will be retained in a non-deployed but "warm" status, with their non-deployed missiles kept in storage. If the missiles were returned to the silos, and each missile was armed with one warhead, the upload potential of the Minuteman III force would increase by 50 weapons.
- (e) The maximum upload capability is 1920; 1,626 assumes that the number of W88/Mark 5 warheads is reduced to give missiles with both warhead configurations about the same range.

Table 2: Prompt and Low-Cost Upload Potential of the Deployed U.S. Strategic Nuclear Force With and Without New START Constraints

Delivery Vehicle	Routine Force Loading Under New START			Uploading		
	Number of Delivery Vehicles	Weapons Per Delivery Vehicle	Total Weapons	Weapons Per Delivery Vehicle	Upload With New START	Upload Without New START
Trident D5 SLBM	240	~4 W76 or W88	~960	8 W76 or W88	~1,086 ^(b)	~1,920 (~1,626) ^(d)
Minuteman III ICBM	400	1 W78 or W87	400	1 W87 or 3 W78	400 ^(b)	~1,000 ^(e)
B-52H Bomber	44	20 ALCM w/ W80 ^(e)	0 (~300) ^(a)	20 ALCM w/ W80	528 (~460) ^(c)	528 (~460)
B-2 Bomber	19 (16) ^(a)	16 B61 or B83 ^(a)		16 B61 or B83	256	256
Total Weapons	~1,360 warheads + ~300 Bombs and ALCMs = ~1,660 total				~2,202	~3,342 to ~3,704

Notes

- (a) Sixteen B-2 bombers are combat coded which means they are maintained in a combat ready status for nuclear and conventional strikes. On a day-to-day basis, deployed bombers are not loaded with nuclear gravity bombs or cruise missiles, although these weapons are kept in storage facilities in or near bomber air bases. Reportedly, there are ~300 nuclear weapons deployed at the three nuclear-capable bomber bases. Bombs at bomber bases can be uploaded in days. There are no bombers maintained exclusively for the nuclear mission. In light of the conventional role of the B-2s, diverting all combat coded B-2s to the nuclear deterrence mission is unlikely.
- (b) Assumes all uploaded warheads are added to Trident SLBMs because this is faster, cheaper and more survivable.
- (c) Each B-52H can carry up to 20 nuclear ALCMs. A 2007 decision resulted in the retention of 528 ALCMs but these have been reduced as a result of 18 years of testing. The number will continue to decline until LRSOs are deployed in the early 2030s.
- (d) The maximum upload capability is 1920. The number 1,626 assumes that the number of W88/Mark 5 warheads is reduced to give missiles with both warhead configurations about the same range.
- (e) In addition to the 400 deployed Minuteman III silos and their deployed missiles, 50 silos will be retained in a non-deployed but "warm" status, with their non-deployed missiles kept in storage. If the missiles were returned to the silos, and each missile was armed with one warhead, the upload potential of the Minuteman III force would increase by 50 weapons.

To restore a U.S. strategic nuclear force with more than about 3,500 warheads, more Columbia-class missile submarines, LRSOs and nuclear bombs must be produced and/or the B83 bombs must be retained and eventually life extended.

The ability to sustain upload indefinitely depends on a number of factors, including the number of warheads that are life extended or newly produced for Minuteman and the Sentinel ICBM which will replace it. To achieve a *full* upload of Minuteman and subsequently Sentinel, the

United States must increase pit (the fissile material component of a nuclear weapon) production or further life extend the W78. The current plan to restore a capability (currently near zero) to produce 80 pits a year by the early 2030s is inadequate.⁵⁹

During the Cold War, the United States produced thousands a year and Russia has increased its production capability to thousands a year.⁶⁰ The Sentinel will carry the W87 and the modified W87-1 which requires a new pit, as does the W93. (The W93 reportedly will replace both Trident warheads).⁶¹ Ironically, the more new pits that are required, the smaller the U.S. arsenal will become, given the state of U.S. pit production. There may be some work-arounds including going to two or three shift day production, but more production capability is essential.

The Costs of Upload

The cost of uploading the legacy strategic forces to over 3,000 weapons, according to an earlier estimate, would be quite modest at approximately \$100 million—largely for transportation and warhead installation. An August 2020 report of the Congressional Budget Office (CBO) concluded

⁵⁹ See the interview of Tom Scheber in, “Interviews,” *Journal of Policy & Strategy*, Vol. 5, No. 2 (Fairfax, VA: National Institute Press, 2025), available at <https://nipp.org/wp-content/uploads/2025/06/Interviews-5.2.pdf>.

⁶⁰ Lt. Gen. Robert P. Ashley, Jr., “Russian and Chinese Nuclear Modernization Trends,” (Washington, D.C.: Defense Intelligence Agency, May 29, 2019), available at <https://www.dia.mil/Articles/Speeches-and-Testimonies/Article/1859890/russian-and-chinese-nuclear-modernization-trends/>.

⁶¹ Kris Osborn, “Pentagon Engineers New W-93 Nuclear Warhead for Trident II D5 Missile,” *Warrior Maven*, April 24, 2025, available at <https://warrormaven.com/air/pentagon-engineers-new-w-93-nuclear-warhead-for-trident-ii-d5-missile>.

that: 1) expanding nuclear forces to the Moscow Treaty limit (2,200) warheads “would not increase the Department of Defense’s (DoD’s) costs relative to its current plans....”; and 2) “Increasing warhead loadings to reach the START II limits [3,500 warheads] would incur about \$100 million in onetime costs for DoD.”⁶² Moreover, the \$100 million would be spent over a period of several years. The CBO indicated there were some long-term sustainment costs, but they would be in the 2040s. It should be noted that the high inflation during the Biden Administration was not anticipated in the CBO’s 2020 cost estimates.

The CBO estimated that the cost of going to the START Treaty limit (6,000 weapons) would be \$88 to \$149 billion. This represents force expansion rather than upload because it about doubles U.S. delivery vehicles to 1,600. The 6,000 number is for accountable weapons. The *de facto* START Treaty deployed weapons limit is about 10,000 if the United States produced more nuclear weapons and cruise missiles and made all B-21s nuclear capable. To assess options for increasing the number of deployed nuclear delivery vehicles, the 2023 Congressional Strategic Posture Commission report provides a more up-to-date and comprehensive analysis than the CBO study.

The U.S. Nuclear Modernization Program and Upload

The following looks at potential changes to the modernization program which in combination with upload could enhance the U.S. capacity to tailor effective deterrence strategies, e.g., via force flexibility and adaptability. The focus here is on low-cost options.

⁶² Congressional Budget Office, “The Potential Costs of Expanding U.S. Strategic Nuclear Forces If the New START Treaty Expires,” August 2020, available at <https://www.cbo.gov/system/files/2020-08/56475-START.pdf>.

U.S. strategic nuclear forces could be fully uploaded before the first element of the planned modernization program becomes operational, which is not yet being pursued with urgency. With limited exceptions, that program will not provide significant new capabilities; rather it will largely provide more of the same. For example, it will *not* provide hypersonic (or apparently even supersonic) nuclear-capable missiles or a new submarine-launched ballistic missile (SLBM).

The United States pursues cycles of nuclear force modernization, which have been separated by decades. This is in contrast to Russian and Chinese practice, which typically involves continuous modernization and two or three different systems for each leg of their nuclear Triads.⁶³ The cyclical nature of U.S. modernization programs now makes upload more important for Washington.

General Cotton observed that the modernization program is the product of the Obama Administration's 2010 *Nuclear Posture Review Report* (NPR) which assumed, as did the previous NPRs, benign great power relations.⁶⁴ As late as the Trump Administration's 2018 NPR, China was assessed to have only 200 nuclear weapons.⁶⁵ Few at the time expressed any expectation that China planned a large nuclear expansion. General Cotton has linked the Chinese nuclear buildup to President Xi Jinping's order that China be ready to invade Taiwan in 2027.⁶⁶

⁶³ *Nuclear Challenges*, op. cit., pp. VII, 1-18.

⁶⁴ See the discussion in, Keith B. Payne and John S. Foster, Jr., *A New Nuclear Review for a New Age* (Fairfax, VA: National Institute Press, 2017), p. 22, available at <https://nipp.org/wp-content/uploads/2021/03/A-New-Nuclear-Review-final.pdf>.

⁶⁵ *Nuclear Challenges*, op. cit., p. IX.

⁶⁶ Senate Armed Services Committee, "Statement of General Anthony J. Cotton," March 26, 2025, p. 3, available at https://www.armed-services.senate.gov/imo/media/doc/testimony_of_general_anthony_jcotton2.pdf.

The 2010 NPR wisely preserved the nuclear Triad but, nevertheless, allowed it to erode. It directed no nuclear testing, minimum changes in the life-extended warheads and no “new nuclear warheads.”⁶⁷ U.S. nuclear adversaries clearly have not observed these constraints. The prohibition on nuclear testing continues despite the fact that both the Trump and Biden Administrations concluded that Russia was conducting yield-producing nuclear tests and there are official concerns about Chinese testing.⁶⁸

Bomber Weapons

To preserve deterrence credibility, the 2018 *Nuclear Posture Review* directed the Defense Department “to prioritize its nuclear hedge planning” to (among other things) retain “the ability to penetrate adversary defenses....”⁶⁹ Holding at risk heavily defended targets independently via bomber weapons demands stand-off capabilities, speed, and stealth. To do so at relatively low cost, and in near term pending the fielding of LRSO and SLCM-N, the United States should explore mating an existing cruise missile frame with an existing nuclear weapon.

⁶⁷ U.S. Department of Defense, *Nuclear Posture Review Report*, 2010, p. vi, xiv, available at https://nuke.fas.org/guide/usa/2010_npr_report.pdf.

⁶⁸ U.S. Department of State, *Adherence and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements*, 2020, pp. 46-52, available at <https://www.state.gov/wp-content/uploads/2022/04/2022-Adherence-to-and-Compliance-with-Arms-Control-Nonproliferation-and-Disarmament-Agreements-and-Commitments-1.pdf>.; and, U.S. Department of State, *Adherence and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements*, 2022, pp. 29-30, available at <https://www.state.gov/wp-content/uploads/2022/04/2022-Adherence-to-and-Compliance-with-Arms-Control-Nonproliferation-and-Disarmament-Agreements-and-Commitments-1.pdf>.

⁶⁹ U.S. Department of Defense, *Nuclear Posture Review*, 2018, p. 40, available at <https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF>.

To support deterrence now, placing a portion of the bombers on alert also is important to increase U.S. force survivability and resilience, i.e., a portion of U.S. bombers must be put on a sustainable alert. This could include, for example, 20 B-52s armed with 20 ALCMs each. Unfortunately, the U.S. bomber capability has eroded to the point that the United States cannot now sustain a nuclear alert for more than a short time. A sustained alert would likely require additional crews, security, maintainers, spare parts, tankers (e.g., on alert), and infrastructure improvements.⁷⁰ These requirements must be addressed urgently.

The Biden Administration program of record for bombers nearly zeroed funding for research and development on the nuclear-capable B-2 and the non-nuclear B-1, and cut R&D funding by about 50 percent for the nuclear-capable B-52.⁷¹ The possible implication of this is that, as opponent air defenses improve, U.S. bomber capability could decline until significant numbers of nuclear-capable B-21s become operational.

In this context, it may be important to note that near-term ICBM and SLBM upload could provide expanded missile capabilities to suppress opponents' air/missile defenses, and thereby help mitigate opponents' questions about the U.S. capability to deliver weapons against advanced defenses—questions that otherwise could undermine deterrence.

⁷⁰ Oriana Pawlyk, "Putting Nuclear Bombers Back on 24-Hour Alert Would Exhaust the Force, General Says," *Military Com*, April 22, 2021, available at <https://www.military.com/daily-news/2021/04/22/putting-nuclear-bombers-back-24-hour-alert-would-exhaust-force-general-says.html>.

⁷¹ Lieutenant Colonel Ross Hobbs, "Risking America's Long-Range Strike Capability," *Air and Space Forces Magazine*, April 4, 2025, available at <https://www.airandspaceforces.com/article/risking-americas-long-range-strike-capability/>.

Hard and Deeply Buried Targets (HDBTs)

All U.S. adversaries have hard and deeply buried facilities. In 2005, the National Academies of Sciences reported there were 10,000 HDBTs worldwide, 20 percent had a strategic function and strategic HDBTs were increasing at about 10 percent per year.⁷² The nuclear-armed authoritarian leaders depend upon HDBTs to assure their survival. Any expectation that they can serve as reliable sanctuaries is very likely to degrade the effectiveness of U.S. deterrence strategies. According to the National Academies' report, "Nuclear weapons are the only weapons that can destroy targets deep underground or in tunnels."⁷³ It noted that, "With the current U.S. nuclear arsenal, a number of the more important strategic HDBTs cannot be held at risk of physical destruction of the functional area."⁷⁴ There are some very deep facilities that cannot be held at risk with even a few nuclear weapons.⁷⁵

The Pentagon's 2024 China military report stated that, "The PLA maintains a robust and technologically advanced underground facility (UGF) program to conceal and protect all aspects of its military forces, including C2, weapons of mass destruction, logistics, and modernized missile, ground, air, and naval forces. The PRC has thousands of UGFs and constructs more each year. These UGFs are central to the PRC's counter intervention and power projection efforts, enabling the PLA to protect valuable

⁷² National Research Council, *Effects of Nuclear Earth-Penetrator and Other Weapons* (Washington, D.C.: National Academies Press, 2005) Chapter 4, available at <https://doi.org/10.17226/11282>.

⁷³ *Ibid.*, Chapter 6.

⁷⁴ *Ibid.*, Chapter 4.

⁷⁵ *Ibid.*, Summary, Chapter/2.

assets from the effects of missile strikes and conceal military operations from adversaries.”⁷⁶

Increasing the U.S. capacity to hold UGFs at risk in the near term is another reason upload can contribute to deterrence. HDBTs are important targets to hold at risk in this regard because they may protect what some adversaries value most. Any expectation that they can serve as reliable sanctuaries is very likely to degrade the effectiveness of U.S. deterrence strategies. As former Defense Secretary Harold Brown observed in 1983: “It is important for U.S. forces to be able to threaten retaliation against the assets that the Soviet leaders appear to prize, which are not only their urban industrial facilities but their nuclear and conventional forces and the hardened shelters that protect their political and military control centers, as well as their own lives.”⁷⁷ The same principle certainly seems to apply to contemporary authoritarian leaderships.

The weapons available for upload may lack the yield and accuracy necessary to be effective against *very deep* HDBTs. Without earth/rock penetration capability, 5.8 megatons of yield are required to destroy an HDBT buried to 400 meters (and this is *not* the deepest HDBT).⁷⁸ This is over 10 times higher than the reported yields of current U.S.

⁷⁶ U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China*, 2024, p. 111, available at <https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF>.

⁷⁷ See, the testimony of Harold Brown in, U.S. Senate, Committee on Armed Services, *MX Missile Basing System and Related Issues*, Hearings, 98th Congress, 1st Session (Washington, D.C.: USGPO, 1983), p. 7. See also, *Report of the President’s Commission on Strategic Forces* (Washington, D.C.: The White House, April 1983), p. 7.

⁷⁸ *Effects of Nuclear Earth-Penetrator and Other Weapons*, op. cit., Chapter 4.

ballistic missile nuclear weapons.⁷⁹ The weapons that may have held HDBTs at risk during the Cold War with a single or multiple strikes—the Peacekeeper ICBM, the Advanced Cruise Missile and the multi-megaton B53—are no longer available to upload. Nevertheless, Minuteman and subsequently Sentinel uploading can provide expanded coverage against the number of UGFs that can be held at risk via attack by one or more weapons.

Yield Diversity

As former commander of STRATCOM Admiral Charles Richard (Ret.), former senior NSC and Pentagon official Frank Miller, and Senior Research Fellow at the Heritage Foundation Robert Peters have noted, to deter adversaries that are increasingly deploying nuclear forces geared for warfighting, the United States needs diverse capabilities, including “variable yield systems; and systems that can be generated from within theater on air, ground, and sea-launched platforms.”⁸⁰ A variety of yields enhances flexibility and adaptability, thereby facilitating the potential for tailoring deterrence. Variable yields can also help reduce collateral damage—potentially strengthening the credibility of U.S. deterrence strategies.⁸¹ The reduction of

⁷⁹ “Complete List of All U.S. Nuclear Weapons,” *Atomic Archive*, March 30, 2023, available at <https://nuclearweaponarchive.org/Usa/Weapons/Allbombs.html>.

⁸⁰ Admiral Charles Richard, USN (Ret.), Hon. Franklin C. Miller, and Robert Peters, “Nuclear Deterrence vs Nuclear Warfighting: Is There a Difference and Does it Matter?,” *Information Series*, No. 623 (Fairfax, VA: National Institute Press, April 15, 2025), available at https://nipp.org/information_series/admiral-charles-richard-usn-ret-hon-franklin-c-miller-and-robert-peters-nuclear-deterrence-vs-nuclear-warfighting-is-there-a-difference-and-does-it-matter-no-623-april-15-2025/.

⁸¹ Keith B. Payne and John S. Foster, Jr., et al., *Nuclear Force Adaptability for Deterrence and Assurance: A Prudent Alternative to Minimum Deterrence*

weapons types reduces available yields, including the highest and some of the lowest. (For example, reportedly the B83 has yields ranging from the low kiloton range to 1.2 megatons.)⁸²

Upload can increase yield diversity somewhat by permitting more low-yield Trident warheads. Retention of the B83 and W88 would help. More significant would be, at low cost, to give the new W93 and the W87-1 warheads variable yields, but they are likely a decade or more away.

According to General Cotton, the new nuclear sea-launched cruise missile (SLCM-N) "...will provide much-needed low-yield, non-ballistic, survivable, and persistent nuclear capability without visible generation...."⁸³ However, the new SLCM-N may not be deployed until 2034.⁸⁴ Upload may be critical for increasing U.S. low-yield capabilities in a timely way. Only a small number of low-yield W76-2s were produced—probably because more could not fit into a New START-limited nuclear force.⁸⁵ With termination of New START, upload could rapidly increase severalfold the number of survivable low-yield

(Fairfax, VA: National Institute Press, 2014), pp. xv, xvii, xix, 16, 21-22, 35, 44, available at <https://nipp.org/wp-content/uploads/2021/05/MD-II-for-web.pdf>.

⁸² "Complete List of All U.S. Nuclear Weapons," op. cit.

⁸³ "Statement of General Anthony J. Cotton," 2025, op. cit., p. 11.

⁸⁴ Sydney J. Freedberg, Jr., "Sub-launched nuclear cruise missile will need 'an entirely new industrial base,' warns Navy admiral," *Breaking Defense*, November 15, 2024, available at <https://breakingdefense.com/2024/11/sub-launched-nuclear-cruise-missile-will-need-an-entirely-new-industrial-base-warns-navy-admiral/>.

⁸⁵ U.S. Department of Defense, "Statement on the Fielding of the W76-2 Low-Yield Submarine Launched Ballistic Missile Warhead," February 4, 2020, available at <https://www.defense.gov/News/Releases/Release/Article/2073532/statement-on-the-fielding-of-the-w76-2-low-yield-submarine-launched-ballistic-m/>.

weapons. More W76-2s could be produced and modified W76-1s could become low-yield weapons.

In the longer run, it may be possible to speed up the nuclear SLCM program and design the W93 and the W87 to have variable yields. The Trident precision accuracy upgrade discussed above could expand *survivable* U.S. low-yield options to include precision low-kiloton or even sub-kiloton weapons.

High Delivery Accuracy

High delivery accuracy also increases deterrence strategy adaptability and targeting flexibility. Enhancing the accuracy of the ballistic missile force would likely strengthen the U.S. nuclear deterrent by increasing damage expectancy against many types of hard targets; in combination with lower-yield weapons, it could also increase the credibility of U.S. deterrence strategies by reducing collateral damage. The B61-12 and B61-13 are now the only U.S. precision nuclear weapons. The new Sentinel ICBM and warhead package reportedly will be considerably more accurate than the 1970-vintage Minuteman III.⁸⁶ If so, Sentinel uploading, would provide additional weapons with greater accuracy. It is unclear whether the second Trident II life extension program will enhance accuracy beyond the improvement provided by the W93/Mark 7 reentry vehicle in 2040.

⁸⁶ "Lockheed Martin chosen to design and build reentry vehicle for future Sentinel nuclear ballistic missile," *MilitaryAerospace.com*, November 9, 2023, available at <https://www.militaryaerospace.com/senso.s/article/14301230/lockheed-martin-nuclear-ballistic-missile-reentry-vehicle>; and, Northrop Grumman, "Building Upon the Minuteman Legacy," no date, available at <https://www.northropgrumman.com/space/sentinel/about-sentinel>.

A *portion* of the Trident W76 force could be given precision accuracy at modest cost. Tests of W76/Mark 4 reentry vehicles in 2003 and 2005 demonstrated that they “...could steer toward a target and strike with improved accuracy” and could “...slow down and control the impact conditions....”⁸⁷ Controlling impact conditions could enhance capabilities against some HDBTs with a specialized penetrator warhead. Trident could carry either the low- or high-yield W76s. An abortive program for a conventional Trident 20 years ago was estimated to achieve a 10 meter accuracy within two to four years at a cost of about \$500 million.⁸⁸ Uploading ICBM and SLBMs would expand U.S. capabilities with accuracy and the additional numbers could help compensate for inadequate accuracy via two-on-one targeting in some scenarios.

Dealing with the Non-Strategic Nuclear Threat

Russia has a “vast arsenal of non-strategic nuclear weapons.”⁸⁹ Most estimates range from 2,000 (the official number) to 10,000—10 to 50 times the reported U.S.

⁸⁷ Captain Terry Benedict, “A New Role for the Trident Fleet,” *Proceedings*, June 2006, available at <https://www.usni.org/magazines/proceedings/2006/june/new-role-trident-fleet>.

⁸⁸ Amy F. Woolf, “Conventional Warheads for Long Range Ballistic Missiles: Background and Issues” (Washington, D.C.: Congressional Research Service, January 2009), pp. 7, 9, available at <https://sgp.fas.org/crs/nuke/RL33067.pdf>.

⁸⁹ Office of Director of National Intelligence, *Annual Threat Assessment of the U.S. Intelligence Community*, March 2025, p. 20, available at <https://www.dni.gov/files/ODNI/documents/assessments/ATA-2025-Unclassified-Report.pdf>.

number.⁹⁰ In addition, China may already have exceeded the U.S. non-strategic nuclear force.⁹¹

Even the low estimates of Russian non-strategic nuclear weapons would allow Russia to launch many types of attacks against U.S. allies – to which Washington may not be able to respond promptly or effectively with non-strategic systems. That reality poses a threat to deterrence, particularly extended deterrence, given the likely need for low-yield, regional U.S. nuclear options for credible deterrence in regional contingencies.⁹² In the Indo-Pacific, this deterrence credibility problem may be exacerbated by the problem of U.S. aircraft vulnerability in the face of thousands of Chinese missiles. Reportedly, “...the U.S. military has built just 22 such [fighter aircraft] shelters in the Indo-Pacific region.”⁹³ Hence, unless on nuclear alert, nuclear-capable fighters may well be vulnerable to pre-emptive attack.

The following NATO figure illustrates the enormous disparity that exists in these types of nuclear weapons.

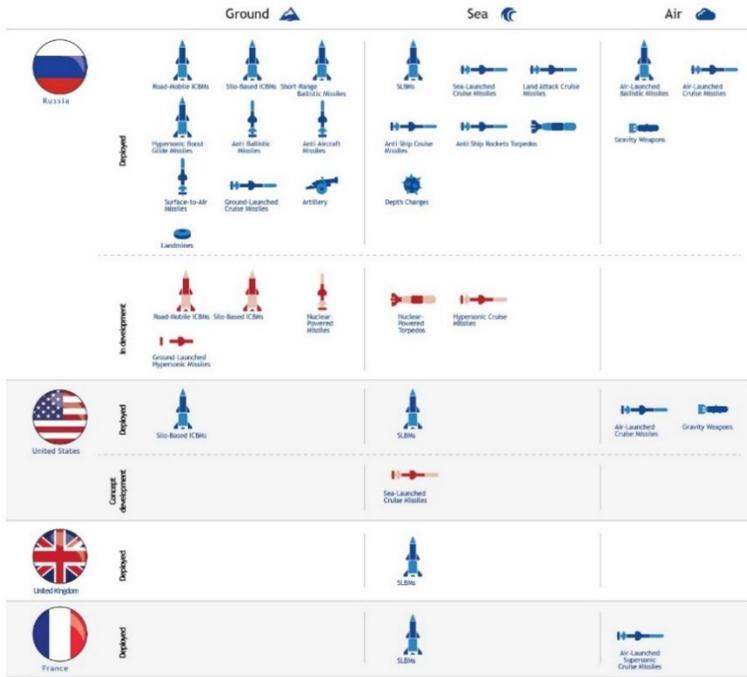
⁹⁰ Schneider, *How Many Nuclear Weapons Does Russia Have?*, op. cit., pp. 189-190.

⁹¹ House Committee on Oversight and Accountability, “Congressional Testimony of James E. Fanell, CAPT USN (Retired),” June 26, 2024, p. 6, available at <https://oversight.house.gov/wp-content/uploads/2024/06/Fanell-Testimony.pdf>.

⁹² See, for example, the discussion in, Joe Gould, “Strategic Command chief: sea missile cancellation opens ‘deterrence and assurance gap,’” *DefenseNews.com*, April 5, 2022, available at <https://www.defensenews.com/pentagon/2022/04/05/us-strategic-command-chief-sea-missile-cancellation-opens-deterrence-and-assurance-gap/>.

⁹³ Bill Gertz, “Lawmakers urge more hardened U.S. aircraft shelters in Asia as China bulks up,” *The Washington Times*, May 9, 2024, available at <https://www.washingtontimes.com/news/2024/may/9/lawmakers-urge-more-hardened-us-aircraft-shelters-/>.

Figure 1: Comparing Non-Strategic Nuclear Weapons Arsenals



ICBM: Inter-Continental Ballistic Missile
SLBM: Submarine-Launched Ballistic Missile

Note: Russia often has multiple varieties of the same type of weapon, and does not disclose all its nuclear weapons systems, meaning that some may not be listed here.

Source: Jens Stoltenberg, *The Secretary General's Annual Report, 2020*

The Defense Department apparently has consistently underestimated Chinese nuclear capabilities.⁹⁴ Even so, China is assessed as having nuclear-capable, air-launched ballistic missiles, hypersonic glide vehicles, intermediate-range ballistic missiles and medium-range ballistic missiles,⁹⁵ all of which the United States lacks. In February 2024,

⁹⁴ Tom Cotton, *Seven Things You Can't Say About China* (New York: Broadside Books, 2025), p. 52.

⁹⁵ *Nuclear Challenges*, op. cit., p. vi.

General Cotton said China "...has approximately 1,000 medium- and intermediate-range dual-capable...ballistic missiles..."⁹⁶ Other sources credit China with nuclear-capable cruise missiles, short-range ballistic missiles, and gravity bombs.⁹⁷

Given Russian, Chinese and North Korean theater nuclear escalation options, the United States needs more non-strategic nuclear capability for credible extended deterrence purposes. The nuclear SLCM-N program may be accelerated if the existing TLAM Block 5 SLCM is given a nuclear capability.⁹⁸ This is a very important possible step. Similarly, it is critical to maintain the effectiveness of the airborne non-strategic nuclear deterrent (e.g., NATO's DCA). To do so, it is necessary to provide the F-35 with a stealthy stand-off capability and strike range extension. Two prime low cost candidates exist: 1) a nuclear-armed version of the AGM-154 Joint Standoff Weapon modified to carry a propulsion system which can be carried in the F-35 bomb bay; and, 2) a nuclear-armed version of the longer range AGM-158 Joint Air-to-Surface Standoff Missile Extended Range which must be carried externally reducing stealth. In the long run, it may be necessary to provide a

⁹⁶ Senate Armed Services Committee, "Statement of General Anthony J. Cotton," March 9, 2023, p. 6, available at <https://www.armed-services.senate.gov/imo/media/doc/2023%20USSTRATCOM%20Congressional%20Posture%20Statement%20-%20SASC.pdf>.

⁹⁷ Mark B. Schneider, "The Chinese Nuclear Threat," *Information Series*, No. 599 (Fairfax, VA: National Institute Press, September 26, 2024), available at https://nipp.org/information_series/mark-b-schneider-the-chinese-nuclear-threat-no-599-september-26-2024/.

⁹⁸ See the suggestion by Rob Soofer in, Sydney J. Freedberg, Jr., "Sub-launched nuclear cruise missile will need 'an entirely new industrial base,' warns Navy admiral," *Breaking Defense*, November 15, 2024, available at <https://breakingdefense.com/2024/11/sub-launched-nuclear-cruise-missile-will-need-an-entirely-new-industrial-base-warns-navy-admiral/>.

small nuclear-capable hypersonic missile to deal with very advanced defenses.

There are additional potential options to increase the U.S. non-strategic nuclear capability at modest cost. The nuclear SLCM could be deployed on a ground-based launcher. To help deter potential Russian, Chinese and North Korean use of battlefield nuclear weapons, any of the U.S. conventional ground-launched missiles could be given dual-capability at modest cost. For example, the W82 nuclear artillery round could be recreated. Nothing new would have to be developed. It is small and light enough to be carried by virtually any delivery vehicle. The way the United States currently does business under stockpile stewardship, it would likely take a decade to do this. This should be changed.

Strategic force upload may be a helpful, near-term—albeit partial—means to strengthen extended deterrence. That is, uploading Trident could provide additional low-yield targeting capabilities much more quickly than other options. Doing so would likely contribute significantly to extended deterrence credibility as longer-term U.S. regional options mature. Recent tabletop exercises have highlighted the importance of low-yield options for credible U.S. extended deterrence.⁹⁹

Extended Deterrence in the Indo-Pacific

There are no U.S. nuclear weapons deployed in the Indo-Pacific region, giving Russia, China and North Korea dangerous coercive leverage as they expand, diversify and improve their nuclear capabilities.¹⁰⁰ The Congressional

⁹⁹ Markus Garlauskas, Lauren Gilbert, and Kyoko Imal, *A rising nuclear double-threat in east Asia : Insights from our Guardian Tiger I and II tabletop exercises*, op. cit.

¹⁰⁰ “Conversations on National Security: Major General Michael J. Lutton,” *Information Series*, No. 487 (Fairfax, VA: National Institute

Strategic Posture Commission concluded that there is an “urgent need” for U.S. theater nuclear forces to be “deployed or based in the Asia-Pacific theater.”¹⁰¹

The 2010 NPR argued that the U.S. ability to forward deploy “...bombers with either bombs or cruise missiles and forward-deployment of dual-capable fighters....” was then adequate for extended deterrence.¹⁰² However, that claim was made well before the outlines of the unprecedented, current threat context were recognized. There is a serious question of whether the United States has *any real* capability for *timely* deployment of these capabilities. This necessitates sufficient deployable nuclear-certified aircraft, crews, maintainers, refueling tankers and security forces. These are in short supply. Forward deployed bombers have the same issues. Without the ability to maintain nuclear alert, forward deployed bombers would be more vulnerable.

None of the U.S. INF-range ballistic, cruise or hypersonic missile programs is nuclear capable. The way the United States is doing business today, there is likely no possibility of giving any of them nuclear capability by 2027. The current strategic modernization program is unlikely to provide any new capability by 2027 other than the new versions of the B61 bomb. Even the B-21 “Nuclear qualification will also take two years or so after IOC [probably in 2029].”¹⁰³ The rest of the modernization program is 2030 or beyond.

Press, April 27, 2021), available at https://nipp.org/information_series/conversations-on-national-security-major-general-michael-j-lutton-no-487-april-27-2021/.

¹⁰¹ Creedon and Kyl, et al., *The Final Report of the Congressional Commission on the Strategic Posture of the United States*, op. cit., p. viii.

¹⁰² *Nuclear Posture Review Report*, 2010, op. cit., p. 28.

¹⁰³ Congressional Research Service, “Air Force B-21 Raider Long-Range Strike Bomber,” September 22, 2021, p. 4, available at <https://www.congress.gov/crs-product/R44463>.

Acceleration of the nuclear SLCM program is necessary but unlikely to be fully adequate. Giving dual capability to at least one U.S. hypersonic and other INF-range missiles would allow Asia-Pacific deployment of significant nuclear capability, enhancing extended deterrence and reducing the prospect of nuclear proliferation by threatened allies. In the near term, inexpensive warhead upload may be the only available option to enhance nuclear deterrence of a possible 2027 timeline for a Chinese invasion of Taiwan. To help in this regard, if the United States starts soon, all of the Trident force and almost half of the Minuteman force likely could be uploaded by mid-2027. Doing so, while insufficient under looming threat conditions, could both enhance deterrence in the near term and reduce the prospect of proliferation by desperate allies.¹⁰⁴

Conclusion

The contemporary threat environment is unprecedented. For example, in addition to numerous explicit Russian nuclear threats, Putin's "suspended" and violated New START Treaty fans considerable uncertainty about the extent of possible Russian nuclear uploading. There is increasing evidence that Russia is above the deployed warhead limit. The Biden State Department's assertion that it had "high confidence" that Russia was not much above the New START deployed warhead limit is incredible; Russia has had enough time to upload all of its strategic nuclear forces since the last New START Treaty inspection in March 2020.

¹⁰⁴ A prominent German commentator recently called for 1,000 additional European nuclear weapons to deter Russian nuclear threats. See, James Rothwell, "EU needs '1,000 more' nuclear missiles to deter Putin," *The Telegraph*, March 1, 2025, available at <https://www.telegraph.co.uk/world-news/2025/03/01/eu-needs-1000-more-nuclear-missiles-to-deter-putin/>.

In light of growing nuclear threats, the existing U.S. New START Treaty-limited strategic nuclear force and the planned modernization program are inadequate. The U.S. non-strategic nuclear capability is particularly limited. To preserve deterrence, the dangerous Russian, Chinese and North Korean nuclear buildups must be countered and their monopoly on forward deployed nuclear weapons in the Indo-Pacific must end. In the best case, this likely will take significant time with the current modernization program. Hence, a near-term option to redress the looming nuclear imbalance and threats to deterrence is through inexpensive upload. Upload can dramatically increase the capability of the current U.S. strategic nuclear forces and the benefits from the nuclear modernization program of record. Absent upload, the United States will realize only about half of the potential benefit from this program in terms of warhead numbers.

A prudent deterrence response to an unprecedented threat context involving the potential for opportunistic or coordinated aggression and the long-standing Russian and Chinese nuclear buildups includes nuclear weapons upload of legacy and future forces. It likely is impossible, for example, to hold at risk the increasingly large number of Chinese and Russian deterrence-related assets, including nuclear weapons and facilities, with a New START Treaty-limited force. The United States must proceed with the planned nuclear modernization program. But, it likely will be too slow and ultimately too limited for confident deterrence in a rapidly worsening threat environment. At this point, nuclear upload is likely the only way America can adequately enhance the force size and flexibility needed to tailor deterrence in the near term for the prevention of great power conflict, including major aggression against U.S. allies.

Appendix A. Sources for Tables 1 and 2

Number of Delivery Vehicles

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- Tom Kaminski, “America’s Shield,” *Combat Aircraft*, Vol. 26, No. 2, February 2025, p. 42.

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- SLBMs: Bureau of Arms Control, Verification, and Compliance, Department of State, “New START Treaty Aggregate Numbers of Strategic Offensive Arms,” January 1, 2014; and, National Nuclear Security Administration, Department of Energy, *FY 2014 Stockpile Stewardship and Management Plan* (Washington, D.C.: National Nuclear Security Administration, Department of Energy, June 2013), p. 2-2.
- ICBMs: Amy F. Woolf, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, RL33640 (Washington, D.C.: Congressional Research Service, October 22, 2013), p. 12; and, National Nuclear Security Administration, Department of Energy, *FY 2014 Stockpile Stewardship and Management Plan* (Washington, D.C.: National Nuclear Security Administration, Department of Energy, June 2013), p. 2-2.
- Bombers: Edward L. Warner III, Secretary of Defense Representative to post-New START negotiations, written response for the record, Senate Foreign Relations Committee, *The New START Treaty (Treaty Doc. 11-5)*, S. Hrg. 11-738, 111th Cong., 2nd session (Washington, D.C.: GPO, 2010), pp. 265-266.

Weapons Capacity Per Delivery Vehicle

- SLBMs: Woolf, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, op. cit., p. 19.
- ICBMs: Woolf, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, op. cit., p. 11; and, Government Accountability Office, *ICBM Modernization: Approaches to Basing Options and Interoperable Warhead Designs Need Better Planning Synchronization*, GAO-12-831 (Washington, D.C.: Government Accountability Office, September 2013), p. 6.
- Bombers: Department of the Air Force, *U.S. Air Force Long-Range Strike Aircraft White Paper* (Washington, D.C.: Department of the Air Force, November 2001), p. A-1; and Maj. Gen. Roger Burg, USAF, Director of Strategic Security, Office of the Deputy Chief of Staff for Operations, Plans, and Requirements, Headquarters U.S. Air Force, prepared statement in Senate Armed Services

Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2008, Part 7*, S. Hrg. 110-201, Pt. 7 (Washington, D.C.: GPO, 2008), p. 56.

- Hans M. Kristensen, Matt Korda, Eliana Johns and Mackenzie Knight, "United States nuclear weapons, 2025," *Bulletin of the Atomic Scientists*, 2025, Vol. 81, No. 1, p. 53.

"Warm" Status of Non-Deployed Silos and Missiles

- "Senior defense official" cited in Robert Burns, "US Will Cut Deployed Nuke Missile Force By 50," Associated Press, April 8, 2014.

Chapter 2

What Can Congress Do to Facilitate the Upload of Nuclear Weapons?

Executive Summary

Adapting U.S. nuclear forces to strengthen deterrence in the face of growing threats by adversaries is an urgent imperative. Consistent with its Article I authorities under the Constitution, the Congress has the ability to adapt U.S. nuclear posture by mandating and providing funding for enhancements to U.S. strategic nuclear programs. Unfortunately, given the current state of the U.S. nuclear enterprise, options to improve the efficacy, reliability, and credibility of the U.S. nuclear deterrent are limited or will take years to implement. However, the most rapid option for bolstering U.S. nuclear capabilities is the upload of non-deployed warheads on ICBMs and SLBMs.

There are several actions the Congress should take promptly with respect to the upload of nuclear weapons. These include requiring official reports to identify U.S. deployed deterrence force requirements, Russian and Chinese upload capability and U.S. response options; ensuring adequate fiscal resources are provided to implement upload decisions and actions; directing expedited infrastructure improvements to meet national requirements; and mandating the reconstitution of a modern hedge stockpile of non-deployed warheads in the event of a further deterioration in the strategic environment. The Congress should move out expeditiously to implement these actions.

Introduction

Consistent with its Article I authorities under the Constitution, the Congress can exercise its power to fund (or not to fund) defense and national security programs and to establish, modify, or revoke existing policy with respect to U.S. military activities and priorities, including nuclear weapons and strategic force programs. This can be done through the use of several legislative vehicles, but the most likely and appropriate vehicles are the annual National Defense Authorization Act (NDAA) and the DoD Appropriations Act.

The NDAA contains numerous provisions relating to U.S. strategic forces. For example, Subtitle C of Title 16 in the Fiscal Year (FY) 2025 NDAA contains eighteen separate sections dealing with U.S. nuclear forces.¹ Along with authorizing funding for defense programs, it addresses a range of defense policy issues, some of which can be highly controversial. In addition, the House and Senate Armed Services Committees (HASC and SASC), which are responsible for the annual NDAA process, typically issue report language accompanying each year's NDAA that is often directive in nature, requiring the Secretary of Defense or the president to submit various reports or take specific actions related to the U.S. nuclear weapons establishment. Although such directive report language is not signed by the president and is not considered legally binding, failing to comply with its requirements often leads Congress to impose penalties on the executive branch that can stymie the administration's plans. Those penalties often include funding cuts or restrictions that make implementation of various administration priorities difficult if not impossible.

¹ *Servicemember Quality of Life Improvement and National Defense Authorization Act for Fiscal Year 2025* (Public Law 118-159), December 23, 2024, available at <https://www.congress.gov/bill/118th-congress/house-bill/5009/text>.

As James Madison stated in *Federalist 58*, this so-called “power of the purse may, in fact, be regarded as the most complete and effectual weapon with which any constitution can arm the immediate representatives of the people, for obtaining a redress of every grievance, and for carrying into effect every just and salutary measure.”²

In the past, Congress has restricted or prohibited funding for various nuclear weapons-related programs, has imposed conditions on the president’s ability to negotiate nuclear arms control agreements, and has limited the ability of the president to make unilateral U.S. nuclear force reductions. All of these actions are consistent with the Congress’ law-making responsibilities under the Constitution. In addition to imposing limitations and restrictions, the Congress has the ability to direct that certain actions be taken and to provide funding, through the authorization and appropriations process, to implement those actions. Therefore, the Congress has the ability to adapt U.S. nuclear posture by mandating and providing funding for enhancements to U.S. strategic nuclear programs. This includes directing and facilitating the upload of nuclear weapons on U.S. delivery systems to strengthen deterrence.

Importantly, for Congress to take actions that are legally binding on the administration, those actions must be agreed to on a bipartisan basis and incorporated in legislation signed into law by the president. The annual NDAA is the most relevant vehicle for addressing defense issues, as it contains thousands of provisions agreed to on a bipartisan basis by the two defense authorization committees (HASC and SASC). However, it may not always be possible to obtain bipartisan support within the individual defense committees for legally binding requirements on the administration. In such cases, committee report language

² James Madison, *Federalist 58*, available at https://avalon.law.yale.edu/18th_century/fed58.asp.

offers an alternative means for expressing the committees' desires on major defense issues that may be too controversial or difficult to be included in statutory language. These HASC and SASC committee reports allow the authorization committees to explain their respective defense priorities and to direct that certain actions be taken even though they were not incorporated into the legally binding NDAA that is signed into law by the president.

Recommendations

Adapting U.S. nuclear posture to address the deterioration in the contemporary international security environment will require enhancements to existing legacy nuclear systems and the development and deployment of more modern, sophisticated nuclear capabilities to strengthen deterrence. Unfortunately, given the current state of the U.S. nuclear enterprise, options to improve the efficacy, reliability, and credibility of the U.S. nuclear deterrent are limited or will take years to implement. However, the most rapid option for bolstering U.S. nuclear capabilities is the upload of non-deployed warheads on ICBMs and SLBMs.

Specifically, there are several actions the Congress should take with respect to the upload of nuclear weapons, which are highlighted below. Some of these can be incorporated into statutory language in the NDAA while others can be addressed in directive report language.

- *Direct full implementation of the recommendations of the Strategic Posture Commission regarding the upload of U.S. nuclear weapons.*

Sec. 1687 of the National Defense Authorization Act for Fiscal Year 2022 (Public Law 117-81) established a bipartisan "Congressional Commission on the Strategic Posture of the United States." The commission issued its

report in October 2023. Among its findings was that Russia has “added substantial warhead upload capacity to its ICBMs and Submarine Launched Ballistic Missiles (SLBMs)” and that “Russia’s modernized nuclear warhead design and production infrastructure have significant surplus capacity to implement a decision to upload.”³ Consequently, the commission recommended that the United States take several actions in response. These include preparing to upload a number of “hedge” warheads in the U.S. non-deployed nuclear stockpile and exercising the upload option on existing deployed ICBMs and SLBMs.⁴

The Congress should affirm the commission’s recommendations and legislate as a matter of policy that the United States will act to implement them expeditiously as a national priority. This can be done through statutory language in the FY 2026 NDAA.

- *Direct the Secretary of Defense to submit a report to the congressional defense committees in both classified and unclassified form on the state of Russian and Chinese warhead upload capacities and their supporting infrastructure should they decide to upload warheads on existing nuclear delivery platforms.*

This report should provide details on Russian and Chinese industrial production capacities as they relate to nuclear warhead development and should assess the implications for deterrence of any decision by Russia and/or China to expand the size and capabilities of their nuclear arsenals by

³ Madelyn R. Creedon, Chair, Jon L. Kyl, Vice Chair, et.al, *America’s Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States*, October 2023, pp. 9, 92, available at <https://www.ida.org/-/media/feature/publications/a/am/americas-strategic-posture/strategic-posture-commission-report.ashx>.

⁴ *Ibid.*, pp. 45, 48, 99.

uploading nuclear weapons on ICBMs and SLBMs. Understanding the full potential of Russian and Chinese upload capabilities is essential for determining whether the U.S. upload potential is sufficient to negate any advantage Russia and China, together or separately, might perceive in pursuing this option. In addition, the report should assess the likely rationale for any Russian and/or Chinese decision to upload non-deployed warheads and the implications of such a decision for U.S. deterrence.

- *Incorporate a Sense of Congress resolution into the FY 2026 NDAA expressing Congress' view that U.S. upload actions should be linked to Russian and Chinese nuclear weapons developments, aggressive goals, and related U.S. deterrence requirements for holding at risk what opponents value most.*

Though not legally binding, a Sense of Congress resolution would be useful for several reasons. First, it would clearly note that U.S. upload actions are a response to, rather than the driver of, Russian and Chinese nuclear weapons developments. In other words, U.S. uploading would be an appropriate response to actions taken by Russia or China to shift the correlation of nuclear forces in their favor. Second, it would place U.S. uploading in the context of meeting deterrence requirements, not “nuclear war-fighting.” Third it would put the executive branch on notice that Congress, on a bipartisan basis, takes this issue seriously. Fourth, in doing so, it foreshadows more direct congressional action to ensure that the expansion of Russian and Chinese nuclear arsenals does not proceed unchallenged, including the potential legislative imposition of various certification requirements, prohibitions, or budgetary actions.

- *Recommend suspension of U.S. implementation of the New START Treaty to allow for upload increases in the number of operationally deployed*

warheads on strategic delivery vehicles and prohibit funding for any New START implementation measures.

The New START Treaty places a limit of 1,550 on the number of operationally deployed, accountable strategic nuclear weapons. The United States, as a matter of policy, has remained bound by this limit, despite the fact that Russia announced it was suspending its participation in New START in 2023 and has ceased allowing the on-site inspections mandated by the treaty and necessary to verify its compliance. Unclassified reports suggest Russia may already have significantly exceeded the allowable New START Treaty limits.⁵ In addition, earlier this year, the State Department conceded that Russia “may have exceeded the deployed warhead limit by a small number during portions of 2024” and that “The United States is unable to make a determination that the Russian Federation remained in compliance throughout 2024 with its obligation to limit its deployed warheads on delivery vehicles subject to the New START Treaty to 1,550, due to Russia’s proximity to the limit as of its last update and failure to fulfill its obligations with respect to the Treaty’s verification regime.”⁶

⁵ See, for example, Mark B. Schneider, “The 2024 Edition of the Federation of American Scientists’ Report on Russian Nuclear Weapons: Flaws and Fallacies,” *Information Series*, No. 587 (Fairfax, VA: National Institute Press, May 20, 2024), available at https://nipp.org/information_series/mark-b-schneider-the-2024-edition-of-the-federation-of-american-scientists-report-on-russian-nuclear-weapons-flaws-and-fallacies-no-587-may-20-2024/; Mark B. Schneider, *How Many Nuclear Weapons Does Russia Have?: The Size and Characteristics of the Russian Nuclear Stockpile, Occasional Paper*, Vol 3, No. 8 (Fairfax, VA: National Institute Press, August 2023), available at <https://nipp.org/wp-content/uploads/2023/09/Vol.-3-No.-8.pdf>.

⁶ Department of State, *Report to Congress on Implementation of the New START Treaty*, January 17, 2025, p. 6, available at https://2021-2025.state.gov/wp-content/uploads/2025/01/UNCLASS_NST-

Russia's suspension of New START frees Moscow to upload nuclear weapons on several of its delivery systems. Continued U.S. unilateral adherence to the 1,550 quantitative limitation in New START greatly limits U.S. upload options. This situation should be remedied immediately. In addition, the New START Treaty should not be extended in any way beyond its February 2026 expiration date so the United States may adjust its nuclear force levels appropriately to respond to the deteriorating security environment.

- *Authorize and appropriate the necessary funding for the Air Force and Navy to exercise the warhead upload option.*

The House and Senate Armed Services Committees should be briefed by both the Air Force and Navy on the cost of ICBM and SLBM warhead upload options and the advantages and disadvantages of uploading a portion of the hedge force as opposed to the entire hedge force. The authorization of funds for uploading warheads should be contained in the FY 2026 NDAA with the actual appropriation of funds provided by the FY 2026 DoD Appropriations Act. Such funding is imperative if the proposed uploading actions are to be implemented.

- *Direct the Secretary of Defense to submit a report to the congressional defense committees on specific upload options, associated costs, timelines for completion, and implications for deterrence of uploading forces or not doing so.*

In addition to cost information provided by the Air Force and Navy, the House and Senate Armed Services

Committees should direct the Secretary of Defense to submit a report to the congressional defense committees within 90 days that addresses 1) the timeline for implementing uploads on both ICBM and SLBM delivery systems; 2) the trade-offs involved in reducing the number of warheads in the “hedge” force through upload; 3) the effect of uploading warheads on the overall U.S. strategic deterrent, including the U.S. extended nuclear deterrent; and 4) options for restoring a hedge force of sufficient size and capability to further augment deterrence. The submission of such a congressional report is unlikely to be controversial, especially since it relates to recommendations proposed by the bipartisan Strategic Posture Commission that Congress established.

- *Direct the National Nuclear Security Administration (NNSA) to improve the pit production process so that pit production can be accelerated in accordance with prior legislative requirements and that additional warheads can be created to upload existing forces and stockpiled as a replacement hedge capability.*

Section 4219 of the Atomic Energy Defense Act (50 U.S.C. 2538a) requires the NNSA to produce at least 80 pits per year by 2030; however, significant concerns exist regarding the ability of NNSA to meet this requirement. For example, a Government Accountability Office (GAO) report in 2023 found that NNSA’s pit production plans are likely to result in major delays and cost overruns.⁷ Therefore, the Congress should direct NNSA to identify and implement procedures

⁷ United States Government Accountability Office, *NUCLEAR WEAPONS: NNSA Does Not Have a Comprehensive Schedule or Cost Estimate for Pit Production Capability*, GAO-23-104661, January 2023, available at <https://www.gao.gov/assets/820/814649.pdf>.

that will allow it to meet the 80-pit annual requirement by 2030.

- ***Mandate that DoD create and maintain a new, more modern, hedge stockpile of non-deployed warheads for possible future deployment.***

As existing hedge warheads are uploaded on ICBMs and SLBMs, Congress should establish, as a matter of policy, that the United States will maintain a significant replacement hedge stockpile to guard against a further deterioration in the strategic environment that increases the risk of deterrence failure. This is necessary to ensure that U.S. nuclear forces are resilient against any such unforeseen changes. As one study noted more than 15 years ago, “For U.S. nuclear forces, resilience is the ability to recover from or adjust to unfavorable strategic developments, technical difficulties, operational challenges, or technological surprises.”⁸ Uploading nuclear weapons on existing platforms is one measure that can help ensure the resilience of the U.S. nuclear force. As this study further concluded, “a reserve of non-deployed warheads in the nuclear weapons stockpile is essential for resilience.”⁹

As far back as the George W. Bush Administration, the need for a hedge capability of non-deployed warheads was described as “insurance against the re-emergence of a hostile peer competitor.”¹⁰ More than two decades later, the United States faces not one but two hostile peer competitors. Therefore, if all existing hedge warheads are uploaded, the

⁸ Dr. Keith Payne, Study Director, et al., *Planning the Future U.S. Nuclear Force, Volume I: Executive Report* (Fairfax, VA: National Institute Press, 2009), p. 16.

⁹ *Ibid.*, p. 19.

¹⁰ Donald H. Rumsfeld, Secretary of Defense, *Department of Defense Annual Report to the President and the Congress* (Washington, DC: GPO, 2002), pp. 89-90.

United States should create a more modern hedge stockpile of non-deployed warheads to hold in reserve.

The Biden Administration's *2022 Nuclear Posture Review* eliminated "hedging against an uncertain future" as a key role for U.S. nuclear weapons.¹¹ This overturned decades of policy direction, promulgated by administrations of both political parties, acknowledging the importance of hedging against the possible resurgence of a hostile Russia or more aggressive China. The ability to upload non-deployed reserve warheads was part of this hedging strategy.

In contrast to the Biden Administration, the Obama Administration validated the need for an "upload hedge." As one analysis described it:

Specifically, the United States will maintain additional warheads in the nuclear stockpile, and the ability to upload those warheads on existing delivery systems to: (1) restore existing force levels in the event of a technical problem with a warhead or delivery system; or (2) field a larger deployed force, if required, in the event of a geopolitical reversal.... This hedge strategy was intended to provide response options against 'a change in the international landscape' or 'a geopolitical surprise' that would 'alter the U.S. calculus about the necessary composition of the deployed force.'¹²

¹¹ Department of Defense, *2022 Nuclear Posture Review*, October 2022, p. 7, available at <https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.pdf>.

¹² Department of Defense, *Report on Nuclear Employment Strategy of the United States Specified in Section 491 of 10 U.S.C.*, June 12, 2013, pp. 4-5, cited in Thomas Scheber and John R. Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps* (Fairfax, VA: National Institute Press, 2015), p. 13, available at <https://nipp.org/wp-content/uploads/2021/03/Assessment-of-US-Readiness-for-web.pdf>.

Conclusion

In short, there are a number of actions Congress can take to facilitate the upload of U.S. nuclear weapons in ways that strengthen deterrence and extended deterrence. These include requiring official reports to identify U.S. deployed deterrence force requirements, Russian and Chinese upload capability and U.S. response options; ensuring adequate fiscal resources are provided to implement upload decisions and actions; directing expedited infrastructure improvements to meet national requirements; and mandating the reconstitution of a modern hedge stockpile of non-deployed warheads in the event of a further deterioration in the strategic environment.

Adapting U.S. nuclear forces to strengthen deterrence in the face of growing threats by adversaries is an urgent imperative. Uploading U.S. delivery systems is the most rapid and effective way to improve the efficacy of the U.S. nuclear deterrent. The Congress should move out expeditiously to implement the actions proposed above.

Chapter 3

Responsive Infrastructure

Executive Summary

Beginning in 1989, after over four decades of continuous operation, the nuclear warhead infrastructure of the United States was shutdown, missions transferred to other sites, aging warheads were life-extended instead of replaced with new warheads, and nuclear testing ceased. The infrastructure has not been fully operational since 1989. Now, over thirty years later, the infrastructure is still not fully operational. The infrastructure is tasked with being ready to assess the reliability of the U.S. nuclear warheads, to evaluate the nuclear arsenals of adversaries, and to respond with warhead life extension programs, other modifications, or new designs in a timely manner. However, the responsive infrastructure needed for that role is still years—perhaps a decade—away. Significant improvements are needed if it is to be capable of that mission.

First, the national laboratories responsible for nuclear warhead designs and reliability assessments will need to restore a more complete skill set for warhead design and development. The current approach for life-extending warheads exercises only a limited set of critical skills for warhead development and production at a time. Prototype or new warhead development programs will be needed to more fully exercise critical skills that have atrophied in order to train a new generation of warhead developers. Also, there exists a lack of balance between computational analysis and experiments at the laboratories. Today, the nuclear warhead development community is overly dependent on computer simulation. Greater emphasis

needs to be placed on experimental activities so that inexperienced warhead designers and engineers can push the limits of design, explore concepts, and develop judgment skills that will be critical in the years ahead.

Second, the facilities for warhead component production have yet to be fully modernized and the overall complex is not fully operational. Several actions are needed in the near term to help achieve a responsive and resilient infrastructure. All are important. Several require urgent attention.

Recommendations requiring urgent action include the following: For plutonium processing and fabrication, proceed with greater urgency to achieve an operational pit fabrication capability at Los Alamos, accelerate the second fabrication site at the Savannah River Site (SRS), and develop plans for each site to be able to scale up plutonium pit production quantities in a timely manner.

For Nuclear test readiness, survey test readiness capabilities and take immediate corrective action to restore a readiness capability to conduct a fully instrumented nuclear test within two years; also, appropriate funds for test readiness and keep the funding in an “escrow” account to be used, when needed, to begin test preparations.

For the Department of Defense (DoD) and the National Nuclear Security Administration (NNSA) program integration, proceed apace on W93 warhead development and give high-level attention to DoD/NNSA integration activities for the W93 program.

Other important recommended actions include accelerating the construction of the replacement uranium and lithium fabrication facilities at Oak Ridge, expanding capacity for non-nuclear component production at the Kansas City Plant and at Sandia, and accelerating the completion of the Tritium Finishing Facility and other modernization projects at SRS.

Introduction: Responsive Infrastructure

The government-owned infrastructure needed to build, sustain, and modify nuclear warheads is of particular concern. A capability that is responsive to changing national security needs and resilient to technical and geopolitical surprises is a necessary part of a risk management approach for the United States and its allies.

The lack of an operational nuclear warhead infrastructure has been discussed as a concern for the past thirty years. For example, a September 2008 white paper signed jointly by Secretary of Defense Robert Gates and Secretary of Energy Samuel Bodman states: “The United States is now the only nuclear weapon state party to the NPT (Nuclear Nonproliferation Treaty) that does not have the capability to produce a new nuclear warhead.”¹ That statement remains true today. The 2009 report of the Perry-Schlesinger Strategic Posture Commission stated that some facilities to produce nuclear components are “genuinely decrepit” and much remains to be done to put in place a modern nuclear infrastructure to serve national security goals for the long term.² In the more than fifteen years since these two reports were published, some significant progress has been made toward a responsive infrastructure, but the overall goal of an operational and responsive infrastructure remains elusive with completion projected well into the future.

¹ Robert M. Gates and Samuel W. Bodman, “National Security and Nuclear Weapons in the 21st Century,” September 2008, p. 19, available at

https://www.bits.de/NRANEU/docs/NucPol21Century_092308.pdf. (This unclassified report was an edited and redacted version of a classified report on the same subject sent to Congress in February 2008.)

² William J. Perry and James R. Schlesinger, et al., *America’s Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Washington, D.C.: United States Institute of Peace Press, 2009), p. 8.

Background

To fully understand the challenge of reestablishing a responsive infrastructure for the United States, some background is helpful. The U.S. nuclear warhead infrastructure operated continuously from its inception in the 1940's until 1989. The business model for this enterprise involved three design laboratories and numerous large-capacity plants which operated continuously for over four decades. The manufacturing plants were geographically dispersed with a final assembly plant in Texas. Deployed warheads were typically replaced with newer warhead designs before the end of service life. Nuclear testing was used to determine the proper function of warheads in development and in the stockpile. Since 1989, four major changes, perhaps better described as *shocks*, have transformed the operation, location, and planning regarding the business model for this enterprise.

- **Shutdown.** The first major shock was the sudden, unplanned break in serial warhead production. In 1989, the Rocky Flats plutonium pit production plant was closed abruptly because of regulatory noncompliance. At that time, plutonium pits for W88 warheads were in production at Rocky Flats and the overall nuclear weapons complex was operating to complete the planned build of W88 warheads for Trident II missiles. In 1991, then-President George H. W. Bush announced that the plant would not be reopened and the planned build of W88 warheads would be truncated with only about a third of the planned number of W88 warheads completed. (This was one element of the second Presidential Nuclear Initiative intended to respond to the new, more cooperative relationship between the United States and the Soviet Union, later Russia.) After more than forty years of

continuous operation, production lines for warhead components fell silent.

- **Reconfiguration.** The second major shock was the plan to reconfigure the nuclear complex. This plan was initiated by the Department of Energy (DOE) in 1991. With warhead production lines idle and no prospect of resumed production in the near term, DOE sought to reduce future costs and improve efficiency by permanently closing some sites and consolidating the functions at other, larger sites. For example, the Rocky Flats pit production plant in Colorado was to be permanently closed and the functions moved to New Mexico and reconstituted as part of Los Alamos National Laboratory; the functions then performed at the Mound Facility in Ohio that produced nonnuclear parts for arming, fusing, and firing devices would be moved to the DOE plant at Kansas City, Los Alamos, and Sandia laboratories.³
- **Mission Change.** The third major shock to the system was the change in strategy to sustain the nuclear stockpile for the future. Instead of replacing older nuclear warheads with newly produced warheads when they reached the end of service life, warheads would be “modified” to extend the service life. The national laboratories would be responsible for determining the components to be replaced and designing and certifying the life extension programs. At the same time, the laboratories were to maintain the capability to

³ Department of Energy, *Nuclear Weapons Complex Reconfiguration Study*, January 1991, p. 15, available at <https://www.osti.gov/servlets/purl/6077838>.

design, develop, and certify new types of nuclear weapons, if required.

- **Cessation of Nuclear Testing.** Finally, a variety of factors led to the abrupt cessation of testing in 1993. The cessation of testing was mandated by the new Clinton Administration without any period of final preparation for a no-testing environment. As of this report, the most recent underground nuclear test performed by the United States was conducted in the fall of 1992. Prior to the cessation of testing and pursuit of a Comprehensive Test Ban Treaty, the United States had tested nuclear warhead designs under development as well as those in the stockpile in order to assess functionality throughout the stockpile-to-target environment and understand physics concepts.

After over four decades of continuous operation, the nuclear warhead infrastructure of the United States was shutdown, missions transferred to other sites, replacement was changed to life extension, and testing ceased. The infrastructure has not been fully operational since 1989. Now, over thirty years later, the infrastructure is still not fully operational. At the same time, the infrastructure is tasked with being ready to assess the reliability of the U.S. stockpile, to evaluate the nuclear arsenals of adversaries, and to respond with life extension programs, other modifications, or new designs in a timely manner.

Response Role for the Infrastructure

The 2001 *Nuclear Posture Review* (NPR) report from DoD called for deep reductions in the number of operationally deployed nuclear warheads and a significant reduction in the total stockpile of nuclear warheads. In order to respond to potential vulnerabilities from arms buildups or advances

by adversaries, the 2001 NPR called for a responsive infrastructure that would be able to resume design and production of nuclear warheads, if needed, in the future.⁴ This new posture was to be in place within a decade. Similarly, the 2018 NPR noted that the necessary responsiveness of the infrastructure was far from being a reality and called for “an effective, responsive, and resilient nuclear weapons infrastructure.”⁵ More recently, the 2023 report bipartisan Strategic Posture Commission (SPC) listed a functioning infrastructure as a necessary component of a “hedge against risk, geopolitical, technical, operational, and programmatic risks that could render U.S. nuclear forces insufficient ...”⁶

What follows is a discussion of the status of, and plans for, several important elements of a responsive and resilient infrastructure.

National Laboratories

The national laboratories that designed nuclear warheads in the extant stockpile must be capable of surveilling and assessing the status of each type of warhead, designing modifications, as needed, for life extension and upgrades,

⁴ Department of Defense, *Nuclear Posture Review Report*, December 2001, p. 14, available at https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/NCB/06-F-1586_Nuclear_Posture_Review.pdf.

⁵ Department of Defense, *Nuclear Posture Review Report*, 2018, p. XIV, available at <https://fas.org/wp-content/uploads/media/2018-Nuclear-Posture-Review-Version-2.pdf>.

⁶ Madelyn Creedon and Jon Kyl, et al., Congressional Commission on the Strategic Posture of the United States, *America’s Strategic Posture, The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Alexandria, VA: Institute for Defense Analysis, 2023), p. 27, available at <https://www.ida.org/-/media/feature/publications/a/am/americas-strategic-posture/strategic-posture-commission-report.ashx>.

and developing new, different, or modified warheads as national security needs dictate.

In the early 1990's, after warhead production lines were idled and advanced warhead development was suspended, funding for the nuclear infrastructure was slashed. DOE developed a strategy for infrastructure sustainment that would give priority to maintaining a healthy scientific community at the national laboratories at the expense of modernizing aging production facilities. Senior leaders at DOE defended this strategy by noting that "the body will die without a head."⁷

With new design and development activities suspended at the laboratories, DOE initiated the development of unique scientific facilities at each of the labs. Research at each of these facilities was to be relevant to the science of nuclear weapons and designed to attract and retain scientists and engineers. Toward this goal, the National Ignition Facility (NIF) was constructed at Lawrence Livermore National Laboratory, the Dual-Axis Radiographic Hydrotest Facility (DARHT) at Los Alamos, and the Microsystems Engineering Science and Applications (MESA) Facility at Sandia. Each of these facilities is a world-class scientific facility; all are currently operational, and upgrades continue to be pursued. In addition, each of the laboratories was included in a supercomputing initiative that has produced some of the most advanced computer systems in the world. These accomplishments are to be applauded for their

⁷ George Miller, "Stockpile Stewardship: What Were We Thinking? How Did It Work Out?," in Brad Roberts (eds.), *Stockpile Stewardship in an Era of Renewed Strategic Competition* (Livermore, CA: Center for Global Security Research, April 2022), p. 7, available at https://cgsr.llnl.gov/sites/cgsr/files/2024-08/CGSR_Occasional_Stockpile-Stewardship-Era-Renewed-Competition.pdf.

contributions to science and the ability to attract talented scientists to the laboratories.

In general, the plan to maintain healthy design laboratories is considered to be a success story. For example, the labs have developed enhanced stockpile surveillance capabilities to better understand warhead aging and to propose timely life extension programs (LEPs). The initial LEPs have been completed or are currently in-work for almost all the warheads in the stockpile. However, one former laboratory director cautioned that, to date, the life extension programs completed have been “modest” in complexity, have required “very long timelines,” and “often encountered significant difficulties.”⁸

In 2015, National Institute for Public Policy (NIPP) commissioned an assessment of U.S. readiness to Design, Develop and Produce Nuclear Warheads—essentially the potential responsiveness of the nuclear infrastructure.⁹ Among the key findings of that assessment (Scheber-Harvey Report) were the following:

- Not all critical nuclear skills at the laboratories and plants are being exercised. The approach for life-extending warheads exercises only a limited set of critical skills for warhead development and production at a time.¹⁰
- There exists a lack of balance between computational analysis and experiments at the laboratories. The nuclear warhead development community is overly dependent on computer

⁸ Ibid, pp. 12, 18.

⁹ Thomas Scheber and John R. Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps* (Fairfax, VA: National Institute Press, 2015), available at https://nipp.org/monographs_cpt/assessment-of-u-s-readiness-to-design-develop-and-produce-nuclear-warheads-current-status-and-some-remedial-steps/.

¹⁰ Ibid., p. xiv.

simulation. As one experienced warhead designer stated, “The codes always lie.” Without sufficient experimental activities against which to test the results of computer simulations, new designers and engineers may not recognize where the codes are unreliable and why. This imbalance between computation and experiments impedes the development of professional judgment to train the next generation of warhead designers and engineers that will be needed in the future.¹¹

- Infrastructure modernization has been delayed repeatedly, and completion remains elusive.¹²

Concerns about test readiness are long-standing, have not abated over the course of years. A 2002 high-level review panel concluded that a much more responsive test readiness posture is needed. In its final report to Congress in March 2002, the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile (The Foster Panel) wrote:

The President should have the latitude for a timely and effective response to unexpected events, whether due to problems in the stockpile or an international situation. Current test readiness of two to three years does not provide a viable option for a timely response. The Panel’s assessment is that test readiness should be no more than three months to a year, depending on the type of test.¹³

¹¹ Ibid.

¹² Ibid.

¹³ John S. Foster, et al., *Final Report of the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile*, March 15, 2002, p. ES-2, available at <https://nuke.fas.org/control/ctbt/text/foster99.pdf>.

Current Assessment of Readiness to Respond

Now, a decade after the 2015 Scheber-Harvey assessment briefly summarized above, not much has changed. For example:

- **Critical skills.** Warhead life extension programs still dominate the workload at the laboratories. No complete, end-to-end exercise of critical design and development skills has been undertaken for decades. This would involve developing a new, or at least different, warhead design and taking it through development to production (at least prototyping) and, perhaps even flight testing. This type of activity would tell senior managers a lot about the real state of readiness to respond in a timely manner to technical or geopolitical surprise. To its credit, Congress has done its part to ensure that the laboratories have explicit authorization to undertake such comprehensive activities as needed to train the next generation of weapon scientists. For example, the FY 2016 National Defense Authorization Act established the Stockpile Responsiveness Program. This legislation states,

It is the policy of the United States to identify, sustain, enhance, integrate, and continually exercise all capabilities required to conceptualize, study, design, develop, engineer, certify, produce, and deploy nuclear weapons to ensure the nuclear deterrent of the United States remains safe, secure, reliable, credible, and responsive.

Unfortunately, the NNSA annual reports on stockpile stewardship and management have not reported any specific actions toward this goal except to acknowledge the legislative tasking.

- **Lack of balance between computation and experiments.** The imbalance between computational assessments and complex experiments at the laboratories has not been corrected. The laboratories remain overly reliant on computer simulations and in need of more confirmatory experiments. For example, the 2015 assessment noted that one experienced designer had opined that the number of hydrodynamic experiments conducted in support of the stockpile stewardship program should be about one per month: twelve per year. The 2015 assessment noted that only four hydrotest experiments had been conducted in FY2013 and seven in 2014.¹⁴ Another complex experimental capability exists in the form of subcritical experiments in Nevada. The 2015 assessment noted that only one subcritical nuclear experiment per year had been carried out in the previous few years. The FY 2024 Stockpile Stewardship and Management Plan (SSMP) states that during 2023, only four hydrodynamic tests were conducted at DARHT¹⁵ Similarly, only one subcritical test was conducted in 2024. The imbalance between computation and experiments appears to persist.
- **Infrastructure modernization.** The 2015 assessment noted that infrastructure modernization had been delayed repeatedly. In 2015 the NNSA plan was to develop the capability to produce 50-80 plutonium

¹⁴ Scheber and Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps*, op. cit., p. 30.

¹⁵ Department of Energy, *Fiscal Year 2024 Stockpile Stewardship and Management Plan*, November 2023, p. F-21, available at https://www.energy.gov/sites/default/files/2023-11/FY24SSMP_FINAL_NOVEMBER_2023_0.pdf.

pits per year at Los Alamos. That goal was to have been accomplished by 2023.¹⁶ As will be discussed more fully later, there is currently no operational capability for the production of plutonium pits. The estimate for a production capacity meeting the congressionally mandated minimum capacity of eighty pits per year¹⁷ by 2030 has slipped to about 2035. The 2015 assessment noted that the replacement facility for uranium and lithium processing had not yet begun construction. The assessment called for a new facility and the shutdown of the existing Uranium Processing Facility (UPF) by 2025.¹⁸ NNSA has been making progress toward these goals, but the eighty-year-old UPF is still in operation and the two new construction facilities to process highly enriched uranium and lithium components are estimated by NNSA to be complete by 2029 and 2031 respectfully, barring further delays.

In sum, not much has changed since the 2015 assessment. Next, this report will discuss the status of several key components of a responsive infrastructure.

Plutonium Pit Production Capabilities

One of the key capabilities needed in a responsive infrastructure is a facility capable of manufacturing plutonium pits for weapon primaries. During the height of

¹⁶ Scheber and Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps*, op. cit., p. 32.

¹⁷ Department of Energy, *Fiscal Year 2025 Stockpile Stewardship and Management Plan*, op. cit., pp. 3-28.

¹⁸ Scheber and Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps*, op. cit., p. 33.

the Cold War, the United States produced between one thousand and two thousand pits per year. However, the United States has not had the capability for serial production of plutonium pits since 1989. The relocation of pit fabrication capabilities from Rocky Flats in Colorado to Los Alamos, New Mexico, seemed relatively straightforward when it was proposed in the early 1990s. Equipment would be moved from Rocky Flats and installed at the Los Alamos plutonium facility that was already operational. This facility, known as PF-4, was primarily for scientific research on pits and the fabrication of plutonium heat sources for applications such as long-duration space probes.

However, soon after some of the equipment was installed and tested at Los Alamos, some problems were encountered. Specifically, the welding machine for plutonium parts did not perform correctly. The same machines, doing the same tasks, and operated by some of the same operators as at Rocky Flats, did not create acceptable welds for the assembly of plutonium parts. Eventually, this problem was traced to the difference in pressure altitude between central Colorado and the mountains of New Mexico. The determination of cause led to a successful fix. This unexpected sensitivity of plutonium welding underscores the complexity of plutonium metal in its various forms. A 2021 article on the history of working with plutonium referred to “the incredible, confounding complexity of plutonium ...”¹⁹

Over the past 30+ years, DOE has proposed several different plans for restoring a plutonium pit fabrication capability. The plans considered have included doing all of

¹⁹ Joseph C. Martz, Franz J. Freibert, and David L. Clark, “The Taming of Plutonium: Pu Metallurgy and the Manhattan Project,” *Nuclear Technology*, Vol. 207 (2021), p. S267, available at <https://www.tandfonline.com/doi/epdf/10.1080/00295450.2021.1913035?needAccess=true>.

the pit fabrication at Los Alamos, moving this capability elsewhere because of earthquake concerns in New Mexico, and the current two-site strategy.

The effort to restore this capability has had some notable successes through the years. One such success is demonstrating the production of pits of different stockpile warheads that could pass the rigorous certification inspection and be “diamond-stamped” which signifies acceptance as a stockpile component. In 2024, the plutonium facility at Los Alamos completed this demonstration goal when it produced a diamond-stamped W87 pit for the Minuteman III intercontinental-range ballistic missile.²⁰

Other notable accomplishments include the production of thirty-one pits for W88 warheads for submarine-launched ballistic missiles (SLBMs) over a period of about five years (2007-2011). This supply of newly produced pits is important to replace older W88 warhead pits that are removed from service, one per year, and destructively tested to observe aging trends and estimate reliability.²¹ Recall that the W88 warhead build was terminated abruptly in 1989 when Rocky Flats was closed and, therefore, many fewer W88 warheads were produced than planned. This build of thirty-one W88 pits allows for deployment of a constant number of W88 warheads for 31 years since the pits removed for reliability sampling can be replaced by these newly built pits.

In 2018, the DoD and NNSA released a joint statement that, instead of developing a single pit production facility at Los Alamos, a two-site option would be pursued. The second site is to be a modification of the Mixed-Oxide Fuel

²⁰ Department of Energy, *Fiscal Year 2025 Stockpile Stewardship and Management Plan*, op. cit., p. X.

²¹ Arnie Heller, “Monitoring a nuclear weapon from the inside,” *Science & Technology* (June 2008), pp. 13-14, available at <https://str.llnl.gov/sites/str/files/2024-04/2008.07.pdf>.

Fabrication Facility (MFFF) at the Savannah River Site (SRS) in South Carolina. The stated production goal at the SRS site is at least fifty pits per year. In response to language in the 2019 Senate Energy and Water Appropriations Bill, NNSA commissioned The Institute for Defense Analyses (IDA) to conduct an independent analysis of various pit production options including an expanded single site at Los Alamos and a two-site option. The IDA final report concluded that “None of the rejected alternatives is demonstrably superior to the two-site option announced by DOE/NNSA and certified by the NWC [Nuclear Weapons Council].” The two-site option provides resilience and redundancy for the Nuclear Security Enterprise. Additionally, the IDA report concluded that the goal of thirty pits per year at Los Alamos was “potentially achievable given sufficient time, resources, and management focus, although not on the schedules or budgets currently forecasted.”²² The assessment concluded that eventually achieving a production rate of eighty pits per year is possible but will be extremely challenging. None of the options can be expected to achieve the goal of eighty pits per year by 2030 as required by the law.²³ The IDA assessment cautioned that DoD would need to decide how to respond to this shortfall.²⁴

When the IDA report was published in 2019, NNSA listed a goal of 2026 for achieving a thirty pit per year production capability at Los Alamos. The most recent

²² David E. Hunter, et al., *Independent Assessment of the Two-Site Pit Production Decision: Executive Summary*, Institute for Defense Analyses, May 2019, p. 4, available at <https://www.ida.org/-/media/feature/publications/i/in/independent-assessment-of-the-two-site-pit-production-decision-executive-summary/d-10711.ashx>.

²³ War and National Defense, 50 U.S. C. § 2538a, available at <https://www.law.cornell.edu/uscode/text/50/2538a>.

²⁴ Hunter, et al., *Independent Assessment of the Two-Site Pit Production Decision: Executive Summary*, op. cit., p. 5.

SSMP states that the completion date has slipped to 2028 and the NNSA estimated timeframe for commencement of pit production at SRS is now 2035.²⁵ Clearly, the congressionally mandated goal of a plutonium pit production capacity of at least eighty pits per year by 2030 will not be met. The historical trend in tracking the progress of complex, one-of-a-kind facilities that are key for responsiveness and resilience for the nuclear complex indicates that these dates may well slip further unless significant resources and management focus are expended.

The lack of a plutonium pit production facility of sufficient capacity to provide responsiveness for the stockpile is arguably the most important shortfall to be corrected in the current complex. Eighty pits per year is unlikely to be sufficient for the long-term. The United States needs to plan for a pit production capacity that is greater than that just based on current stockpile levels as a hedge.

Recommendations for Plutonium Processing and Fabrication

- Proceed with greater urgency and purpose to achieve an operational capability at Los Alamos and accelerate the pit fabrication site at SRS.
- Develop plans and facility readiness to be able to scale-up plutonium pit production quantities beyond eighty pits per year in a timely manner.

²⁵ Department of Energy, *Fiscal Year 2024 Stockpile Stewardship and Management Plan*, op. cit., pp. 5-10.

Production Capabilities for Highly Enriched Uranium and Lithium Components for Warhead Secondaries

The following discussion of warhead capabilities to fabricate highly enriched uranium (HEU) and lithium parts for warhead secondaries is more straightforward than the preceding discussion on plutonium pits.

The secondary is where the lion's share of explosive yield is generated in a modern nuclear weapon. While the primary generates a few thousands of pounds of explosive yield, the secondaries of modern weapons generate tens or hundreds of thousands of pounds of yield.

For the past eighty years, HEU and lithium parts for secondaries have been fabricated at a plant at the Y12 site in Oak Ridge, Tennessee. One of the essential facilities for these parts at Y12 is the Uranium Processing Facility (UPF) which is over eighty years old. During the deliberations of the Perry-Schlesinger Strategic Posture Commission, commission members toured several locations in the nuclear weapons complex. One of the visits was to the UPF (building 9212) at Y12. This plant dates to the Manhattan Project and has been operated continuously to fabricate HEU parts. It is considered by many to be the poster child for decrepit and outdated facilities in the nuclear weapons complex.

According to a 2020 NNSA fact sheet:

Building 9212 is a large chemical processing facility that was completed in November 1945 as a chemical recovery operation to recycle uranium. It was the location of the first production of uranium metal at Y-12 and the earliest nuclear weapons production facility at Y-12. Since then, it has been modified many times to meet changing national security missions, but, generally speaking, is optimized for a large nuclear weapons production

mission necessary during the buildup of U.S. thermonuclear forces in the 1950's and 1960's. It continues to serve as one of the primary chemical processing and enriched uranium production facilities at Y-12.²⁶

This facility has been maintained with great effort and expense. In the Perry-Schlesinger commission's final report, commission members referred to this and other outdated facilities as "genuinely decrepit."²⁷ Touring the facility was compared to visiting a museum that displays technology from the 1940's and 50's—controlled by valves, dials, and manual controls instead of digital technology.

It is significant to note that this "decrepit" facility is still operating and in the 1990's it was key when Y-12 was called upon to build warhead secondaries as replacement components for a warhead type that remains in the modern stockpile.

Construction of modern replacement facilities for HEU and lithium parts is in work. The most recent SSMP calls for the new Uranium Processing Facility (UPF) to be completed and operational by 2029 and the lithium facility completed by 2031.²⁸

Recommendations for Uranium Processing and Fabrication

- To the extent possible, accelerate the completion of the replacement UPF and lithium facilities at Y-12.

²⁶ "Y-12 Facility Descriptions," August 2020, available at <https://www.energy.gov/nnsa/articles/y-12-facility-descriptions>.

²⁷ Perry and Schlesinger, et al., *America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States*, op. cit., pp. 47-51.

²⁸ Department of Energy, *Fiscal Year 2025 Stockpile Stewardship and Management Plan*, op. cit., p. X.

Production Capabilities for Warhead Arming, Fusing, and Firing Systems, Neutron Generators, and Other Non-nuclear Components

In addition to the facilities specializing in components with special nuclear materials, the weapons complex needs a variety of non-nuclear components that are critical for the safe, secure operation and control of nuclear warheads. These non-nuclear components include arming, fusing, and firing systems as well as neutron generators. Most of these components are manufactured at the Kansas City National Security Complex (KCNSC) and at Sandia National Laboratories.

In 2014, the activities at Kansas City were moved into a newly constructed site which is currently undergoing further expansion. Between Sandia and Kansas City, the non-nuclear needs for stockpile life extension programs have been successfully met by these facilities. However, capacity at both Kansas City and Sandia will need to be expanded to accommodate the future workload and to be able to respond to unplanned contingencies.

Recommendations for Non-nuclear Components

- Expand capacity at both the Kansas City Plant and at Sandia to enable greater capacity and, thereby, provide resilience.

Tritium Production and Handling Capabilities

Tritium is a radioactive isotope of hydrogen that is used in modern nuclear weapons to “boost” the explosive yield. Since tritium decays at a rate of about five percent per year, the supply of tritium must be replenished periodically. Until the late 1980s, the production of tritium and the filling/refilling of tritium reservoirs was done at the

Savannah River Site (SRS). Tritium was produced in reactors and extracted in order to transfer the tritium produced into reservoirs and installation into nuclear weapons. Nuclear arms reduction agreements and the end of the Cold War resulted in dramatic reductions in the number of deployed nuclear weapons. This resulted in a glut of tritium extracted from retired warheads. As a result, the aged reactors at SRS were shut down in the late 1980's.

During the 1990's the DOE evaluated options for resuming the production of tritium. In late 1998, DOE announced that it had chosen as the primary means of producing tritium irradiating lithium rods in a light water reactor. In 2003, after several developmental experiments, the first batch of lithium fuel rods were loaded into a reactor at the Watts Bar Nuclear Plant in Tennessee. In 2005, the rods were removed and shipped to SRS for the extraction of tritium.²⁹

Since the initial run in 2005, the process of irradiating lithium rods at Watts Bar and subsequent tritium extraction at SRS has been refined. However, one important tritium handling facility at SRS is over sixty-five years old and is badly in need of replacement. While construction of a new Tritium Finishing Facility (TFF) has been approved and initial funding appropriated, construction is not projected to be complete until about 2034.³⁰ The fundamental approach to tritium production for the future appears to be on track, but the construction of modern facilities for tritium handling needs to be accelerated.

²⁹ United States Nuclear Regulatory Commission, "Tritium Production," *Backgrounder*, June 2005, available at <https://www.nrc.gov/docs/ML0325/ML032521359.pdf>.

³⁰ Department of Energy, *Fiscal Year 2024 Stockpile Stewardship and Management Plan*, November 2023, pp. 3-22, available at https://www.energy.gov/sites/default/files/2023-11/FY24SSMP_FINAL_NOVEMBER_2023_0.pdf.

Recommendations for Tritium

- Accelerate the completion of the TFF and other needed modernization projects at SRS.
- Ensure that tritium production can be scaled up to meet operational needs should the number of operationally deployed warheads be significantly increased.

Nuclear Test Readiness

As noted earlier, the United States ceased nuclear testing in late 1992. At that time, the near-term resumption of testing was anticipated with the goal of improving the safety and security of nuclear warheads. However, in early 1993, President Clinton extended the test moratorium indefinitely in pursuit of a global, “zero-yield” Comprehensive Test Ban Treaty (CTBT). Later, in August 1995, President Clinton signed a directive establishing “safeguards” to be maintained in a no-testing environment. Those safeguards included: the conduct of a Science-Based Stockpile Stewardship Program, the maintenance of the “basic capability to resume nuclear testing,” and conditions under which the President would be prepared to withdraw from the CTBT under the “supreme national interests” clause to conduct whatever testing was required.³¹ Clinton directed that after FY 1996, the United States readiness posture for resuming nuclear testing would be based on testing within two to three years following a decision to proceed.

Today, most of the nuclear testing safeguards remain relevant and have been adequately maintained. However, one of these safeguards has not been fully maintained and

³¹ U.S. Department of State, “Comprehensive Test Ban Treaty Safeguards,” *Fact Sheet*, available at <https://usinfo.org/usia/usinfo.state.gov/topical/pol/arms/ctbt/factsafe.htm>.

is of particular concern: the safeguard to maintain the readiness to conduct a nuclear test, which may become necessary. According to DOE/NNSA, there has been no funding specifically for nuclear test readiness since FY 2010. NNSA has maintained that the routine activities being conducted for subcritical nuclear experiments at the National Security Site in Nevada essentially fulfill this readiness requirement. DOE/NNSA asserts that the current “test readiness strategy is to reconstitute underground nuclear explosive testing if or when needed, rather than maintaining obsolete facilities and capabilities.”³² In 1997, a former director of Los Alamos supported this approach and stated that most of the key skills needed for test readiness are being exercised in the conduct of subcritical testing in Nevada.³³

Currently, NNSA tasks its Nevada site with being “ready to perform an underground nuclear test using a test article drawn from the existing stockpile and limited diagnostics within 36 months.” NNSA also assumes that a nuclear test would be conducted only when the President has declared a national emergency or other similar contingency.³⁴ A 36-month readiness timeline for testing appears to be inconsistent with the assumption of a national emergency.

At least one high-level review panel agreed that a much more responsive test readiness posture is needed. In its final report to Congress in March 2002, the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile (The Foster Panel) wrote:

³² Department of Energy, *Fiscal Year 2024 Stockpile Stewardship and Management Plan*, op. cit., pp. 4-21.

³³ Siegfried S. Hecker, “Letter to Hon. Jon Kyl,” September 24, 1997, available at <https://www.govinfo.gov/content/pkg/CHRG-105shrg44720/html/CHRG-105shrg44720.htm>.

³⁴ Department of Energy, *Fiscal Year 2024 Stockpile Stewardship and Management Plan*, op. cit., pp. 4-20.

The President should have the latitude for a timely and effective response to unexpected events, whether due to problems in the stockpile or an international situation. Current test readiness of two to three years does not provide a viable option for a timely response. The Panel's assessment is that test readiness should be no more than three months to a year, depending on the type of test.³⁵

John Hopkins, a former associate director for nuclear weapons technology and former Director for Nuclear Testing at Los Alamos, has been an outspoken critic of the NNSA test readiness posture. For example, in 2017, Hopkins argued that:

- much, if not most, of the equipment and technology required for nuclear testing in the past has not been adequately maintained, is obsolete, or has been sold or salvaged;
- the knowledge needed to conduct a nuclear test, which comes only from testing experience, is all but gone; and
- the whole testing process – whether to conduct one test or several – would in essence have to be reinvented, not simply resumed.³⁶

The potential funding for one or more nuclear tests is an important issue. There are at least two important aspects of this funding issue:

³⁵ Foster, et al., *Final Report of the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile, Report to the Senate Armed Services Committee*, op. cit., p. ES-2.

³⁶ Bill Gertz, "Los Alamos Expert: U.S. Unable to Conduct Nuclear Tests," *Washington Free Beacon*, March 2, 2017, available at: <https://freebeacon.com/national-security/los-alamos-expert-u-s-unable-conduct-nuclear-tests/>.

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- First is the overall cost of conducting a nuclear test. No credible cost data exists to estimate the cost of a fully instrumented nuclear test in the current environment. The best estimate is to extrapolate from 1992 when a nuclear test cost around \$100 million dollars. Of course, in 1992, all the necessary equipment was ready and operational. In short, a test would be expensive.
 - Second is the uncertainty over whether the cost of a test would be taken from the annual budgets for the laboratories or funded by a separate appropriation. For more than thirty years, the nuclear weapon laboratory directors have certified that the stockpile of warheads meet reliability and performance standards and there is no immediate need to resume nuclear testing. That judgement call has likely been biased somewhat by the view that, if a nuclear test is requested, the funding for the test would likely come at the expense of other laboratory programs. For example, a former lab director argued against testing by stating,

data is not free ... to get more data of one type, you have to sacrifice something else. ... e.g., if you have to give up advanced computing or all laboratory experiments to afford full-scale nuclear testing, it is a poor bargain, in my opinion.³⁷

How important is testing? Some test-experienced senior managers at the nuclear labs have argued that the scientific foundation for assessing the performance of warheads in the stockpile is eroding without nuclear testing. For example, in a 2019 article, one former associate laboratory

³⁷ Miller, "Stockpile Stewardship: What Were We Thinking? How Did It Work Out?," *op. cit.*, p. 16.

director and a senior warhead designer listed several concerns about the health of warheads in the stockpile. Those concerns include the fact that:

... the physical state of weapons in today's stockpile differs from what it was when their performance (e.g., yield) was tested, and second, the current nuclear test moratorium precludes a decisive determination of whether these changes in physical state adversely affect performance.³⁸

If a confirmatory nuclear test was to be scheduled in the near term, a life-extended W76 warhead would be a good candidate for testing to determine whether the modifications have affected performance, and if so, in what way. Why the W76? The now-complete W76 life extension program for submarine-launched ballistic missiles was extensive. According to one description, it involved

... changes to both the reentry body and the warhead package; replacing detonators; replacing chemical high explosives; refurbishing the secondary; adding a new arming, fusing and firing (AF&F) system; adding a new gas reservoir and transfer support system; and a new lightning arrestor connector.³⁹

Finally, if the United States decides to conduct a nuclear test, the collection of as much test data as possible should be a priority to make the best use of this opportunity. It is

³⁸ John C. Hopkins and David Sharp, "The Scientific Foundation for Assessing the Nuclear Performance of Weapons in the US Stockpile is Eroding," *Issues in Science and Technology* Vol. XXXV, No. 2, (Winter 2019), p. 23, available at <https://issues.org/the-scientific-foundation/>.

³⁹ Pat Host, "W76-1 Life Extension Program Reaches Production Phase Halfway Point," *Defense Daily*, October 31, 2014, available at <https://www.defensedaily.com/w76-1-life-extension-program-reaches-production-phase-halfway-point/navy-usmc/>.

unclear from the available documentation whether NNSA still maintains the required capability to build and deploy test sensors and radiochemical collection and analysis capabilities to support a fully instrumented nuclear test. Collection of this data would enable scientists at the labs to benchmark the latest computer codes for future use.

Recommendations for nuclear test readiness:

- Since nuclear testing may be needed, we need to survey test readiness capabilities and take immediate corrective action to restore a readiness capability to conduct a fully instrumented nuclear test; and
- Appropriate funds for test readiness improvements and keep the funding in an “escrow” account that could be immediately used to begin test preparations after concerns over one or more stockpile warheads results in decision to seek presidential approval to test. This escrow fund would help alleviate the concerns at the labs over having to immediately cut other nuclear weapon programs in order to begin preparations for a nuclear test.

DoD and NNSA Integration for Nuclear Weapons Development

No complex industrial process can be expected to restart without serious problems after having been shut down for decades, having had a huge turnover of the work force, and having had plants and processes moved to different locations. That is the challenge that will face the nuclear weapons complex as it develops new warheads and integrates them with modern DoD-developed weapon delivery systems.

The most recent warhead to successfully go from concept development to the deployed stockpile is the W88 warhead for Navy SLBMs. That development occurred about forty years ago during a time when the serial production of warheads in the complex was the norm. In the intervening forty years, a few new warhead acquisition programs have been proposed and some have begun development. However, senior government officials have, until now, found reasons to terminate these programs before completion.

NNSA integration with DoD program offices gets exercised within the project officer groups for each warhead type. Life extension programs have helped to exercise this integration activity to a limited degree. However, completely new warhead development is more complex and involves the creation of military characteristics and survivability criteria in nuclear environments which the new warheads design will have to meet. The initiative to develop and deploy the W93 warhead is likely to encounter numerous challenges. It is the first newly developed warhead planned for deployment in forty years and should not be delayed further.

Recommendations for DoD and NNSA Integration:

- Give high-level attention to DoD/NNSA integration activities for the development of the W93 warhead.

Contractor-based Infrastructure for Strategic Bombers, Intercontinental-Range and Submarine-Launched Ballistic Missiles, Cruise Missiles, and Maneuvering Hypersonic Delivery Vehicles

Discussion of a responsive infrastructure would not be complete without at least some observations about the

commercial defense industry responsible for nuclear weapon delivery vehicles (e.g., heavy bombers, ballistic missiles, and cruise missiles).

DoD is deep into a generational modernization of its nuclear force. Already well underway are the development and production of the B21, a next-gen strategic bomber, and a Long-Range Standoff Missile (LRSM). The LRSM has undergone numerous flight tests and is slated to be operational by the end of the decade. The B21 is reported to be in low-rate initial production, however, the fleet of long-range bombers will need adequate tanker support in order to complete their missions. At present, the number of long-range aerial refueling aircraft to support bomber operations is insufficient and additional tankers and improved capabilities are needed.⁴⁰

Less further along are programs to field the Sentinel ICBM to replace Minuteman III and the Columbia SSBN to replace Ohio-class SSBNs. Both acquisition programs have faced significant challenges. For example, in January 2024, DoD reported to Congress that the Sentinel program was in breach of Nunn-McCurdy due to significant cost overruns. To meet the Navy's goals for ballistic missile submarines and attack submarines, two U.S. shipbuilders, General Dynamics Electric Boat and Newport News, are executing the most significant increase in nuclear-powered submarine and ship construction in over 30 years.⁴¹ Both programs,

⁴⁰ Caleb Egli, "Fueling a Superpower: Reprioritizing the US Air Refueling Fleet for Great Power Conflict," *Journal of Indo-Pacific Affairs*, May 8, 2024, available at <https://www.airuniversity.af.edu/JIPA/Display/Article/3768313/fueling-a-superpower-reprioritizing-the-us-air-refueling-fleet-for-great-power/>.

⁴¹ United States Government Accountability Office, *Columbia Class Submarine: Overcoming Persistent Challenges Requires Yet Undemonstrated Performance and Better-Informed Supplier Investments*, GAO-24-107732 (Washington, D.C.: Government Accountability Office, September 30, 2024), p. 3.

Sentinel and Columbia, are high priority programs, but are behind schedule and over cost.

Recommendations for DoD and the contractor-based infrastructure:

- Do not further delay funding for the recapitalization of any strategic nuclear force programs now underway;
- Increase the build of Columbia-class SSBNs. The planned number of these submarines which carry fewer missiles than Ohio-class submarines is insufficient to maintain the current level of SLBMs at sea; and
- Increase the fleet of tankers to better support long-range bombers.

Cautionary Lessons from Industry

The nuclear warhead complex is government-owned and unique in several ways. However, it is an industry that involves specialized manufacturing processes and, therefore, lessons learned from other industries may well apply. Significant problems have already been encountered when trying to restart production of components for warheads during life extension programs.

Industrial problems in the commercial sector reveal some parallels with that of the nuclear complex. Consider the recent example of problems involving Boeing 737 aircraft. Boeing for decades was an aerospace pioneer, but it's been 20 years since Boeing introduced a new airplane. Since then, the jet maker has instead made updates to its existing models.⁴² Two aircraft crashes in 2018 and 2019

⁴² Sharon Terlep and Andrew Tangel, "Can Boeing Be Fixed? Aerospace Leaders Offer a Repair Manual," *The Wall Street Journal*, January 6, 2025, available at <https://www.wsj.com/business/airlines/boeing-plane->

resulted in 346 fatalities. In 2024, a door blew off a 737 aircraft in flight. These incidents led to investigations into the Boeing corporate culture and industrial practices. One assessment of problems at Boeing cites a change in the previously engineering-centric corporate culture at Boeing following the 1997 merger of Boeing and McDonnell Douglas. One analysis stated,

For most of its history, Boeing had what you might call an engineering-centric culture, with power in the company resting in the hands of engineering and design. ... Executives from McDonnell Douglas ended up dominating and remaking Boeing. They turned it from a company that was relentlessly focused on product to one more focused on profit.⁴³

A former CEO of Boeing who had formerly been CEO of McDonnell Douglas is quoted as saying, "I changed the culture of Boeing, that was the intent, so that it's run like a business rather than a great engineering firm."⁴⁴

The change in the corporate culture at Boeing resulted in the outsourcing of some assembly procedures and the creation of "shadow factories" that were essentially production lines where engineers and mechanics work on fixing, maintaining or updating aircraft instead of new ones." One Boeing official reported, "It seems like 30% of

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n8INl6uWtXbNVEgdGk93fQ%3D%3D.

⁴³ James Surowiecki, "What's Gone Wrong at Boeing," *The Atlantic*, January 15, 2024, available at: <https://www.theatlantic.com/ideas/archive/2024/01/boeing-737-max-corporate-culture/677120/>.

⁴⁴ Ibid.

everybody's job is fixing something that's bad quality or late product or something that shouldn't have happened."⁴⁵ The incident of the door of a 737 that had blown off in flight was traced to procedural errors at one of the shadow factories and work that had been outsourced.

The Boeing case study is one of many possible examples that appears to have parallels with the nuclear warhead complex. Has the corporate culture of the nuclear complex changed since it was shut down in 1989? You bet! In the past the nuclear complex was driven by designers, engineers, and production experts with years of experience in the nuclear industry. It is now driven primarily by analysts and computer simulation personnel that have never designed and produced a new nuclear warhead. Lessons from industry provide concerns that any attempted restart of serial warhead production is not likely to be a smooth process.

For the nuclear warhead enterprise to be successfully returned to functionality, competent leadership and accountability at the National Nuclear Security Administration (NNSA) will be essential. A November 2014 report of the Mies-Augustine Panel that examined the management of NNSA reported that:

NNSA's Stockpile Stewardship Management Plan, which is intended to communicate long-range plans and cost estimates, has varied from year to year in the costs and schedules for the delivery of several major life extension programs and nuclear facilities. The panel concluded that the lack of a

⁴⁵ Sharon Terlep, "Boeing's Push to Boost 737 Production Starts with Closing 'Shadow Factory'," *The Wall Street Journal*, February 14, 2025, available at https://www.wsj.com/business/airlines/boeing-shadow-factory-plane-repairs-fb80dfed?gaa_at=eafs&gaa_n=ASWzDAhagn-o7jpCBSiTfSwRZx1Xz5MUi6xINICIL1uYvL7HZFUJYH4XrybO&gaa_ts=687bdf8c&gaa_sig=0kUpudR7dliCpfnVYd8dj3pkBI5irjMcvhbyT51JUeT95o2wFhgTflqcCO0PDIIS14UWgKdhGSD5zp1jidUgcw%3D%3D.

stable, executable plan for modernization is a fundamental weakness for NNSA.⁴⁶

Furthermore, the panel concluded that “NNSA is on a trajectory toward crisis unless strong leadership arrests the current course and reorients its governance to better focus on mission priorities and deliverables.”⁴⁷ Strong, competent leadership at NNSA and accountability for performance will be required to restore the nuclear enterprise to full operation.

How Do Nuclear Warheads Work? Are Concerns Regarding Reliability Warranted?

Modern nuclear warheads in the U.S. stockpile are much more complex than the chemical explosives found in conventional bombs and missile warheads. Each nuclear warhead in the U.S. inventory involves chemical explosives as well as exotic materials necessary for both nuclear fission and fusion. One warhead in the stockpile is made up of over 5,900 parts.⁴⁸ The warhead designs involve precise timing and multiple, reactive processes for proper operation.

⁴⁶ Quoted in Government Accountability Office, “National Nuclear Security Administration: Observations on Management Challenges and Steps Taken to Address Them,” GAO-15-532T (Washington, D.C.: Government Accountability Office, April 15, 2015), p. 4, available at <https://www.gao.gov/products/gao-15-532t>.

⁴⁷ Richard M. Jones, “Hearing Underscores Problems at the National Nuclear Security Administration,” *American Institute of Physics*, April 24, 2014, available at <https://www.aip.org/fyi/2014/hearing-underscores-problems-national-nuclear-security-administration>.

⁴⁸ “B61 Nuclear Gravity Bomb,” *Brookings*, available at [https://www.brookings.edu/b61-nuclear-gravity-bomb/#:~:text=Three%20views%20of%20a%20B61,weapon's%205%2C919%20parts%20\(foreground\)](https://www.brookings.edu/b61-nuclear-gravity-bomb/#:~:text=Three%20views%20of%20a%20B61,weapon's%205%2C919%20parts%20(foreground)).

Most U.S. nuclear warheads are two-stage devices. The first stage, or primary, includes a subcritical sphere-like shell made of an isotope of plutonium and/or highly enriched uranium. This shell is surrounded by chemical explosive materials, often called lenses. The term lens refers to the function of the explosive material. Just as glass lenses bend and redirect light to aid a vision-impaired individual, the high explosive lenses focus the explosive shock waves so that they compress the plutonium/uranium shell into a dense, somewhat spherical ball.

Some readers may be familiar with photos of early nuclear weapons. Movies such as “Oppenheimer” featured mock-ups of the earliest devices. The “Fat Man” nuclear device depicted in that movie was huge—about a five-foot diameter sphere with many explosive detonators attached to the explosive lenses. Modern primaries feature only a very small number of detonators and the size of the first stage has been greatly reduced and redesigned to enable the completed two-stage warhead to fit into a compact bomb case, missile compartment, or ballistic missile reentry cone.

The detonators have to be fired in a precise, coordinated manner to ignite the high explosives and create the focused shockwave that compresses the plutonium/uranium core into a smaller core that, as a result of its compact size and density, achieves criticality—a self-sustaining nuclear reaction. To enhance the energy release, at the optimal time determined by designers, a source of neutrons is introduced into the now super-critical assembly to initiate an exponentially increasing fission chain reaction and resultant nuclear explosion.⁴⁹

⁴⁹ Bruce T. Goodwin, “Nuclear Weapons Technology 101 for Policy Wonks, Center for Global Security Research,” (Livermore, CA: Center for Global Security Research, August 2021), pp. 18-21, available at https://cgsr.llnl.gov/sites/cgsr/files/2024-08/CGSR_NW101_Policy_Wonks_11-04-21_WEB_v5.pdf.

Additionally, there is another important process involved in the detonation of the first stage of a modern nuclear warhead. A mixture of deuterium and tritium atoms are injected into the primary. Both deuterium and tritium are isotopes of hydrogen atoms. (The hydrogen atom is the lightest atom of the elements in the periodic table. Each hydrogen atom has only one neutron while deuterium and tritium have two and three neutrons, respectively.) The compression and ignition process creates pressure and heat sufficient to fuse deuterium and tritium atoms into helium atoms and the resulting process releases energy and expels a neutron which helps “boost” the growing fission process.

There are numerous ways in which this initial ignition process in the primary can go wrong. For example, the timing of the firing of the detonators can be off, the consistency of the high explosive material can be compromised and result in a shock wave that does not properly compress the plutonium/uranium material, or the introduction of the neutrons can be injected at a time that is slightly different from the precise timing required.

The process described above is just the beginning of the explosion process for a modern nuclear weapon. The explosive power of most primaries (first stages) is less than ten kilotons of yield. The high yield of modern weapons is generated in the second stage.

As the primary is imploding and creating an explosion to produce fission and fusion processes, it creates heat that is so hot that “it glows, not red hot or white hot, but glows in the X-ray spectrum.” The challenge is to contain those X-rays for a very short time in a radiation case and direct them to “compress the secondary, resulting in a thermonuclear detonation” which produces the enormous yield of the H-bomb.⁵⁰

⁵⁰ Ibid, pp. 23-24.

For a modern nuclear warhead to operate as designed, all of these processes have to function in a precise manner while the warhead is literally blowing itself apart. In addition, this series of interactions must all be completed properly within one ten-thousandth of a second. What could go wrong?

One more thing. For the ignition process to send a properly coded signal to fire the detonators, that signal must pass through multiple logic circuits. These circuits are referred to as “use-control” devices and have two primary purposes. First, the use-control circuits are designed to ensure that a firing signal from a verifiably authorized source reaches the detonators. And second, use-controls are designed to ensure that if an adversary, such as a terrorist, gets control of a nuclear weapon and tries to bypass security logic circuits and detonate it, the logic circuit senses the deviation from proper protocols and prevents detonation.

Nuclear warhead designs are engineered to function properly after being subjected to harsh, often violent environments such as from the launch of a ballistic missile and reentry into the atmosphere. The materials must be able to withstand the intense cold of very high altitude and searing heat and G forces of reentry. Each warhead design may also include specialized materials to help the warhead survive and operate in an environment of intense nuclear effects (e.g., neutron flux, X-rays, thermal).

The purpose of this highly condensed description of the operation of a modern nuclear weapon is provided here to provide readers with a basic understanding of the complexity of these weapons and that their reliability and proper operation as they age and are modified should not be taken for granted. To date, most (but not all) warhead life extension programs have been modest in scope. As the existing warheads continue to age, more complex modifications will be required. Each modification represents a change in the certified design of these complex

systems. Proper operation, if needed, should not be assumed, and eventually, these warheads will have to be replaced. In the meantime, it is not unreasonable to consider nuclear testing to verify the proper functioning of U.S. nuclear weapons that are years beyond their design life and that have been modified to replace or upgrade components deemed unreliable due to aging.

For readers who seek more details on the design and operation of nuclear warheads, Bruce Goodwin at Lawrence Livermore National Laboratory has published an excellent tutorial and history of nuclear weapons technology. Much of the description of warhead operation in this paper is a highly condensed version of material from his publication.⁵¹ Also, the Union of Concerned Scientists has a useful article on how nuclear weapons work on their website.⁵²

What about Russia and China? Do They Have Similar Issues Regarding the Operation of Their Nuclear Warhead Infrastructures?

The serial production of nuclear warheads in the United States was abruptly halted in 1989. As the numerous changes, discussed earlier, to the U.S. business model for designing and producing nuclear warheads took effect in the early 1990s, the situation regarding the nuclear warhead complexes in Russia and China were very different from that of the United States. In the early 1990s, the nuclear complex of the United States was considered to be more

⁵¹ Ibid.

⁵² "How Do Nuclear Weapons Work?" *Union of Concerned Scientists*, August 23, 2023, available at <https://www.ucsusa.org/resources/how-nuclear-weapons-work#:~:text=Modern%20nuclear%20weapons%20work%20by,pressure%20needed%20to%20ignite%20fusion>.

capable than those in Russia and China, with the sole exception of the U.S. plutonium pit facility that had been closed but was planned to be relocated. What follows is a condensed description of changes to the nuclear infrastructures of Russia and China over the past three decades.

Russia

The breakup of the Soviet Union resulted in significant challenges for Russia's ability to sustain its huge nuclear force. Following the Soviet Union dissolution, large numbers of nuclear weapons were located in other former Soviet Republics. The physical security of those weapons was an international concern. The United States helped negotiate agreements to return strategic nuclear weapons from Ukraine, Belarus, and Kazakhstan and tactical nuclear weapons from a variety of eastern European countries to Russia. The Nunn-Lugar Program was initiated and funded by the United States to help decommission some of the former Soviet nuclear weapon deployment sites, dismantle warheads, and provide security for those weapons returned to Russia.

In the early 1990s, Russia deployed about ten thousand nuclear warheads on strategic weapons and had about twenty thousand tactical nuclear weapons of various types.⁵³ According to one Russian source,

The disintegration of the Soviet Union also resulted in significant changes in the military industry, affecting Russia's ability to maintain and modernize its strategic forces. The missile production industry was affected the most, since

⁴³ Pavel Podvig, "The Russian Nuclear Arsenal," *Center for International Security and Cooperation, Stanford University*, November 2005, available at <https://ciaotest.cc.columbia.edu/casestudy/case003/case003.html>.

many key research and production facilities were located in Ukraine. Other industries suffered major disruptions in their subcontractor chains. One notable exception was the nuclear weapons production complex, which historically had all its vital research and production facilities located in Russia.⁵⁴

One exception to the exception above that was the Semipalatinsk Russian nuclear test complex which was in Kazakhstan and, therefore was no longer accessible by Russia and had been closed.

When the Strategic Arms Reduction Treaty (START) entered into force in 1994, the treaty permitted Russia to deploy up to six thousand accountable strategic nuclear warheads. Russia and the United States negotiated START II which would have capped the number of accountable strategic nuclear warheads at 3,000 to 3,500 and would have eliminated all multiple warhead ICBMs. Both START and START II included verifiable dismantlement provisions and deadlines. Russia complained that under the treaty provisions it would need to produce several hundred new single-warhead ICBMs to keep pace with the United States and this, along with the dismantlement provisions, were beyond its economic capability. START II was eventually eclipsed by the 2002 Strategic Offensive Reductions Treaty in May 2002 and a month later Russian President Putin announced that Russia was no longer bound by the provisions in START II.

Immediately after the so-called end-of-the-Cold-War, Russia had large numbers of existing nuclear weapons, a nuclear warhead complex that was in-tact within Russian borders, but was shackled by a weak economy. Under Russian President Yeltsin, government spending in Russia was shifted away from military readiness and priority was

⁵⁴ Ibid.

given to rebuilding the Russian economy. Throughout the 1990s, the United States and Russia explored opportunities for cooperation instead of military confrontation. It was in this environment that the Clinton Administration sharply cut funding for the U.S. nuclear complex and terminated all new nuclear warhead development and testing.

The improved relationship between the United States and Russia began to change after President Putin succeeded Yeltsin in 2000. Putin is famous for his April 2005 address to the nation in which he declared that “The collapse of the Soviet Union was the greatest geopolitical catastrophe of the {twenty-first} century.”⁵⁵

Over the past twenty years Russia has put highest priority on rebuilding and modernizing its nuclear forces and the production complex needed to support those forces. It has replaced the closed nuclear testing facility at Semipalatinsk with a revitalized and expanded facility, Novaya Zemlya, above the Arctic Circle, and has conducted numerous experiments at this new test facility.

With a great deal of activity at this revitalized nuclear test facility, Russia’s compliance with its CTBT commitments have been questioned. In fact, the Perry-Schlesinger Strategic Posture Commission report stated in 2009 that “Apparently Russia and possibly China are conducting low yield tests.”⁵⁶ In May 2019, Lt. Gen. Robert P. Ashley, Jr., then-Director of the Defense Intelligence Agency, stated:

Russia’s development of new warhead designs and overall stockpile management efforts have been enhanced by its approach to nuclear testing. The United States believes that Russia probably is

⁵⁵ “Putin Address to Nation: Excerpts,” *BBC*, April 25, 2005, available at <http://news.bbc.co.uk/2/hi/europe/4481455.stm>.

⁵⁶ Perry and Schlesinger, et al., *America’s Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States*, op. cit., p. 83.

not adhering to its nuclear testing moratorium in a manner consistent with the “zero yield” standard.⁵⁷

In late 2023, the Russian government announced that it was revoking its ratification of the CTBT. In September 2024, Andrei Sinitsyn, head of Russia's central nuclear test site at Novaya Zemlya, stated that,

The test site is ready for the resumption of full-scale testing activities. It is fully ready. Laboratory and testing facilities are ready. The personnel are ready. If the order comes, we can start testing at any moment.⁵⁸

While the United States, has been very cautious about any new nuclear warhead development over the past thirty years, Russia has designed and produced numerous new warheads for its deployed weapons systems.⁵⁹

In 2019, Lt. Gen. Robert Ashley, the Director of the Defense Intelligence Agency, talked openly about Russian and Chinese nuclear developments. He stated,

Russia's stockpile of nonstrategic nuclear weapons, already large and diverse, is being modernized with an eye towards greater accuracy,

⁵⁷ Robert P. Ashley, Jr., “The Arms Control Landscape,” *Transcript*, The Hudson Institute, May 31, 2019, available at <https://www.hudson.org/national-security-defense/transcript-the-arms-control-landscape-ft-dia-lt-gen-robert-p-ashley-jr>.

⁵⁸ Astri Edvardsen, “All Clear for Nuclear Testing at Novaya Zemlya, Says Russian Head of Test Site,” *High North News*, September 23, 2024, available at <https://www.highnorthnews.com/en/all-clear-nuclear-testing-novaya-zemlya-says-russian-head-test-site>.

⁵⁹ Mark Schneider, “How Many Nuclear Weapons Does Russia Have? The Size and Characteristics of the Russian Nuclear Stockpile,” *Occasional Paper* Vol. 3, No. 8 (Fairfax, VA: National Institute Press, August 2023), available at <https://nipp.org/wp-content/uploads/2023/09/Vol.-3-No.-8.pdf>.

longer ranges and lower yields to suit their potential war-fighting role.⁶⁰

He also stated that “during the past decade Russia has improved and expanded its [nuclear weapons] production complex, which has the capacity to process thousands of warheads annually.”⁶¹ He elaborated further,

Russia claims to be developing new warhead designs for strategic systems such as a new high-yield, earth-penetrating warhead to attack hardened military targets, like the U.S., allied and Chinese command and control facilities. Russia's development of these new warhead designs and overall stockpile management has been enhanced by its approach to nuclear testing.⁶²

The 2025 DIA Worldwide Threat Assessment states:

Russia is expanding its nuclear forces by adding new capabilities, including nuclear air-to air missiles and novel nuclear systems. Russia probably maintains a nuclear stockpile of about 1,550 deployed strategic warheads and up to 2,000 non-strategic warheads. Russia is expanding its nuclear posture to Belarus by establishing missile and nuclear-capable aircraft capabilities, renovating a nuclear weapons storage site, and training Belarusian crews to handle tactical nuclear weapons. Throughout the Russia-Ukraine conflict, Russia has used nuclear related rhetoric and military exercises to signal its resolve and

⁶⁰ Ashley, Jr., “The Arms Control Landscape,” *op. cit.*

⁶¹ *Ibid.*

⁶² *Ibid.*

deter Russia-perceived Western involvement in the conflict.⁶³

In summary, Russia has revitalized its nuclear warhead infrastructure from its greatly weakened status in the early 1990s to that of a nuclear powerhouse today. It has designed and produced numerous new types of nuclear warheads, is capable of producing over a thousand new warheads each year, and has relocated and revitalized its nuclear testing site. The contrast with the United States, which has produced no nuclear warheads, new or otherwise, since 1989, and has no test readiness program, is stark.

China

In the early 1990s, China could be described as a regional nuclear power. Its nuclear force was estimated to include less than one hundred warheads on ballistic missiles of which only about seventeen had enough range to reach the far western coast of the United States. China also had only one rudimentary ballistic missile submarine which never deployed far from its home base.⁶⁴

Even in the early twenty-first century, U.S. assessments of Chinese military developments dismissed any serious nuclear threat from the People's Republic of China (PRC) nuclear forces. For example, a DoD report to Congress confidently stated,

The technological level of China's defense industrial complex is too far behind that of the

⁶³ Defense Intelligence Agency, *2025 Worldwide Threat Assessment*, 2025, p. 15, available at https://armedservices.house.gov/uploadedfiles/2025_dia_statement_for_the_record.pdf.

⁶⁴ Ron Montaperto, "China as a Military Power," National Defense University Strategic Forum, No. 56, December 1995, available at <https://apps.dtic.mil/sti/pdfs/ADA394422.pdf>.

West to produce weaponry that could challenge a technologically advanced foe such as the United States or Japan for an indefinite period of time.⁶⁵

That characterization of Chinese military technology has changed dramatically since it was published in June 2000. The most recent assessments by DoD of Chinese nuclear capabilities provide quite a different picture. The DoD assessment in 2024 was that China had about 400 ICBMs in its arsenal, all of which could reach the continental United States.⁶⁶ No longer were the Chinese missiles limited to carrying a single warhead. China has now deployed multiple-warhead missiles. China has also recently constructed three new silo fields for ballistic missiles and probably has begun loading missiles into the silos. The PRC nuclear arsenal also includes road-mobile ICBMs and intermediate-range ballistic missiles (IRBMs). It has fielded two types of ballistic missile submarines and is now capable of conducting near-continuous at-sea missile patrols and targeting the United States from its littoral waters. In addition, the PRC has joined the ranks of countries with a strategic nuclear triad by equipping its bombers with a refueling capability as well as the ability to carry air-launched ballistic missiles.⁶⁷

The pace of nuclear developments in China appears to be accelerating. For example, the 2020 report on China's military developments estimated that China possessed an operational nuclear warhead stockpile of about 200

⁶⁵ Department of Defense, *Annual Report on the Military Power of the People's Republic of China*, June 2000, p. 8, available at <https://apps.dtic.mil/sti/pdfs/ADA381499.pdf>.

⁶⁶ Department of Defense, *Military and Security Developments Involving the People's Republic of China*, 2024, p. 65, available at <https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF>.

⁶⁷ *Ibid.*, pp. 103-107.

warheads and that by 2030 that number would at least double.⁶⁸ Just four years later, DoD estimates that the Chinese operational stockpile of nuclear warheads has surpassed 600 and will exceed one thousand by 2030—several years before the U.S. completes its planned infrastructure modernization.⁶⁹ The Defense Intelligence Agency estimates that:

China will continue to increase the size of its force until at least 2035. This supports the PLA's objective to achieve a more diverse nuclear force, comprising systems including low-yield precision strike missiles and ICBMs with multi-megaton yields, to provide a broader range of nuclear response options.⁷⁰

China continues to produce weapons-grade nuclear materials and is expanding its nuclear warhead production infrastructure. In addition, recent upgrades and possible preparation for testing at its Lop Nur nuclear test site have raised concerns about its testing plans.⁷¹ The newly developed nuclear capabilities being fielded by China may well provide a compelling rationale for them to conduct nuclear tests to confirm proper functioning of those warheads.

Russia-China Nuclear Cooperation. The rapid modernization of Russian and Chinese nuclear forces is a serious concern in itself. That concern is heightened further

⁶⁸ Department of Defense, *Military and Security Developments Involving the People's Republic of China*, 2020, p. xiv, available at <https://media.defense.gov/2020/sep/01/2002488689/-1/-1/1/2020-dod-china-military-power-report-final.pdf>.

⁶⁹ Department of Defense, *Military and Security Developments Involving the People's Republic of China*, 2024, op. cit., pp. 107, 109.

⁷⁰ Defense Intelligence Agency, *2025 Worldwide Threat Assessment*, op. cit., pp. 8-9.

⁷¹ Ibid.

by the potential for cooperation by Russia and China against the United States and its allies. In May 2025, a DoD official with responsibilities for nuclear deterrence testified,

Today, the United States faces one of the most unprecedented strategic environments in our Nation's history. China and Russia are modernizing and diversifying their nuclear forces at breathtaking pace, and the Democratic People's Republic of Korea (DPRK) continues to demonstrate its ability to execute a strategic attack. Additionally, our adversaries are increasing their level of coordination and cooperation, which also raises the possibility of simultaneous conflicts with multiple nuclear-armed adversaries.⁷²

During the early part of the twenty-first century, U.S. officials may have felt comfortable with the slow pace of reconfiguring the U.S. nuclear warhead complex. However, the rapid modernization of nuclear forces in Russia and China and the dramatic gap in capability between Russian and Chinese nuclear infrastructures and the capability of the United States is now a valid cause for alarm.

In June 2025, one former DoD official warned that the possibility of a combined Sino-Russian nuclear attack is now a mandatory planning scenario for the United States. He states that his is not just a theoretical concern. As evidence, he cites recent joint Chinese-Russian strategic bomber patrols near Alaska.⁷³

⁷² Statement of Brandi Vann before the House Armed Services Committee, Subcommittee on Strategic Forces, May 7, 2025, p. 3, available at https://armedservices.house.gov/uploadedfiles/passback_bln-119-14d_defense_vann_hasc_nuclear_posture_hearing_statement.pdf.

⁷³ Eric S. Edelman, "America's Latest Problem: A Three-Way Race," *Foreign Policy*, June 2, 2025, available at <https://foreignpolicy.com/2025/06/02/us-nuclear-weapons->

Summary Findings

The need to restore to operation the nuclear warhead design and industrial capabilities of the United States is an urgent concern. Restoring this capability is unlikely to be smooth and without further difficulties. Accomplishments in modernizing nuclear component production facilities initiated over the past two decades provide a useful base for pushing ahead. However, additional funding, high level attention, and acceleration of current infrastructure plans are required to provide the capability to discourage nuclear racing and brinkmanship by Russia and China. The recommended actions cited in this report are the minimum of what is necessary to help restore the nuclear warhead complex to functionality.

Summary of Recommendations for Responsive Infrastructure for Nuclear Warheads

Below are recommended actions needed in the near term to help achieve a responsive and resilient infrastructure. All are important. Several require urgent attention.

Recommendations requiring urgent action:

- ***Plutonium processing and fabrication:*** proceed with greater urgency to achieve an operational pit fabrication capability at Los Alamos; accelerate the second fabrication site at SRS; and develop plans for each site to be able to scale-up plutonium pit production quantities in a timely manner.
- ***Nuclear test readiness:*** survey test readiness capabilities and take immediate corrective action to restore a readiness capability to conduct a fully instrumented nuclear test within two years; also,

appropriate funds for test readiness and keep the funding in an “escrow” account to be used, when needed, to begin test preparations.

- ***DoD and NNSA Integration:*** proceed apace on W93 development and give high-level attention to the DoD/NNSA integration activities for the W93 warhead.

Other important recommended actions:

- ***Uranium processing and fabrication:*** to the extent possible, accelerate the construction of the replacement UPF and lithium facilities at SRS.
- ***Non-nuclear components:*** expand capacity at both the Kansas City Plant and at Sandia to provide resilience.
- ***Tritium production and handling:*** accelerate the completion of the TFF facility and other needed modernization projects at SRS; and ensure that tritium production can be scaled up to meet operational needs should the number of operationally deployed warheads be significantly increased.

Chapter 4

Why Does America Need Golden Dome?

Executive Summary

President Trump's January 27, 2025 Executive Order, *The Iron Dome for America*, calls for a versatile U.S. missile defense system to protect America's citizens, territory, infrastructure, and military forces against all opponents' "ballistic, hypersonic, and cruise missiles, and other advanced aerial attacks. The Trump Administration has given the label "Golden Dome" to a homeland defense against all opponents' missiles.

This guidance departs from past policy and practice: since 1976, no Republican or Democratic administration has deployed missile defenses to reduce the condition of homeland vulnerability to Russian or Chinese strategic missiles. The existing rudimentary homeland missile defense system is intended and largely designed to protect against the missile threats from North Korea.

However, Washington's practice of not deploying more than a minimalist homeland defense against North Korean missiles is dangerous given the looming nuclear threats of a Russian, Chinese, and North Korean "axis of upheaval" that has the clear goal of overthrowing the liberal world order, by force if necessary. Moving progressively now to protect citizens, infrastructure and nuclear forces will help preserve the credibility and capability of U.S. deterrence strategies that must serve to keep the peace. The protection of U.S. nuclear retaliatory capabilities, including nuclear command, control, and communications, is an urgent priority in this regard. The more effectively the United

States provides this protection, the more able it will be to deter war – there are no trade-offs in this regard.

The 2025 Iran-Israel Twelve-Day War included a dramatic duel between Iran's offensive missiles and the defensive interceptors protecting Israel. The outcome of the Twelve-Day War would have been horrific for Israel in the absence of Israel's missile defense capabilities – particularly because Iran targeted civilian centers for destruction. It provides lessons regarding the prospective value of Golden Dome's missile defenses for allies and the U.S. homeland. The approximately 90 percent success rate of layered missile defenses illustrates their potential effectiveness for denying the coercive effects of Russian, Chinese, and North Korean offensive missile threats, i.e., deterring their coercion, and helping to undercut the potential military effects of even large-scale nuclear attacks – thereby helping to deter such strategies. The Twelve-Day War also demonstrated that missile defenses can contribute critically to saving lives and limiting escalation. It also demonstrated: 1) the great value of missile defense as an essential complement to offensive air operations intended to destroy enemy missile capabilities; 2) that “cost-effective at the margin” must not be a decisive criterion for fielding missile defense; and finally, 3) that the United States and allies must move urgently to produce, stockpile, and field layered missile defense capabilities in a timely way and in quantities potentially sufficient for multiple, and possibly simultaneous, great power missile threats and attacks.

Critics of Golden Dome now repeat tired arguments against homeland missile defense that date to the 1960s. These arguments have driven U.S. missile defense policy for decades. But for all their repetition and policy influence, they were suspect during the Cold War and are demonstrably bogus or logically incoherent in the contemporary threat context. If, as seems likely, U.S. technological innovation, in cooperation with allies, can

make Golden Dome for the American homeland and allied lands practicable, there should be no going back.

Introduction

President Trump's January 27, 2025 Executive Order, *The Iron Dome for America*, calls for a versatile U.S. missile defense system to protect America's citizens, territory, infrastructure, and military forces against all opponents' "ballistic, hypersonic, and cruise missiles, and other advanced aerial attacks."¹ It also calls for the examination of cooperation with allies to protect their territories, populations and military forces. This is a sweeping directive for the defense of the United States the likes of which have not been seen since Ronald Reagan's 1983 Strategic Defense Initiative. That research and development program ultimately led to the rudimentary U.S. homeland defense system now deployed to protect against North Korea's long-range ballistic missiles, but not against Russian or Chinese missiles.

The goal of defending American citizens, infrastructure and nuclear forces may seem self-evidently sensible. That, however, is a naïve view given long-standing U.S. missile defense policy. Since 1976, no Republican or Democratic administration has deployed missile defenses to reduce the condition of homeland vulnerability to Russian or Chinese strategic missiles. Americans typically react to this harsh reality with shocked disbelief;² why else should U.S. taxpayers spend hundreds of billions of dollars on defense

¹ The White House, Presidential Actions, *The Iron Dome for America*, January 27, 2025, available at <https://www.whitehouse.gov/presidential-actions/2025/01/the-iron-dome-for-america/>.

² See polling data on public views of missile defense during the Cold War in, Keith B. Payne, *Strategic Defense: "Star Wars" in Perspective* (Lanham, MD: Hamilton, 1986), pp. 233-247.

every year if not—at a minimum—to protect the country from attack?

Washington's archaic policy *against* deploying anything beyond a minimalist homeland defense against North Korean missiles is dangerous given the looming nuclear threats of a Russian, Chinese, and North Korean "axis of upheaval" that has the clear goal of overthrowing the liberal world order, by force if necessary. Russia has explicitly lowered its threshold for using nuclear weapons and frequently issues coercive nuclear threats; China's leadership has identified 2027 as a possible timeline for taking Taiwan,³ and has not ruled out the use of nuclear weapons to do so, if necessary. Both have been engaged in an extensive expansion of their nuclear forces for well over a decade.

Republican and Democratic administrations foolishly expected the post-Cold War international system to be a cooperative "new world order,"⁴ governed by a near-universal liberal enlightenment. To the dismay of Western capitals, Russia, China, and North Korea (and Iran) instead see themselves at war with the United States because it is the impediment to their common goal. Washington and the West are only now awakening to the harsh reality of this war.

An American homeland defense against all opponents' missiles, now labeled "Golden Dome" by the Trump

³ See Olivia Victoria Gazis, "CIA Director William Burns: 'I wouldn't underestimate' Xi's ambitions for Taiwan," *CBS News*, February 23, 2023, available at <https://www.cbsnews.com/news/cia-director-william-burns-i-wouldnt-underestimate-xis-ambitions-for-taiwan/>.

⁴ See for example, President George H. W. Bush, *Address Before a Joint Session of the Congress on the Persian Gulf Crisis and the Federal Budget Deficit*, September 11, 1990, George H. W. Bush Presidential Library and Museum, available at https://bush41library.tamu.edu/archives/public-papers/2217_

Administration,⁵ is an urgent step Washington must take to strengthen deterrence and, concurrently, to prepare for the possibility that deterrence will fail, i.e., both to prevent war and prepare for the possibility of war.

Golden Dome and the Deterrence of War

As described by the Executive Order and Pentagon, Golden Dome will “progressively” protect U.S. citizens, critical infrastructure and nuclear capabilities.⁶ No one should expect Golden Dome to emerge fully mature to defend against all opponents’ missiles. But moving progressively to protect citizens, infrastructure and nuclear forces will help preserve the credibility of U.S. deterrence strategies that must serve to keep the peace. The protection of U.S. nuclear retaliatory capabilities, including nuclear command, control, and communications, is the urgent priority in this regard. The more effectively the United States provides this protection, the more able it will be to deter war. How so?

First, a basic necessity for deterrence is that U.S. nuclear forces and infrastructure are able to survive any nuclear first strike intended to destroy them; they must be able to pose an enduring threat of retaliation. Golden Dome’s protection of U.S. nuclear forces and infrastructure may become increasingly key for the fundamental requirement that U.S. forces be survivable. As Russian and Chinese long-range nuclear missile capabilities continue to expand, and Moscow and Beijing increasingly coordinate and cooperate, the potential nuclear strike threat to eliminate

⁵ *Secretary of Defense Pete Hegseth Statement on Golden Dome for America*, May 20, 2025, available at <https://www.defense.gov/News/Releases/Release/Article/4193417/secretary-of-defense-pete-hegseth-statement-on-golden-dome-for-america/>.

⁶ *Ibid.*

U.S. retaliatory deterrence capabilities will become severe, and the active defense of those U.S. capabilities may be essential for their survival and capacity to pose a retaliatory threat.

More specifically, also necessary for deterrence is the U.S. capability to “tailor” deterrence by holding at risk those particular assets that opponents value most.⁷ Golden Dome’s potential protection of U.S. ICBMs and nuclear infrastructure will help preserve the U.S. capability to threaten the many hardened and underground military and political sites that likely constitute the highest values of Russia’s, China’s and North Korea’s autocratic rulers – their “tools of power and control.”⁸ The need for such a deterrent capability against Moscow was recognized as far back as 1983 by the bipartisan President’s Commission on Strategic Forces. Its report concluded that, for deterrence, the United States “...must be able to put at risk those types of Soviet targets – including hardened ones such as military command bunkers and facilities, missile silos, nuclear weapons and other storage, and the rest – which the Soviet leaders have given every indication by their actions they value most and which constitute their tools of power and control.”⁹ This basic deterrence principle almost certainly

⁷ The 2024 Biden Administration’s nuclear employment guidance said, “The Guidance continues to emphasize the need to, first and foremost, hold at risk what adversaries value most. It also reiterates the need to maintain counterforce capabilities to reduce potential adversaries’ ability to employ nuclear weapons against the United States and its allies and partners....” U.S. Department of Defense, *Report on the Nuclear Employment Strategy of the United States*, November 2024, p. 3, available at <https://media.defense.gov/2024/Nov/15/2003584623/-1/-1/1/REPORT-ON-THE-NUCLEAR-EMPLOYMENT-STRATEGY-OF-THE-UNITED-STATES.PDF>.

⁸ *Report of the President’s Commission on Strategic Forces* (April 1983), p. 6, available at <http://web.mit.edu/chemistry/deutch/policy/1983-ReportPresCommStrategic.pdf>

⁹ *Ibid.*

applies to today's autocratic rulers. Golden Dome's unique protection of the specific U.S. capabilities needed to pose such a deterrent threat, and thereby tailor deterrence to contemporary autocratic foes, is likely to become key to preventing great power war.

Second, Russian and Chinese regional "theories of victory" over U.S. allies and partners include coercive nuclear threats to America intended to destroy the U.S. will to act in defense of allies, and thus the credibility of U.S. deterrence commitments.¹⁰ The priority goal is to paralyze U.S. leaders with fear of Russian and/or Chinese nuclear escalation or, if necessary, to destroy the U.S. military infrastructure needed for U.S. power projection abroad—either way leaving U.S. allies without American support and highly vulnerable to defeat. The 1962 Cuban Missile crisis and the contemporary war in Ukraine both demonstrate U.S. leaders' understandable fear of nuclear escalation against U.S. territory,¹¹ and the potential effectiveness of opponents' coercive nuclear threat strategies. U.S. leaders, Republican and Democrat, have repeatedly expressed the fear of escalation as their reason

¹⁰ For an early discussion of contemporary "Red" "theories of victory," see, Brad Roberts, *The Case for U.S. Nuclear Weapons in The 21st Century* (Stanford, CA: Stanford University Press, 2016), pp. 35, 99, 103-104, 192-194, 260-262, 268-271.

¹¹ For a useful discussion of the Cuban Missile Crisis see, Matthew R. Costlow, "Deterring Opportunistic Aggression During the Cuban Missile Crisis: Necessary Reminders and Applications for Today," *Information Series*, No. 624 (Fairfax, VA: National Institute Press, May 6, 2025), available at https://nipp.org/information_series/matthew-r-costlow-deterrence-is-integrated-in-theory-but-not-in-practice-the-problem-and-partial-solution-no-614-february-3-2025/. For a discussion of Russian nuclear threats in the Ukraine War, see Michaela Dodge, *What Do Russia's Nuclear Threats Tell Us About Arm Control Prospects?*, *Occasional Paper*, Vol. 4, No. 1 (Fairfax, VA: National Institute Press, January 2024), available at <https://nipp.org/papers/what-do-russias-nuclear-threats-tell-us-about-arms-control-prospects/>.

for great caution with regard to support for Ukraine. As Russia and China expand their cooperation “without limits,” protecting U.S. citizens and military infrastructure against Russian and Chinese coercive nuclear threats intended to destroy U.S. will and power projection capabilities will become increasingly critical for the credibility of America’s extended deterrence “umbrella” for allies.

Russian and Chinese commentators have charged that America’s Golden Dome will upset deterrence “stability” and must be rejected. However, the fact that both Moscow and Beijing have long pursued their own missile defense shields and, in fact, that Russia has a long-standing *nuclear-armed* national missile defense system, shows their criticism of Golden Dome to be agitprop intended to stop an American defensive program that threatens to strengthen U.S. deterrence capabilities against their respective theories of victory.

Golden Dome and Preparation for Conflict

Deterrence has long been the primary goal of U.S. nuclear policy and strategic forces. However, the increasing potential for deterrence failure or irrelevance is likely given multiple, dedicated opponents who are willing to risk military conflict, emphasize the role of nuclear weapons, and have the common goal of overturning the existing global order. Nuclear escalation in a regional conflict is perhaps most likely. This is an unprecedented threat context in which the United States must prioritize both deterrence and the preparation for deterrence failure. In the event of war, Golden Dome’s defense of citizens, infrastructure and nuclear forces could uniquely save lives, reduce damage and contribute to the resiliency of U.S. military forces and operations. Deterrence must, of course, remain a priority goal; but the preparation to defend in the

event of war also must be a priority. Fortunately, the more capable U.S. defenses are in the event of war, the more likely Washington will be able to deter war. There are no trade-offs in this regard.

Lessons from the Twelve-Day War

There are several basic lessons from the 2025 Israel-Iran Twelve-Day War regarding the likely value of missile defenses, particularly for, but not limited to, missile threats to U.S. allies. During the war, Israel's layered missile defenses reportedly intercepted some 90 percent of the 500-550 missiles Iran launched at Israel.¹² Apparently 36 of the Iranian missiles that penetrated Israeli defenses detonated in population centers, killing 28 persons, inflicting thousands of injuries, and displacing over 13,000 Israelis.¹³

While Iran pursued diverse offensive missile systems for decades, Israel focused on fielding multiple layers of missile defenses, including different defensive systems optimized to intercept incoming missiles at different altitudes, thereby increasing the odds of successful intercepts. In particular, a multi-layered defensive system

¹² Sebastien Roblin, "How Did Israel's Air Defense Fare Against Iran's Ballistic Missiles?" *Forbes*, July 2, 2025, available at <https://www.forbes.com/sites/sebastienroblin/2025/06/30/how-did-israels-air-defenses-fare-against-irans-ballistic-missiles/>.

¹³ Amy Spiro, "These are the 28 victims killed in Iranian missile attacks during the 12-day conflict," *Times of Israel*, June 29, 2025, available at <https://www.timesofisrael.com/these-are-the-28-victims-killed-in-iranian-missile-attacks-during-the-12-day-conflict/#:~:text=Twenty%20people%20were%20killed,at%20home%20with%20his%20family>. See also, Emanuel Fabian, "The Israel-Iran war by the numbers after 12 days of fighting," *Times of Israel*, June 24, 2025, available at <https://www.timesofisrael.com/the-israel-iran-war-by-the-numbers-after-12-days-of-fighting/#:~:text=Iran's%20remaining%20capabilities,launchers%2C%20according%20to%20IDF%20estimates.&text=In%20terms%20of%20Iran's%20defenses,IAF%20fighter%20jets%20and%20drones>.

can enable “shoot-look-shoot,” in which an initial defensive intercept, if unsuccessful, is followed by a second intercept shot that is aided by improved information regarding the location and likely destination of the attacking missile. Israel’s considerable defensive success during the Twelve-Day War may have benefited from Israel’s multiple layers of missile defenses and corresponding “shoot-look-shoot” opportunities.¹⁴

The effectiveness of Israel’s layered defenses demonstrates their potential value for the deterrence of aggression by decisively denying aggressors the expectation that their missiles will be of reliable military or coercive use. This value of layered defenses is applicable to regional missile threats to allies and to intercontinental nuclear missile threats to the U.S. homeland. Russia, China and North Korea appear to anticipate that limited missile threats to the United States will enable them to coerce Washington away from coming to the aid of U.S. allies—thereby enabling their expansionist plans against U.S. allies.¹⁵ Layered U.S. missile defenses provided by Golden Dome could usefully deny opponents’ confidence in such coercive threats to the United States and restore the effectiveness of U.S. extended deterrence for allies; layered defenses could also undercut their confidence in the potential military effects of even large-scale nuclear attacks—thereby helping to deter such attacks.

The war also demonstrated the unparalleled value of defenses in the event deterrence fails. The outcome of the Twelve-Day War would have been far more destructive of lives, property and infrastructure in the absence of Israel’s layered missile defense capabilities—particularly because

¹⁴ Roblin, “How Did Israel’s Air Defense Fare Against Iran’s Ballistic Missiles?”, *op. cit.*

¹⁵ See Brad Roberts, *The Case for U.S. Nuclear Weapons in The 21st Century* (Stanford, CA: Stanford University Press, 2016), pp. 35, 99, 103-104, 192-194, 260-262, 268-271.

Iran targeted civilian centers for destruction. The up to 470 Iranian missiles that were intercepted over Israel almost certainly would have inflicted thousands of additional casualties and billions of dollars in additional civilian and military destruction.¹⁶

This point again applies to regional missile threats to allies and to intercontinental nuclear missile threats to the U.S. homeland. There are, of course, considerable differences in protecting against Iran's hundreds of conventionally armed missiles and defending against thousands of nuclear warheads on intercontinental missiles. Even Israel's remarkably successful 90 percent defensive success rate against hundreds of Iran's conventionally armed missiles could lead to intolerable destruction if an attack against the United States involved thousands of Russian and Chinese nuclear missile warheads. Critics of Golden Dome seem to emphasize this type of scenario in their effort to cast doubt on the potential value of missile defense.¹⁷ However, that scenario is only one of many possible nuclear attack scenarios confronting Washington, and perhaps the most likely to be deterred by the U.S. potential to defeat adversaries' offensive military goals with the help of missile defenses and the corresponding threat of a massive U.S. nuclear reply. In other very plausible conflict scenarios, missile defense protection of society and infrastructure could prove extremely valuable in limiting damage. For example, as noted above, even imperfect defenses could help not only to deter Russian, Chinese, or North Korean coercive nuclear threats but, if deterrence failed to prevent Putin's coercive threats of nuclear attack,

¹⁶ Roblin, "How Did Israel's Air Defense Fare Against Iran's Ballistic Missiles?," *op. cit.*

¹⁷ See for example, "Trump 'Golden Dome' plan tricky and expensive: experts," *Le Bourget* (France), June 20, 2025, available at <https://www.france24.com/en/live-news/20250619-trump-golden-dome-plan-tricky-and-expensive-experts>.

layered defenses could greatly reduce the consequent U.S. civilian casualties and damage to infrastructure and society.

“Cost Effective at the Margin”

The war also readily demonstrated that the past U.S. self-imposed requirement, that missile defenses be “cost effective at the margin,”¹⁸ is an absurd standard – worthy of peacetime accounting, not wartime realities. That accounting standard mandates that defensive interceptors must not cost more to produce and deploy than do the offensive missiles to be intercepted. However, the likelihood that Iranian missiles cost considerably less to produce and deploy than the Israeli interceptors that defended against them was hardly the priority concern for Israel as its missile defenses prevented the destruction of hundreds of civilian and military infrastructure targets. A more useful comparison is of the alternative approaches to defeating offensive missiles in varying contexts. A more useful comparison is of the effectiveness of alternative approaches to defeating offensive missiles in varying contexts, e.g., offensive strikes against opponents’ missile systems prior to their launch, and ground-based, sea-based, and space-based missile defenses.

Limiting Escalation

In addition, in the absence of Israel’s layered defenses, the repeated barrages of attacking Iranian missiles would

¹⁸ See the discussion in Matthew R. Costlow, “A Curious Criterion: Cost Effectiveness at the Margin for Missile Defense,” *Information Series*, No. 537 (Fairfax, VA: National Institute Press, October 21, 2022), available at https://nipp.org/information_series/matthew-r-costlow-a-curious-criterion-cost-effective-at-the-margin-for-missile-defense-no-537-october-21-2022/.

certainly have led to a much greater escalation of the war. In that case, Israel would have been compelled to engage in much more extensive offensive operations against Iran to destroy Iranian missiles, launchers, and storage sites on the ground prior to their launch. During the war, even with near-absolute air superiority over Iran, discriminate Israeli air strikes apparently destroyed approximately 50 percent of Iran's launchers, and Iranian missile launches continued until the very end of the fighting.¹⁹ In effect, while Israeli air attacks against Iranian missile capabilities on the ground were of great importance, these so-called "left-of-launch" operations to destroy Iranian missile capabilities on the ground were inadequate. The effectiveness of Israeli missile defenses was a necessary complement to and enabled a critical limit on Israel's escalation of the war. This potential value of missile defenses as a means of limiting war escalation again applies to regional conflicts and threats to allies and to intercontinental nuclear missile threats to the U.S. homeland.

Defense Production and Inventories

Finally, the Twelve-Day War demonstrated conclusively the importance of readily available interceptor quantities. The multiple waves of Iranian missile attacks apparently stressed the available inventory of U.S. interceptors, particularly had they been needed elsewhere simultaneously.²⁰ For example, given the rate of use in the Middle East, the U.S. Patriot missile defense system reportedly was reduced to only 25 percent of the number of

¹⁹ Roblin, "How Did Israel's Air Defense Fare Against Iran's Ballistic Missiles?", op. cit.

²⁰ See Amira El-Fekki, "US Missile Defenses Heavily Depleted in Shielding Israel: report," *Newsweek*, June 27, 2025, available at <https://www.newsweek.com/us-missile-defenses-heavily-depleted-shielding-israel-report-2091465>.

interceptors needed to support broader Pentagon plans.²¹ Prior to the war, Iran reportedly possessed approximately 2,500 ballistic missiles and was producing 50 additional missiles per month.²² Had the war occurred months or years later, it could have been a contest between the greater number of Iranian offensive missiles and readily available defensive interceptors. Given the Iranian rate of missile production, this competition may have been disastrous for Israel given the limited production rate of interceptor missiles in Israel and the United States. The question of Iran's nuclear potential, of course, likely was critical with regard to the timing of Israel's attack. However, this question of competing inventories of Iranian missiles vs. available interceptors must also have driven Israeli considerations. This is an important lesson from the Twelve-Day War to be learned for the defense of the United States. The total number of deployed U.S. interceptor launchers for homeland defense now stands at 44—an absurdly low inventory given the much greater missile threats now facing the United States.

In short, the sufficient production and fielding of missile defense capabilities must be shaped by the number and character of the missile threats to be deterred and defeated. The United States and allies now confront the large and growing missile arsenals of Russia, China and North Korea. NATO Secretary General Mark Rutte recently emphasized the chilling potential of Russia and China launching a simultaneous attack against the West, initiating World War

²¹ Hugo Lowell, "US has 25% of all Patriot missile interceptors needed for Pentagon's military plans," *The Guardian*, July 8, 2025, available at <https://www.theguardian.com/us-news/2025/jul/08/us-pentagon-military-plans-patriot-missile-interceptor>.

²²Fabian Hinz, "Israel's attack and the limits of Iran's missile strategy," *Online Analysis*, International Institute for Strategic Studies, June 18, 2025, available at <https://www.iiss.org/online-analysis/online-analysis/2025/06/israels-attack-and-the-limits-of-irans-missile-strategy/>.

III.²³ Unfortunately, this reality underscores the urgency of the bipartisan Commission on the National Defense Strategy conclusion in its 2024 report: “The commission found that U.S. industrial production is grossly inadequate to provide the equipment, technology and munitions needed today, let alone given the demands of great power conflict. A protracted conflict, especially in multiple theaters, would require much greater capacity to produce, maintain and replenish weapons and munitions.”²⁴

In summary, the Twelve-Day War’s dramatic duel between Iran’s offensive missiles and the defensive interceptors protecting Israel provides lessons regarding the prospective value of Golden Dome’s missile defenses for allies and the U.S. homeland. In the absence of Israel’s layered missile defenses, Iran’s missile attacks would have inflicted much greater devastation. The success of layered missile defenses illustrates their potential effectiveness for denying the coercive effects of Russian, Chinese, and North Korean limited offensive missile threats, i.e., deterring their coercion, and helping to undercut the potential military effects of even large-scale nuclear attacks – thereby helping to deter such strategies. The Twelve-Day War also demonstrated that missile defenses can contribute critically to saving lives and limiting escalation. It also demonstrated: 1) the great value of missile defense as an essential complement to offensive air operations intended

²³ See Taryn Pedler and Will Stewart, “World War III will start with simultaneous Xi and Putin invasions,” *Daily Mail.com*, July 6, 2025, available at <https://www.dailymail.co.uk/news/article-14879371/World-War-III-start-simultaneous-Xi-Putin-invasions-taking-globe-brink-Armageddon-warns-NATO-chief-Mark-Rutte.html>.

²⁴ As reported in, Tom Jurkowsky, “National Defense Strategy Commission: We Are Not Prepared,” *RealClearDefense*, October 21, 2024, available at https://www.realcleardefense.com/articles/2024/10/21/national_defense_strategy_commission_we_are_not_prepared_1066457.html?utm_campaign=dfn-ebb&utm_medium=email&utm_source=sailthru.

to destroy enemy missile capabilities; 2) that “cost-effective at the margin” must not be a decisive criterion for fielding missile defense; and finally, 3) that the United States and allies must move urgently to produce, stockpile, and field layered missile defense capabilities in a timely way, and in quantities potentially sufficient for multiple, and possibly simultaneous, great power missile threats and attacks.

The Arguments Against Golden Dome

Critics of Golden Dome now repeat tired arguments against homeland missile defense that date to the 1960s.²⁵ These arguments are that: 1) mutual vulnerability to nuclear destruction is necessary for “stable” deterrence, and thus Golden Dome’s protection must be rejected as “destabilizing”; 2) missile defenses will not protect perfectly, and short of near perfection, they are not worth the cost; and, 3) the deployment of Golden Dome will start an “action-reaction” arms race, while rejecting homeland missile defense enables nuclear arms control.²⁶ In short, critics argue that Golden Dome would be imperfect, “destabilize” deterrence, and cause an arms race, while the continuing absence of serious homeland defense is the basis for arms control. These are the standard arguments rolled

²⁵ These critical arguments from the Cold War are reviewed in, Payne, *Strategic Defense: “Star Wars” in Perspective*, op. cit., pp. 29-178; more recently see, David J. Trachtenberg, *Next Steps in Homeland Missile Defense, Occasional Paper*, Vol. 5, No. 1 (Fairfax, VA: National Institute Press, January 2025), available at <https://nipp.org/papers/next-steps-in-homeland-missile-defense/>.

²⁶ See for example, Celia McDowall and Ankit Panda, “Trump wants denuclearization and a ‘Golden Dome.’ He can’t have both,” *Bulletin of the Atomic Scientists*, April 29, 2025, available at https://thebulletin.org/2025/04/trump-wants-denuclearization-and-a-golden-dome-he-cant-have-both/?utm_source=SocialShare&utm_medium=CopyLink&utm_campaign=CopyLink&utm_term.

out once again to reach the desired conclusion that continued vulnerability to Russian and Chinese nuclear missiles is preferable to missile defenses.

These arguments have driven U.S. missile defense policy for decades. But for all their repetition and policy influence, they were suspect during the Cold War and are demonstrably bogus in the contemporary threat context. Each can be addressed in order.

First, as should be most obvious, American homeland vulnerability is not necessary for deterrence. In fact, homeland vulnerability is detrimental to U.S. deterrence strategies. It is the *vulnerability of opponents* to U.S. deterrence threats that enables U.S. deterrence strategies to be effective, not U.S. vulnerability to opponents' threats. Defending U.S. civilians, infrastructure and nuclear forces will strengthen the credibility of those deterrence threats for the reasons discussed above. The well-worn critique that U.S. homeland missile defense is somehow detrimental to U.S. deterrence goals is logically incoherent, but that does not seem to discourage critics from advancing it.

Second, Golden Dome need not protect perfectly to be of great value—perfection rarely exists and is a contrived standard by which to criticize U.S. missile defense. Golden Dome's "progressive" protection of U.S. citizens, critical infrastructure and nuclear capabilities, even though imperfect, will contribute to the credibility and capability of U.S. deterrence strategies. And, in the event of war, less than perfect defenses could help limit damage to U.S. society, particularly in the event of limited coercive nuclear attacks, and strengthen the resiliency of U.S. nuclear and non-nuclear power-projection forces—thereby contributing to the forward defense of allies and defeat of opponents.

Third, history demonstrates conclusively that the U.S. deployment of homeland missile defenses does *not* preclude arms control, nor does the absence of U.S. missile defense somehow reliably *enable* effective arms control. The

2002 Moscow Treaty with Russia imposed deep nuclear reductions and was negotiated and implemented *concurrently* with the U.S. decisions to deploy homeland defenses for the first time in decades. And, the 1972 ABM Treaty, which effectively precluded homeland missile defense and was rationalized as the basis for ending further Soviet nuclear expansion, was immediately followed by an enormous increase in Soviet nuclear forces—despite continuing U.S. arms control efforts. In fact, Soviet officials said that the ABM Treaty was welcomed in Moscow because reduced spending on missile defense enabled them to *expand* Soviet nuclear forces.²⁷ Confident predictions to the contrary, the absence of U.S. missile defense actually *promoted an increase* in Soviet offensive nuclear forces, not arms control.

In short, it is clear from empirical evidence that U.S. homeland missile defense did *not* preclude nuclear arms control in 2002, nor did its absence with the ABM Treaty *enable* effective arms control. The aged arms control criticisms of missile defense, that Golden Dome will preclude arms control, while its absence would reliably enable arms control, are fully inconsistent with historical realities. Again, that historical fact does not discourage continued claims that arms control and homeland missile defense are mutually exclusive.

Conclusion

In conclusion, every past or prospective deployment of strategic forces has pro and con arguments. That is the nature of the subject. That said, in the looming, unprecedentedly dangerous threat context, the need for

²⁷ As discussed in William E. Odom's classic text on the Soviet military, *The Collapse of the Soviet Military* (New Haven, CT: Yale University Press, 1998), pp. 71, 85-86.

Golden Dome's homeland missile defense to strengthen deterrence and prepare for possible conflict is overwhelming. In contrast, the aged arguments against homeland missile defense, now replayed yet again against Golden Dome, are demonstrably bogus or logically incoherent. Those arguments do not reflect thoughtful analyses, but a long-standing political agenda opposed to U.S. missile defense. The 2025 Twelve Day War, featuring Iran's missile attacks and Israel's missile defenses, provides ample illustrations of the great value of layered missile defenses, for both allies and the U.S. homeland. If, as seems likely, U.S. technological innovation, in cooperation with allies, can make Golden Dome for the American homeland and allied lands practicable, there should be no going back.

Chapter 5

Why Arms Control Must Fail

Executive Summary

Americans typically believe that fundamental disagreements can be overcome through the patient application of logic, reasoning, and common sense. This applies to negotiations with adversaries; it is often assumed that international tensions and the risk of war, especially nuclear war, can be alleviated through arms control agreements. This is a culturally egotistical view that assumes opponents share the same goals and objectives as the United States and that, with due diligence, the United States can succeed in concluding agreements that not only enhance U.S. security but provide outcomes that make the overall strategic environment more stable and secure. Though a noble sentiment, this view is naïve, unsupported by history, ignores contemporary realities, and is unlikely to produce the desired positive results.

There is a growing body of evidence supporting the proposition that U.S. adversaries do not share such goals and objectives. In simple terms, both China and Russia—which pose the greatest threat to U.S. security—are not interested in “stability” as the United States defines it. Rather, their goal is to work against a stability that preserves the status quo. America’s primary rivals, China and Russia, believe the time has come to change the existing world order in a way that displaces the United States as the predominant global power—militarily, economically, and politically. They seek a world order more accommodating to their authoritarian worldviews and interests. These opposing objectives are what make meaningful arms control impossible.

As long as Russia and China continue to view the United States as the main impediment to their drive for global supremacy, arms control is destined to fail. It is simply unrealistic to assume that Moscow or Beijing will agree to any meaningful limitations on their respective military buildups, as those buildups underpin their drive for global dominance. This reality, disappointing though it may be, must be recognized and acknowledged lest the United States repeat past follies and suffer the disillusionment of policy failures yet again. In the current international environment, such failures can have catastrophic consequences.

Introduction

Americans typically believe that fundamental disagreements can be overcome through the patient application of logic, reasoning, and common sense. In international relations, creative diplomacy is often seen as the key to solving intractable problems. This applies to negotiations with adversaries; it is often assumed that international tensions and the risk of war, especially nuclear war, can be alleviated through arms control agreements. Though a noble sentiment, this view is naïve, unsupported by history, ignores contemporary realities, and is unlikely to produce the desired positive results.

This stark conclusion runs counter to the American cultural belief that disagreements among opponents can always be overcome with good faith dialogue and discussion. Such a belief is premised on the notion that all sides share a common desire to bridge their differences in ways that lead to mutually beneficial outcomes.

This is a culturally egotistical view that assumes opponents share the same goals and objectives as the United States and that, with due diligence, the United States can succeed in concluding agreements that not only enhance

U.S. security but provide outcomes that make the overall strategic environment more stable and secure.

The central problem with this belief is that there is a growing body of evidence supporting the proposition that U.S. adversaries do not share such goals and objectives. In simple terms, both China and Russia—which pose the greatest threat to U.S. security—are not interested in “stability” as the United States defines it. Rather, their goal is to work against a stability that preserves the status quo. These opposing objectives are what make meaningful arms control impossible.

Different Worldviews, Irreconcilable Differences

The United States is a status quo power. The focus of U.S. foreign policy is on maintaining or restoring stability in the international environment. Why? Because global instability heightens the risk of upheaval and conflict, which can have catastrophic results with decidedly negative consequences for U.S. global interests. The view that arms control is the best way to ensure stability among rival powers has been reflected over the years in numerous policy and strategy documents. Most recently, for example, as the Biden Administration’s *2022 Nuclear Posture Review* (NPR) stated, “The United States will pursue a comprehensive and balanced approach that places a renewed *emphasis on arms control, non-proliferation, and risk reduction to strengthen stability...*”¹ Indeed, arms control is described as a way to “enhance strategic stability with the PRC [People’s Republic of China] and Russia...” and as offering “the most effective,

¹ Department of Defense, *2022 Nuclear Posture Review*, October 27, 2022, p. 1, available at <https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.pdf>. (emphasis added)

durable, and responsible path to reduce the role of nuclear weapons in our strategy and to prevent their use.”² Yet the 2022 NPR also acknowledged that U.S. and Russian “priorities are not identical, underscoring the importance of dialogue, when conditions permit, to address each side’s differing goals and perceptions of military systems that affect strategic stability.”³ Indeed, the stability that the United States seeks to “strengthen” and “enhance” is one that works to resolve conflicts via international law and institutions vice the use of military force—characteristics of a world order created and nurtured by the United States after World War II. This is clearly not the kind of stability America’s adversaries have in mind or wish to cement in practice.

Indeed, America’s primary rivals, China and Russia, believe the time has come to change the existing world order in a way that displaces the United States as the predominant global power—militarily, economically, and politically. They seek a world order more accommodating to their authoritarian worldviews and interests. And their expanding military cooperation reflects a belief that they will more likely succeed by working together rather than separately. In the contemporary political environment, the phrase, “The whole is greater than the sum of its parts,” often attributed to Aristotle,⁴ can be interpreted as meaning that Beijing and Moscow can accomplish more in support of their common purpose through collaborative and coordinated actions than by acting separately.

² *Ibid.*, p. 16.

³ *Ibid.*, pp. 16-17.

⁴ See, for example, <https://se-scholar.com/se-blog/2017/6/23/who-said-the-whole-is-greater-than-the-sum-of-the-parts#:~:text=SE%20Philosophy%2C%20Emergence,%E2%80%9CThe%20whole%20is%20greater%20than%20the%20sum%20of%20the%20parts,properties%20of%20a%20system%3A%20Emergence>.

The United States now must confront not one, but two, major nuclear powers. This is an unprecedented development that greatly complicates deterrence, as what may deter one party may be insufficient to deter the other, and the risks of opportunistic aggression may grow.⁵ In addition, U.S. allies may feel less secure as the United States tries to balance the demands of deterring both powers simultaneously while assuring allies of the U.S. commitment to their own security.

The Dangers of Wishful Thinking

Unfortunately, the United States has yet to come to grips with how best to address deterrence in a world of two nuclear peers. This has led to calls by some to advance arms control efforts as if limitations on armaments will help solve the deterrence problem by codifying a situation of strategic stability. For example, the chief American negotiator for the New START Treaty has argued that the United States should conduct “two parallel negotiations” with Russia and China and “exercise mutual restraint in order to avoid a nuclear arms race—in other words, arms control.”⁶ Despite difficulties in the U.S.-Russia-China relationship, she has

⁵ For a comprehensive discussion of this point, see Matthew R. Costlow, *Deterring the New Pacing Threats: Opportunistic and Coordinated Aggression, Occasional Paper*, Vol. 5, No. 3 (Fairfax, VA: National Institute Press, March 2025), available at <https://nipp.org/papers/matthew-r-costlow-deterring-the-new-pacing-threats-opportunistic-and-coordinated-aggression/>.

⁶ Rose Gottenmoeller, “Arms Control Is Not Dead Yet: America Should Pursue Parallel Nuclear Negotiations With China and Russia,” *Foreign Affairs*, April 15, 2025, available at <https://www.foreignaffairs.com/united-states/arms-control-not-dead-yet>.

asserted, "I do think that it is possible to move forward on negotiating an arms control deal."⁷

The deal she envisions would be a 10-year arms control agreement that would focus on predictability in the nuclear relationship with China and lock in the numerical limits in New START vis-à-vis Russia. "In short," she notes, "with the Chinese, it is all about nuclear predictability. With the Russians, it is all about sustaining nuclear limits.... China should agree not to undermine the limits of New START by rushing to parity with the United States.... Our main goal should be to sustain a stable environment...."⁸ Consequently, she proposed "a ban on upload for the duration of the treaty," asserting that uploading warheads "adds expense, adds complexity, [and] adds delays into our program of record."⁹ Moreover, she asserted that if the United States uploaded warheads on its missiles, "Russia might do the same, and a form of arms race could begin."¹⁰ In the absence of New START inspections and Russia's 2023 "suspension" of participation in the treaty, Russia may have already uploaded warheads on its existing missiles.¹¹ Indeed, the assertion that U.S. actions are the driver of similar adversary reactions and that U.S. strategic restraint will result in similar adversary restraint is a Cold War theory that is demonstrably false.¹²

⁷ Interview with Rose Gottemoeller by the National Institute for Deterrence Studies, July 11, 2025, available at <https://www.youtube.com/watch?v=qEmJmgTFTZ0>.

⁸ Ibid.

⁹ Ibid.

¹⁰ Rose Gottemoeller, "Arms Control Is Not Dead Yet: America Should Pursue Parallel Nuclear Negotiations With China and Russia," op. cit.

¹¹ Keith B. Payne and Mark B. Schneider, "Deterrence Requirements and Low-Cost Nuclear Upload Options," *Information Series*, No. 626 (Fairfax, VA: National Institute Press, June 5, 2025), available at <https://nipp.org/wp-content/uploads/2025/06/IS-626.pdf>.

¹² See Hon. David J. Trachtenberg, Dr. Michaela Dodge, and Dr. Keith B. Payne, *The "Action-Reaction" Arms Race Narrative vs. Historical Realities*

In addition, she proposed that missile defenses should “enter into our [arms control] considerations,” arguing that “we need a new discussion of what it means to undermine the strategic offensive deterrence of the great nuclear powers.”¹³ The belief that missile defenses undermine strategic offensive deterrence harkens back to another Cold War notion that defenses are “destabilizing” and that stability is best preserved by leaving society vulnerable to an adversary’s nuclear threats. This is the kind of convoluted thinking that led to the 1972 Anti-Ballistic Missile (ABM) Treaty, which prevented the United States from deploying nationwide defenses to protect against the expanding Soviet ballistic missile threat. In today’s world, where both Russia and China are expanding their nuclear weapons capabilities and brandishing nuclear threats against the United States and the West, such an approach is illogical and divorced from reality, and President Trump’s “Golden Dome” initiative is a long-overdue and necessary response to growing missile dangers.

Arguments that arms control with Russia and China is necessary “to sustain a stable environment” and that the United States should “convince Beijing that its interests lie in predictability and stability”¹⁴ ignore the fact that neither Moscow nor Beijing are interested in sustaining the “stability” that the United States favors, as that stability -- in the eyes of the Russian and Chinese leaderships -- relegates them to second-class status on the world stage.

Despite an extensive record of historical evidence to the contrary, there is almost a messianic belief in the value of arms control for achieving U.S. national security objectives.

(Fairfax, VA: National Institute Press, March 2021), available at <https://nipp.org/wp-content/uploads/2021/04/Action-Reaction-pub.pdf>.

¹³ Rose Gottemoeller, “Arms Control Is Not Dead Yet: America Should Pursue Parallel Nuclear Negotiations With China and Russia,” *op. cit.*

¹⁴ *Ibid.*

As another former arms control negotiator opined, “Looking to the expiration of New START, the United States could pursue an interim regime of mutual restraint with Russia.... Decades of nuclear arms control have improved strategic stability and reduced the risk of nuclear conflict. Continued mutual restraint might help sustain these gains if risks can be managed.”¹⁵

Others contend that resuming arms control negotiations with Russia is imperative, noting that divisive issues like Ukraine “should not delay prompt attention by the United States and Russia to a restart of the dialogue on a post-New START agreement.... Ending or pausing their arms control dialogue will contribute to unnecessary force building and more uncertainty about the qualities of their weapons inventories.”¹⁶

The Arms Control Association has argued, “Today, nuclear arms control and disarmament are more important than ever. Now is the time to call on your Representative and Senators to show there is bipartisan support for strong U.S. leadership for nuclear arms control.”¹⁷ Last year, a resolution introduced in the House of Representatives called on the Biden Administration “to pursue nuclear arms control and risk reduction dialogue with the Russian Federation to maintain strategic stability.”¹⁸ An identical

¹⁵ William Courtney, “Averting Unconstrained Nuclear Risks with Russia,” RAND, April 15, 2025, available at <https://www.rand.org/pubs/commentary/2025/04/averting-unconstrained-nuclear-risks-with-russia.html>.

¹⁶ Lawrence J. Korb and Stephen Cimbala, “Why Trump Should Embrace Nuclear Arms Control,” *The National Interest*, April 16, 2025, available at <https://nationalinterest.org/feature/why-trump-should-embrace-nuclear-arms-control>.

¹⁷ Arms Control Association, “Enough is Enough,” April 2024, available at <https://www.armscontrol.org/blog/2024-04/inside-aca>.

¹⁸ H. Res. 1079, March 13, 2024, available at <https://www.congress.gov/bill/118th-congress/house-resolution/1079/text>.

resolution was introduced in the Senate several days later.¹⁹ And as one former senior Obama and Biden Administration has argued, “a new strategic [arms control] framework is urgently needed.... This is not a call to abandon arms control – far from it. It is a call to **reimagine** it.... the primary focus going forward must be stability....”²⁰ However, the notion that the path to stability lies through arms control is illusory, as the parties differ in what they seek to accomplish and how they see arms control as a tool to accomplish it.

This advocacy wrongly assumes a commonality of interests and objectives among Washington, Moscow and Beijing. For example, suggesting that arms control now will reverse China’s nuclear ambitions ignores the reality that Beijing’s nuclear buildup underpins its desire to expand its power and influence at America’s expense—a goal that China is unlikely to abandon by agreeing to negotiate arms limitations in the interest of “stability.” Similarly, decades of Soviet/Russian arms control cheating, coupled with the massive buildup of Russian nuclear forces and the plethora of nuclear threats expressed by Russian officials, show that Moscow has no interest in “mutual restraint.”

There is no reason to believe China or Moscow have any interest in arms control to facilitate the U.S. definition of “stability.” Rather, they seek to upset the existing world order with assertive behavior and extensive military and nuclear capabilities—the antithesis of stability. Wishful thinking that they share U.S. goals is more likely to encourage further delays in the necessary and long-overdue U.S. strategic modernization program, further undermining

¹⁹ S. Res. 593, March 19, 2024, available at <https://www.congress.gov/bill/118th-congress/senate-resolution/593/text>.

²⁰ Frank A. Rose, “The Future of Arms Control: Time for a New Strategic Framework,” *Just Security*, July 11, 2025, available at <https://www.justsecurity.org/116786/the-future-of-arms-control-time-for-a-new-strategic-framework/>. (emphasis in original)

the efficacy and credibility of the U.S. nuclear deterrent, including the U.S. extended nuclear deterrent. At a time when nuclear deterrence is under significant stress, this would be dangerous folly.

The Trilateral Challenge

In support of its national objectives, China has become increasingly aggressive in its posturing and its military activities, creating military bases in the South China Sea, challenging the territorial sovereignty of its neighbors, rejecting international arbitration of territorial disputes, threatening the autonomy of Taiwan, improving its military forces, and dramatically expanding its nuclear capabilities. China seeks to overturn American dominance and to take what Beijing envisions as its rightful place of prominence on the world stage. Indeed, as one former Chinese military official has declared, China's rise is "unstoppable," noting, "Even if the US wants to contain China, it can't. The United States is tired of policing the world."²¹ As the commander of U.S. Indo-Pacific Command recently testified, "Beijing's aggressive maneuvers around Taiwan are not just exercises – they are dress rehearsals for forced unification."²² Moreover, the Chinese leadership appears to have abandoned its self-proclaimed policy of minimal nuclear deterrence in favor of an aggressive buildup of its nuclear forces, which the former commander of U.S. Strategic

²¹ Cited in Seong Hyeong Choi, "China's rise 'unstoppable' as US grows tired of policing the world: Zhou Bo," *South China Morning Post*, April 8, 2025, available at

<https://www.scmp.com/news/china/military/article/3304275/chinas-rise-unstoppable-us-grows-tired-policing-world-zhou-bo>.

²² Statement of Admiral Samuel J. Paparo before the House Armed Services Committee, April 9, 2025, p. 3, available at

https://armedservices.house.gov/uploadedfiles/indopacom_posture_statement_2025.pdf.

Command has referred to as “breathtaking” and a “strategic breakout.”²³

Russia likewise has decided to work against U.S. interests virtually across the board as it, too, seeks to upend the existing world order. Indeed, Russia considers NATO, and particularly the United States, its “main enemy.”²⁴ Vladimir Putin has stated that “We are witnessing the formation of a completely new world order, nothing like we had in the past.... The former world arrangement is irreversibly passing away, actually it has already passed away, and a serious, irreconcilable struggle is unfolding for the development of a new world order.” Calling for “the development of a new international system that aligns with the interests of the global majority,” he noted Moscow’s desire to work with those who share Russia’s objectives – notably China – stating that “the level of trust between Russia and China is at its highest point in recent history.... China is our ally....”²⁵ Russia’s military and nuclear buildup over the past several decades has been astounding. Russian Foreign Minister Sergey Lavrov stated, “We’re self-sufficient. We have everything. We know how to ensure our defense capability. If they [the United States] feel that their nuclear arsenals are very outdated and continue to become obsolete against the backdrop of our upgraded weapons,

²³ John Vandiver, “‘Breathtaking expansion’: US Strategic Command leader expects further revelations of China’s nuclear weapons advancement,” *Stars and Stripes*, October 18, 2021, available at <https://www.stripes.com/theaters/europe/2021-10-18/china-us-russia-nuclear-weapons-hypersonics-stratcom-3283272.html>.

²⁴ A new Russian naval doctrine signed in 2022 declared NATO to be an existential threat to Russia AFP, “Russia Says U.S., NATO ‘Main Threats’ to National Security,” *The Moscow Times*, July 31, 2022, available at <https://www.themoscowtimes.com/2022/07/31/russia-says-us-nato-main-threats-to-national-security-a78453>.

²⁵ Vladimir Putin, “Valdai Discussion Club meeting,” November 7, 2024, available at <http://en.kremlin.ru/events/president/news/75521>.

then they should be probably interested in somehow correcting this discrepancy.”²⁶

Moscow and Beijing appear committed to an “irreconcilable struggle” to create a new world order. Such fundamental objectives cannot be papered over by arms control agreements. In this environment, arms control based on wishful thinking is a palliative that seeks to address the symptoms rather than the cause of the different political goals that drive Russian and Chinese armaments. Arms control advocates often confuse cause with effect. As Ronald Reagan used to say, “We don’t mistrust each other because we’re armed; we’re armed because we mistrust each other.”²⁷

A Dangerous Entente

In isolation, considering China’s and Russia’s increasingly aggressive behavior and their respective military buildups that underpin their more arrogant posture is worrisome enough. What U.S. policy makers must confront today is the reality of greater cooperation and collaboration between these two nuclear armed powers and the implications of this confederation for deterrence, extended deterrence, and Western security.²⁸

²⁶ “Russia not to ‘offer anything to anyone’ on New START Treaty – Lavrov,” *TASS*, April 14, 2025, available at <https://tass.com/politics/1943571>.

²⁷ Quoted in The Ronald Reagan Presidential Foundation and Institute, “Ronald Reagan and Mikhail Gorbachev” (undated), available at <https://www.reaganfoundation.org/ronald-reagan/the-presidency/mikhail-gorbachev>.

²⁸ For a more detailed discussion of this point, see David J. Trachtenberg, “Deterrence Implications of a Sino-Russian Entente,” in James H. Anderson and Daniel R. Green (eds.), *Confronting China: US Defense Policy in an Era of Great Power Competition* (New York, NY: Bloomsbury Publishing, Inc., 2024), pp. 169-192.

Russia's growing entente with China appears to be more than just a marriage of convenience. The breadth and scope of Moscow's cooperation and collaboration with Beijing is unprecedented. Numerous joint military exercises, including air and naval operations, have been conducted, with both countries' strategic bombers landing in the other's territory for the first time ever a few years ago. Sino-Russian cooperation extends to virtually all areas of the military sphere—from the joint development of novel offensive weapons systems and space technology to cooperation on defensive capabilities such as early warning and integrated air and missile defense systems.²⁹ China is assisting Russia in its brutal war against Ukraine and, as the commander of U.S. Indo-Pacific Command has stated, is helping Moscow "rebuild its war machine" in exchange for Russian military assistance in other areas.³⁰

Discussions, *Da*; Negotiations, *Nyet*

Although arms control is unlikely to produce any meaningful results, this is not to argue against discussions or the desirability of engaging in open and regular communications. As Winston Churchill said in 1954,

²⁹ See, for example, Dmitry Gorenburg, Elizabeth Wishnick, Paul Schwartz, and Brian Waidelich, "How Advanced Is Russian-Chinese Military Cooperation?" *War on the Rocks*, June 26, 2023, available at <https://warontherocks.com/2023/06/29000/> and Brian G. Carlson, "The Growing Significance of China-Russia Defense Cooperation," U.S. Army War College Strategic Studies Institute, September 18, 2024, available at <https://ssi.armywarcollege.edu/SSI-Media/Recent-Publications/Display/Article/3908561/the-growing-significance-of-china-russia-defense-cooperation/>.

³⁰ Lolita C. Baldor, "China, North Korea and Russia military cooperation raises threats in the Pacific, US official warns," *Associated Press*, April 10, 2025, available at <https://apnews.com/article/pacific-russia-china-north-korea-weapons-ukraine-8ad7156898f1391557d5e53d5d09a02c>.

“Meeting jaw to jaw is better than war.”³¹ Yet, while supporters of increased dialogue tend to believe that this will lead to greater understanding among the parties³² and, hence, expose areas of common agreement that may have been elusive, it is also possible, and likely probable, that greater dialogue, rather than narrow the areas of disagreement, may actually expose more of them and highlight the “irreconcilable” nature of the parties’ goals and objectives.

Indeed, it strains credulity to believe that open lines of communication will reduce tensions and improve the overall strategic environment when the parties’ goals and objectives are diametrically opposed. Similarly, it is unlikely that greater “transparency” in armaments will lead Moscow or Beijing to accommodate the U.S. desire to preserve the existing world order, which they both believe is decidedly unfavorable to them. Tellingly, leading Russian spokespersons have declared Russia to be already at war with the United States. For example, as the director of the Center for Middle Eastern and Central Asian Studies in Moscow stated, “The United States is the enemy. It is our enemy. It is a hostile state that aims to destroy our country... We are at war!”³³ Such views, increasingly spread by Russian propagandists, reflect the worldview of a Russian leadership that believes, as Putin has stated, that

³¹ Former UK Prime Minister Harold Macmillan later adapted this phrase to say that “jaw-jaw is better than war-war.” See “Red Herrings: Famous Quotes Churchill Never Said,” International Churchill Society, available at <https://winstonchurchill.org/publications/finest-hour/finest-hour-141/red-herrings-famous-quotes-churchill-never-said/>.

³² One former arms control official has stated, “Washington should engage with Beijing to understand its objectives... the United States should be trying to build mutual understanding with China....” See Gottemoeller, *op. cit.*

³³ Cited in Julia Davis, *In Their Own Words: How Russian Propagandists Reveal Putin’s Intentions* (Hannover, Germany: ibidem-Verlag, 2024).

Moscow is in an “irreconcilable struggle” with the United States and the West over the nature of the world order. In this struggle, Western notions of arms control as a mutually beneficial endeavor and a stabilizing factor in international relations do not align with Russia’s strategic objectives and, therefore, cannot succeed.

The United States has historically deluded itself into believing that U.S. strategic restraint would be reciprocated by adversaries; that American accommodation and good will would prompt China and Russia to become partners with the West rather than adversaries; that neither side benefits from escalating tensions or instability; and that arms control agreements would serve as a catalyst for improved political relations. Each of these expectations, and similar optimistic hopes, have been dashed by reality. As one trenchant analysis concluded, the U.S. government’s “systemic delay” in calling out Russia’s repeated arms control violations, the “enduring lack of government openness regarding the immense Chinese nuclear build-up,” and the long-delayed U.S. nuclear modernization program have not produced the kind of reciprocal restraint or improved political relationships that U.S. decision makers expected. Indeed, U.S. arms control policy has been driven by self-deception.³⁴ And in today’s environment, there is little reason to believe the results will be different. As the statement, often attributed (or misattributed) to Albert Einstein, goes, “The definition of insanity is doing

³⁴ Keith B. Payne, *Deterrence and Arms Control: Ending the Deceptive “Holiday from History,”* *Information Series*, No. 616 (Fairfax, VA: National Institute Press, February 10, 2025), available at https://nipp.org/information_series/keith-b-payne-deterrence-and-arms-control-ending-the-deceptive-holiday-from-history-no-616-february-10-2025/.

the same thing over and over again and expecting different results.”³⁵

There are existing channels for communication that could be resuscitated in an effort to seek greater insight into Russian posture and programs. For example, although the Congress severely restricted U.S.-Russian military-to-military interactions after Russia’s illegal invasion of Crimea in 2014, the legislation did not prevent military-to-military communication.³⁶ But even military-to-military discussions are liable to prove disappointingly inadequate as long as Russian strategic objectives remain contrary to U.S. national security interests. Above all, the United States should refrain from turning dialogue into a negotiation with the expectation that concrete results can be achieved to the benefit of all parties as though this is a zero-sum game. It is not. The United States must be prepared to acknowledge and accept that certain disputes are unbridgeable, no matter how creative U.S. diplomacy is and how determined American diplomats are in seeking common ground. Even Russian officials have acknowledged that political realities make meaningful arms control negotiations with the United States unlikely. As Kremlin spokesman Dmitry Peskov recently stated, “At the moment, it is very difficult to imagine the beginning of such

³⁵ Christina Sterbenz, “12 Famous Quotes That Always Get Misattributed,” *Business Insider*, October 7, 2013, available at <https://www.businessinsider.com/misattributed-quotes-2013-10>.

³⁶ Kevin Baron and Patrick Tucker, “After Secret Trump Meeting, Russia Offers to Resume Military Relations,” *Defense One*, July 18, 2018, available at <https://www.defenseone.com/threats/2018/07/russia-wants-resume-us-military-relations-after-mysterious-trump-putin-meeting-surprising-pentagon-congress/149865/>. Also see, “Ukraine crisis: US suspends military cooperation with Russia,” *The Telegraph*, March 4, 2014, available at <https://www.telegraph.co.uk/news/worldnews/europe/ukraine/10674777/Ukraine-crisis-US-suspends-military-cooperation-with-Russia.html>.

negotiations.”³⁷ Indeed, the process of negotiation takes time and, in typical U.S. practice, negotiations are accompanied by the delay or cancellation of programs that are the subjects of negotiations. In the contemporary context, negotiations that are highly unlikely to help solve imminent security challenges would delay or cancel urgently needed programs for the sake of hapless diplomacy. The United States must not allow itself to fall into this trap again.

The Lessons of History

The eminent strategist Colin Gray often said that arms control works best when needed least.³⁸ In other words, arms control agreements are easier to reach among countries who share the same worldview, political goals, and objectives. But these are precisely the countries for which arms control agreements are unnecessary. The United States neither wants nor needs arms control agreements with Britain or France. Where arms control is seen as necessary, however, is with adversaries. Yet, the differing goals and objectives of U.S. adversaries make such agreements either impossible to conclude or unlikely to benefit U.S. national security interests.

³⁷ Guy Faulconbridge and Dmitry Antonov, “Russia says the future of nuclear arms control with US and others looks bleak for now,” *Reuters*, April 8, 2025, available at <https://www.reuters.com/world/kremlin-says-it-is-hard-imagine-talks-with-us-new-nuclear-arms-reduction-treaty-2025-04-08/>.

³⁸ Cited in Keith B. Payne and David J. Trachtenberg, *Arms Control in the Emerging Deterrence Context*, *Information Series*, No. 559 (Fairfax, VA: National Institute Press, July 19, 2023), available at https://nipp.org/information_series/keith-b-payne-and-david-j-trachtenberg-arms-control-in-the-emerging-deterrence-context-no-559-july-19-2023/#:~:text=Colin%20S.,have%20inimical%20foreign%20policy%20objectives.

This basic principle was either forgotten or ignored during the Cold War, when it was thought the Soviet Union's agreement to arms control treaties reflected a common belief and a shared commitment to stability. In fact, the Soviet approach was to seek unilateral advantage and to stem American technological progress in areas where the Soviets were lacking. The 1972 ABM Treaty was the poster child for this approach. U.S. officials believed the treaty reflected a common belief in the principle of Mutual Assured Destruction and that banning nationwide strategic defenses and leaving the American population deliberately vulnerable to Soviet nuclear attack would dissuade the Soviets from building large offensive nuclear forces. In reality, the opposite was the case as the greatest buildup of large Soviet counterforce capabilities occurred after the ABM Treaty was signed.³⁹ In general, the results of arms control have often been the opposite of what U.S. officials hoped for and expected.⁴⁰ Importantly, as a recent analysis concluded, "Russia's and China's actions are governed by their own perceptions of national security requirements and their own foreign policy goals and objectives; they are not simply mechanistically fashioned to be in line with U.S. requirements and goals—however self-evidently

³⁹ For additional details, see Hon. David J. Trachtenberg, Dr. Michaela Dodge and Dr. Keith B. Payne, *The "Action-Reaction" Arms Race Narrative vs. Historical Realities* (Fairfax, VA: National Institute Press, March 2021), available at https://nipp.org/monographs_cpt/the-action-reaction-arms-race-narrative-vs-historical-realities/.

⁴⁰ Keith B. Payne and David J. Trachtenberg, *Arms Control in the Emerging Deterrence Context, Information Series*, No. 559, op. cit. Also see Keith B. Payne and David J. Trachtenberg *Deterrence in the Emerging Threat Environment: What is Different and Why it Matters, Occasional Paper*, Vol. 2, No. 8 (Fairfax, VA: National Institute Press, August 2022), pp. 60-66, available at <https://nipp.org/wp-content/uploads/2022/08/OP-Vol.-2-No.-8.pdf>.

reasonable Washington believes its own policies and goals to be.”⁴¹

Repeated instances of Soviet cheating on arms control agreements also demonstrated that Soviet goals did not align with those of the United States, as the Soviets sought to exploit the American penchant to comply with its arms control obligations while cheating to achieve unilateral advantage. In fact, the record of Soviet arms control violations is a sobering one, and the Russian Federation’s record is hardly any better. Lest one forget, it was Moscow’s violation of the Intermediate-range Nuclear Forces (INF) Treaty and the Open Skies Treaty that led President Trump in his first term to withdraw the United States from those agreements.

Conclusion

As long as Russia and China continue to view the United States as the main impediment to their drive for global supremacy, arms control is destined to fail. It is simply unrealistic to assume that Moscow or Beijing will agree to any meaningful limitations on their respective military buildups, as those buildups underpin their drive for global dominance. Under these circumstances, the United States must not succumb to the temptation of accepting an agreement that appears attractive but in reality works against U.S. national security interests.

Both Russia and China recognize that the United States is reluctant to escalate a crisis and that instead Washington seeks de-escalation “off ramps” that will not upset the status quo. Yet, both Moscow and Beijing are willing to pursue escalation when they believe it will work to their

⁴¹ Ibid.

relative advantage.⁴² The American concept of “stability” does not align with theirs. The Western desire to maintain the status quo, grounded in norms and rules of behavior intended to preserve the sanctity of national borders, runs counter to their desire to change the status quo and establish a new world order in their favor. Under these conditions, meaningful arms control that advances American security and national interests is a chimera.

This reality, disappointing though it may be, must be recognized and acknowledged lest the United States repeat past follies and suffer the disillusionment of policy failures yet again. In the current international environment, such failures can have catastrophic consequences.

⁴² As Vladimir Lenin famously said, “You probe with bayonets: if you find mush, you push. If you find steel, you withdraw.” Quoted at <https://www.goodreads.com/quotes/6874779-you-probe-with-bayonets-if-you-find-mush-you-push>.

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The Contributing Authors are responsible for their views as expressed in their respective contributions to this report; these views do not necessarily reflect the official policy or position of the National Institute for Public Policy, the Department of Defense, or any institution with which the contributing authors are affiliated.

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