NATIONAL DEFENSE UNIVERSITY

NATIONAL WAR COLLEGE

FUTURE DIRECTIONS FOR GREAT POWER NUCLEAR ARMS CONTROL
U.S. STRATEGIC COMMAND SCHOLAR'S PAPER

Lt Col T. Justin Bronder, USAF, PhD

USSTRATCOM Liaison and Advisor
Paul Bernstein, Center for the Study of Weapons of Mass Destruction

National War College Faculty Advisor
Col Patrick Donley, USAF

Table of Contents

List of Tables and Figures

Executive Summary

This National Defense University (NDU) Scholars paper addresses a topic proposed by U.S. Strategic Command (USSTRATCOM) on the future of nuclear arms control. Although there is an extensive collection of academic and advocacy publications on this topic, USSTRATCOM and others would be well-served by a focused study synthesizing and methodically comparing plausible arms control courses of action and their impacts in the period following the end of the New Strategic Arms Reduction Treaty (START) in 2026.

To that end, this NDU Scholars paper analyzes potential costs, benefits, and risks associated with four primary approaches to arms control with the other great powers Russia and China. These approaches include maintaining bilateral U.S.-Russian strategic arms limitations at similar levels to today; pursuing major long-term nuclear warhead reductions in a legally binding multilateral framework; a set of bilateral U.S.-Russia and U.S.-China agreements based on non-ratified agreements covering nuclear and non-nuclear topics; and abandoning arms control to pursue U.S. nuclear superiority. Specific conditions for each potential arms control approach, grounded in the thorough body of proposed options from current literature or advocacy publications, provide details to scope each course of action.

Potential impacts from these four arms control approaches are evaluated across five criteria: Strategic Stability, Extended Deterrence, Proliferation, Cost and Competitive Advantage. Differences between approaches are theoretically estimated to be "positive," "negative," or "neutral" from the U.S. perspective, using the current 2021 status quo in each category as a baseline "neutral" rating. The four approaches are evaluated against these criteria for the decade following the recent New START extension, 2026 to 2036. This evaluation is further supported by projected strategic force structures for the three great power nations according to the conditions

of each arms control framework. The impacts from the different resulting force structures are then reviewed quantitatively using simple models of U.S-Russian strategic nuclear force exchanges.

The analysis extends the existing work in this area by projecting and then qualitatively comparing potential outcomes stemming from possible arms control agreements. An overview of the results from analyzing each proposed arms control approach is presented in the chart below:

Approach	Strategic Stability	Extended Deterrence	Proliferation	Cost	Competitive Advantage	Political Feasibility
Approach 1: Bilateral strategic arms limitations	Positive	Neutral	Neutral	Neutral	Neutral / Negative	Likely
Approach 2: Long term multi-lateral reductions	Neutral / Negative	Negative	Neutral	Positive / Neutral	Positive / Neutral	Unlikely
Approach 3: Bilateral non-ratified frameworks	*Positive** / *Neutral**	Positive / Neutral	Neutral / Negative	Neutral / Negative	Positive / Neutral	Likely / Less Likely
Approach 4: Pursue nuclear superiority	Negative	Negative	Negative	Neutral / Negative	Negative	Less Likely / Unlikely

These results highlight important considerations for policymakers and future researchers in this area. Four conclusions and associated recommendations include:

- **Conclusion 1:** Extending the current New START-like regime provides a feasible approach to maintain traditional strategic stability, however, such an approach fails to address potentially destabilizing trends related to non-nuclear strategic technologies and China's modernizing forces.
- **Recommendation 1:** Elements of Approach 1 and Approach 3 as defined in this paper can be combined for a more comprehensive framework addressing related concerns of stability, extended deterrence, proliferation, and global competition. Military and political leaders

should investigate the interplay of both traditional and new aspects of strategic stability to shape the priorities for expanded conditions in a post-New START regime that potentially encompasses multiple agreements. This investigation should also be paired with relevant aspects of USSTRATCOM-specific analysis of risks of strategic deterrence failure to understand the best role that arms control can serve in advancing national security. Analysis into parallel bilateral agreements with Russia and China should be prioritized as a feasible and flexible path to such an expanded strategic stability regime.

- **Conclusion 2:** Analyzing the political feasibility of each approach revealed potentially significant hurdles to each alternative. Comparing approaches indicates there are potential alternatives to a traditionally ratified agreement in the form of political agreements coupled with sufficiently motivated mutual restraint.
- **Recommendation 2:** Given the major international and domestic obstacles to a new, fully ratified agreement, arms control discussions at all levels should include a review of measures that can be taken as backups or "off ramps" from ratification that still secure as binding of an agreement as possible. Technical exchanges, mutual declarations, remote site inspections supported by National Technical Means or other technologies, and other such means should be discussed as a secondary option to support a politically binding agreement should ratification fall short. An agreement, even non-ratified, that addresses priority issues and helps motivate mutual restraint may prove to be an effective paradigm for major arms control breakthroughs in the future.
- **Conclusion 3:** An approach that seeks significant reductions in nuclear forces would entail serious risks in the contemporary security environment. If the risks and tensions between

major powers decrease, arms control could help catalyze a more benign geopolitical situation, especially if supported in a binding, multilateral framework.

- **Recommendation 3:** Strategic leaders should look for indicators that the international geopolitical context is trending toward being more benign. If such indicators are present, leaders should be prepared to look for opportunities to leverage expanded, multilateral arms control or disarmament options to help catalyze these trends in a way that advances the ability of the United States, its allies and competitors to pursue common interests.
- **Conclusion 4:** Pursuing nuclear superiority without a supporting arms control framework leads to negative repercussions across evaluated criteria. Even if a force build up is pursued as a negotiating tactic for an improved arms control agreement, the analysis completed in this study indicates the United States cannot achieve a clear advantage without significant nuclear and/or non-nuclear budget increases through 2036. This is due to the readily available strategic and non-strategic nuclear arsenal that Russia could leverage in response to U.S. arms racing efforts over this period.
- **Recommendation 4:** An across-the-board arms race with Russia, even if leveraged as a negotiating tool, appears to have low likelihood of success in the next 15 years. This type of approach, if employed, should instead study and identify narrow areas of competition that can be leveraged for similarly exact impact. Similarly, "mirroring" strategies should be avoided to instead focus on extending areas where U.S. qualitative advantages offer the best course of action – potential examples include missile defense, precision guidance, and spaced-based technologies.

Introduction

Arms control in the nuclear age has proved a useful tool of national security, meeting ends as diverse as reducing the risks of nuclear war to channeling strategic competition.[1] Yet a number of trends indicate arms control may be at an inflection point; the suitability of this tool in general and the viability of securing new agreements specifically are both unclear.[2] The unraveling of key U.S.-Russian agreements, an international security environment marked by great power competition, and the emergence of new technologies all underscore that the current arms control paradigm, which evolved during the Cold War, is under duress. The recent New Strategic Arms reduction Treaty (New START) extension somewhat reverses the trend that has seen the collapse the Antiballistic Missile (ABM) Treaty and Intermediate-Range Nuclear Forces (INF) agreement. However, the pathway to a future ratified treaty is uncertain due to continued mistrust between Washington and Moscow as well as the politically polarized domestic environment in the United States.[3] Russia's recent history of violating binding agreements, New START excluded, adds additional obstacles to continued bilateral coordination.[4] Looking beyond the two nuclear superpowers, uncertainty regarding China's nuclear modernization and expansion is also challenging how U.S. leaders consider both regional and strategic stability.[5] The continued

[1] John Maurer, "Purposes of Arms Control", *Texas National Security Review*, Vol. 2, No. 1, November 2018, 8-27; Timothy Crawford and Khang Vu, "Arms Control and Great Power Politics," *War On The Rocks*, November 4, 2020, https://warontherocks.com/2020/11/arms-control-and-great-power-politics/; Adam Scheinman, "Making Sense of the Nonproliferation-Disarmament Divide", *War on the Rocks*, August 6, 2020, https://warontherocks.com-/2020/08/making-sense-of-the-nonproliferation-disarmament-divide/.

[2] Christopher A. Ford, "US Priorities for 'Next-Generation Arms Control," *Arms Control and International Security Papers*, Vol. 1, No. 1, April 6, 2020, 1-3.

[3] Carrie A. Lee, "Electoral Politics, Party Polarization, and Arms Control: New START in Historical Perspective," *Orbis*, Vol. 63, No. 4, Fall 2019, 545-564.

[4] Ford, 1-2; Brad Roberts, "On Adapting Nuclear Deterrence to Reduce Nuclear Risk," *Daedalus*, Vol. 149, No. 2, Spring 2020, 75; Linton Brooks, "The End of Arms Control?" *Daedalus*, Vol. 149, No. 2, Spring 2020, 84-88; Jon Brook Wolfstahl, "Why Arms Control?," *Daedalus*, Vol. 149, No. 2, Spring 2020, 103.

[5] U.S. Defense Department, *Military and Security Developments Involving the People's Republic of China 2020 – Annual Report to Congress*, Office of the Secretary of Defense, September 2020, 55-56, 85; Nobumasa Akiyama, "Nuclear Weapons: arms-control efforts need China," *Nature*, Vol. 584, August 6, 2020, 40-42.

development of non-nuclear strategic technologies such as precision strike or hypersonics and increased military competition in domains like space and cyberspace add still further complications for long-held views on deterrence, stability, and arms control.[6]

In this dynamic geopolitical context, there have been a wealth of academic, defense, and advocacy publications discussing new approaches for nuclear arms control.[7] However, proposed frameworks for new bilateral or multilateral agreements are not thoroughly compared in any existing work. Additionally, important implications for interconnected elements of U.S. strategy – defense budgets, force postures, deterrence, and nonproliferation, to name a few – are often not fully explored. This paper aims to close this gap by leveraging the extensive body of recent arms control proposals while applying a well-defined analytical framework to enable a systematic and thorough comparison of potential arms control courses of action. This evaluation essentially takes a two-step approach – synthesizing proposed arms control approaches into four distinct options and then methodically comparing each approach against a set of qualitative criteria. This qualitative comparison is complimented by models estimating U.S.-Russian strategic nuclear force exchanges under the separate arms control regimes.

The resulting analysis clarifies the utility of each approach in achieving favorable geopolitical outcomes in the era of great power competition. Implications for long-term U.S. security and nuclear policy are provided in the Conclusion along with supporting recommendations for future research or policy discussions. The four proposed arms control

[6] Steven E. Miller, "A Nuclear World Transformed: The Rise of Multilateral Disorder," *Daedalus*, Vol. 149, No. 2, Spring 2020, 33; Heather Williams, "Asymmetric arms control and strategic stability: Scenarios for limiting hypersonic glide vehicles," *Journal of Strategic Stability*, Vol. 42, No. 6, August 2019, 789-795.
[7] See, for example, Francis Gavin, *Nuclear Weapons and American Grand Strategy* (Washington, D.C.: Brookings Institution Press, 2020); Matthew Kroenig, *The Logic of American Nuclear Strategy: Why Strategic Superiority Matters* (United States: Oxford University Press, 2018); Vince Manzo, *Nuclear Arms Control Without a Treaty? Risks and Options After New START*, Center for Naval Analyses report, March 2019; George Perkovich and Pranay Vaddi, *Proportionate Deterrence: A Model Nuclear Posture Review* (Washington D.C.: Carnegie Endowment for International Peace, 2021); James Timbie, "A Way Forward," *Daedalus*, Vol. 149, No. 2, Spring 2020, 190-205.

approaches include maintaining bilateral U.S.-Russian strategic arms limitations at similar levels to today; pursuing major long-term nuclear warhead reductions in a legally binding multilateral framework; a set of bilateral U.S.-Russia and U.S.-China agreements based on purely political agreements covering a range of nuclear and non-nuclear topics; and abandoning arms control to pursue U.S. nuclear superiority

Nuclear Arms Control Background

The dynamics of an actual nuclear war have, fortunately for mankind, been purely theoretical. Theories on this topic, along with accompanying nuclear-related weapons and technology developments, evolved throughout the Cold War until today in tandem with thinking on arms control and non-proliferation. Historically, arms control has served goals such as managing proliferation of specific weapons, promoting general stability, and strengthening norms or institutions.[8] In the nuclear era these objectives were further shaped by the classical philosophies of Thomas Schelling, Morton Halperin, Bernard Brodie, and others to form arms control approaches aimed at making nuclear war less likely or, should it occur, less costly.[9]

Spurred by political and conceptual breakthroughs that helped break the action-reaction cycle of arms buildups that characterized the initial years of the Cold War, arms control became a critical tool in managing U.S.-Soviet nuclear competition and nuclear risks.[10] The first major breakthroughs in this regard were the multilateral Limited Test Ban Treaty (LTBT) the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) as well as the U.S.-Soviet Strategic Arms

[8] Stuart Croft, *Strategies of arms control: A history and typology* (New York: Manchester University Press, 1996).
[9] Thomas Schelling and Morton H. Halperin, *Strategy and Arms Control* (Washington D.C.: Pergamon-Brassey's, 1985). 1-3; Croft, 33-35.
[10] Alexey Arbatov, "Mad Momentum Redux? The Rise and Fall of Nuclear Arms Control," *Survival*, Vol. 61, No. 3, May 2019, 7-38.

Limitation Treaty (SALT) and ABM Treaty. These agreements required years of negotiations, a process that in itself provided some stability by making the terms of superpower competition more explicit.[11] When ratified, this group of multilateral and bilateral treaties successfully accomplished several goals that can be generally categorized under the umbrella of strategic stability and risk mitigation.[12] These goals were furthered by additional confidence building measures such as the "hotline" set up between Washington and Moscow to mitigate risks of accident or inadvertent escalation. That formal agreements such as ABM and SALT were reached after passing through multiple U.S. presidential administrations testifies to the commonality of the classical thinking on nuclear arms control which existed in the era.[13] The long road to ratification for these agreements also helped solidify critical theories on deterrence and mutual vulnerability.

Yet the timeframe required for ratification also highlights that underneath these common assumptions there was major contention between different political, military, and technical perspectives regarding the fine details of these treaties.[14] These competing perspectives were frequently manifested in pragmatic policy debates within U.S. and Soviet circles. Some of the central topics that were debated included the nuclear weapons budget (with individual military services further competing for resources in the U.S. case), domestic support for Cold War policies, and impacts to relations between adversaries.[15] Paraphrasing the adage that "all politics are local," these discussions underscore the decidedly "local" or parochial interests that impacted international nuclear arms control debates for both Washington and Moscow.

---

[11] Schelling, Thomas, "The Future of Arms Control", *Operations Research*, Vol. 9, No. 5, September/October 1961, 722-724.
[12] James Goodby, *Approaching the Nuclear Tipping Point : Cooperative Security in an Era of Global Change* (Lanham, MD: Lanham, Rowman and Littlefield, 2017), 9-12; Croft, 33-37.
[13] Fred Kaplan, *The Bomb: Presidents, Generals, and the Secret History of Nuclear War* (New York: Simon and Schuster, 2020), 87-88 and 132-133; Croft, ibid.
[14] Kaplan, 132-135; Maurer, 19-24.
[15] Brendan Rittenhouse Green, *The Revolution that Failed: Nuclear Competition, Arms Control and the Cold War* (Cambridge, UK: Cambridge University Press, 2020), 8, 55-58; Crawford and Vu.

The continued growth in both the capabilities of the U.S. and Soviet nuclear forces and overall stockpiles which endured long after SALT and ABM ratification also illustrates the cross-cutting motivations that shaped these agreements.[16] These continued arms racing trends indicate how arms control accelerated the Cold War competition in certain directions – technologically and geopolitically – while still serving the ultimate goal of avoiding war.[17] The overall success of these treaties must therefore be considered in the context of the multiple domestic and international agendas they embraced. This compromise proved pivotal for forging the needed coalitions for ratification and helped the treaties remain relevant and stabilizing even as arsenals grew and potentially destabilizing technologies like Multiple Independently Targetable Reentry Vehicles (MIRVs) and ballistic missile defense (BMD) continued to evolve.

By the late 1970s, however, the nuclear and geopolitical landscape had evolved enough that traditional arms control approaches were beginning to fall short. This was due in large part to degrading relations between Washington and Moscow– particularly after the Soviet invasion of Afghanistan – and deeper divisions between U.S. partisan political interests at home.[18] The U.S. arms control agenda also grew wider under the influence of more progressive interests; these interests prioritized overall weapons caps in a manner that was difficult to reconcile with other approaches focused on limiting certain characteristics of strategic nuclear weapons. These factors all combined to make new agreements such as SALT II unworkable.[19] Yet long-term competition trends ended up working out in favor of arms control and U.S. national interests by the mid-1980s. NATO's Dual Track Decision, which deployed new U.S. intermediate range missiles to Europe as

[16] Green, 156-157.
[17] Maurer, 25-27; Crawford and Vu.
[18] Croft, 37-38; Kaplan, 136-140.
[19] Thomas Schelling, "What Went Wrong With Arms Control?", *Foreign* Affairs, Vol. 64, No. 2, Winter 1985/86, 219-233.

leverage over Moscow for an agreement on future reductions, and the U.S. qualitative advantages pursued through the Strategic Defense Initiative (SDI), brought sufficient competitive pressure on the Soviet Union to negotiate on intermediate range and strategic forces. Just as important were internal dynamics within the U.S.S.R, where decades of moribund economic performance forced Mikhail Gorbachev to make major nuclear weapons cuts and avoid an arms race that was proving beyond his country's capabilities.[20] The resulting U.S.-Soviet summit at Reykjavik in 1986 and (negotiated separately) INF Treaty later in 1987 opened a new chapter in restricting the long-running nuclear competition by setting the stage for major strategic reductions and eliminating an entire class of "non-strategic" nuclear weapons.

After continued debates throughout the rest of the decade, the collapse of the Soviet Union provided further impetus for completing the strategic reductions begun by Reagan and Gorbachev and to mitigate new proliferation risks. The Strategic Arms Reduction Treaty (START), signed in 1991, achieved significant nuclear force reductions through a limit of 6,000 warheads and 1,600 delivery vehicles. At nearly the same time, the Cooperative Threat Reduction (CTR) program ushered in a new collaborative framework to address potential proliferation risks emerging in former Soviet states. The follow-on effects of this cooperation also strengthened the NPT as Belarus, Kazakhstan and Ukraine joined as non-nuclear states after shedding their Soviet-era arsenals. These significant and binding regimes were also supplemented by the unilateral Presidential Nuclear Initiatives (PNIs), which accomplished the largest reduction of nuclear arsenals in history thanks to a confluence of domestic and international considerations.[21] These

[20] Amy Woolf, "Bargaining With Nuclear Modernization: Does it Work?" *Arms Control Today*, October 2020, https://www.armscontrol.org/act/2020-10/features/bargaining-nuclear-modernization-does-work. Kaplan, 165-169.
[21] Susan J. Koch, "The Presidential Nuclear Initiatives of 1991-1992," *Center for the Study of Weapons of Mass Destruction Case Study 5* (Washington D.C.: National Defense University Press, September 2012), 21-23.

factors contributed to unilateral reductions on the Russian side, epitomizing the potential strength of mutual restraint in arms control under the right strategic conditions.[22]

Continued management of proliferation risks dominated arms control priorities in the late 1990s and early 2000s. The apparently unipolar nature of the world in the era, in conjunction with a focus on unilateral U.S. policy approaches during the George W. Bush administration, prompted a pivot away from the principal U.S.-Russian axis in arms control. This new political approach complicated the bilateral arms control equation as the United States withdrew from the ABM treaty to address new threats from rogue regimes like Iran with a European-based Ballistic Missile Defense system to augment NATOs existing capabilities, later re-scoped and coined the European Phased Adaptive Approach (EPAA).[23] This decision, which culminated a domestic debate over BMD that began as far back as the Nixon administration, has weighed heavily on U.S.-Russia negotiations since despite numerous offers of transparency measures from Washington.[24] Steps to mitigate the risks of the rising North Korean threat have likewise affected U.S-Chinese tensions.

The unique Strategic Offensive Reductions Treaty (SORT) provided some momentum for continued strategic weapons reductions in 2002. Though officially a ratified treaty – predominantly due to the Kremlin's preference on this point – SORT gave no specific instructions warhead limits, force postures, or verification criteria and instead served as a guide for mutual restraint between the two nuclear powers within the bounds of the continuing START agreement.[25] The legacy of SORT can be viewed as helping to bridge the gap in continued reductions prior to

---

[22] Schelling and Halperin, 77.
[23] *The Great American Gamble: Deterrence Theory and Practice from the Cold War to the Twenty-First Century* (United States: National Institute Press, 2008), 386-387.
[24] Steven Pifer, *Nuclear Arms Control Choices for the Next Administration*, Brookings Institute, October 2016, 28-34.
[25] *Treaty Between the United States of America and The Russian Federation on Strategic Offensive Reductions (SORT / Treaty of Moscow)*, Signed May 24, 2002, accessible at the Inventory of International Nonproliferation Organizations and Regimes, Center for Nonproliferation Studies, https://media.nti.org/documents/sort_moscow_-treaty.pdf.

the "reset" in bilateral relations undertaken by the Obama administration and the ratification of the New START agreement in 2010. This agreement, recently extended to 2026, limits each side to a maximum of 700 deployed launchers (i.e., missiles and bombers) with an overall cap at 800 (which includes non-deployed systems) and 1,550 deployed nuclear warheads. Under New START rules, strategic bombers count as one launcher and one warhead regardless of their payload capacity. The full New START regime also includes extensive rules governing verification and data exchanges to help incorporate new "strategic" systems.

Again, cross-cutting agendas were on display for this latest agreement. Domestically, President Obama achieved the needed Senate support by reciprocating with a major nuclear modernization program.[26] The treaty also left out contentious topics for both sides that are still very relevant today. This includes BMD and precision-strike capabilities that Russia views as destabilizing as well as non-strategic nuclear weapons (NSNW), which are a priority issue for the United States. The continued maintenance of New START supports the idea that related theories of stability, deterrence, and mutual vulnerability developed during the Cold War still have some valence today. Yet as highlighted in the introduction, the current era of great power competition and continued pace of technological development have resulted in a strategic context that is challenging these classical theories. The international environment in many ways looks much different from when New START first brought U.S. and Russian deployed strategic warheads and delivery vehicles to their current limits.

This short review of the history of arms control highlights a few key takeaways that should prove useful in understanding this new era. First, even during eras of intense competition between "great powers," arms control agreements proved to be valuable in reducing the risks of the nuclear

[26] Lee, 545-564; Kaplan, 293-294.

war and promoting strategic stability. This was often accomplished in different ways. Depending on the strategic context, for example, agreements which successfully aided stability did not always reduce forces or the associated costs of preparing for a potential nuclear war. Second, these agreements had impacts well-beyond the specific weapons systems covered under their conditions; examples include helping secure advantages in long-term arms races, shaping competition between global powers, and bolstering confidence for both international allies and domestic audiences.[27] Third, given these numerous and competing goals, a compromise between rival agendas – both domestically and internationally – has often proved crucial for the longest lasting agreements like the ABM Treaty and New START. Many potentially workable agreements have also failed to come to fruition due to an inability to compromise competing motivations or from other complicating strategic factors. When both sides have similar levels of motivation, epitomized during the unilateral PNIs in the early 1990s, mutual restraint has proved effective as well and obviated the need for a binding agreement.

The overall conclusion is, unsurprisingly, that the worth of a nuclear arms control agreement must be judged in a greater strategic context. Interconnected topics such as deterrence, stability, alliance cohesion, and defense budgets need to be considered in light of overall strategic goals – not to mention the other parties' priorities – to ensure any arms control agreement is a useful tool of national security and not merely an end it itself. Indeed, the longest lasting agreements embodied multiple agendas while adapting to new contexts.

These conclusions are not novel in the rich intellectual history of arms control, but they do form a useful guide for framing a new analytical method to compare potential future arms control options. Completing this type of analysis is important to help the United States and its allies

[27] James Cameron, "What History Can Teach," *Daedalus*, Vol. 149, No. 2, Spring 2020, 124-127; Maurer, ibid., Crawford and Vu, ibid.

navigate a dynamic, multipolar international security environment. As the clock begins to wind down toward the 2026 sunset of the only remaining strategic bilateral agreement in New START, now is the time to set the trajectory for the next period of arms control agreements; or, conversely, to determine if such tools remain suitable for achieving national security goals in this new era. Starting from the conclusion that disparate strategic considerations are required to fully understand the utility and implications of any arms control agreement, the next section defines several useful and specific criteria for adjudicating the relative merits of new arms control approaches. This analytical methodology is then applied to four specific arms control frameworks, synthesized from recent publications, to more fully explore the national security implictions stemming from the many expert opinions on this crucial topic.

Methodology and Literature Review

The history of nuclear arms control reiterates important links between arms control and other aspects of national security. This paper will explore these interrelated elements in the context of plausible future arms control approaches to better understand the costs, benefits, and risks of potential paths forward in today's dynamic geopolitical environment. The most relevant of these related considerations which lend themselves to a comparative analytical framework include Strategic Stability, Extended Deterrence, Proliferation, Cost and Competitive Advantage. In addition to their relevance to arms control, these categories are also characterized by a fairly common understanding or "baseline" in the current strategic context. This "baseline," understood from the point of view of the United States, thus provides a useful benchmark for evaluating *relative* changes against today's situation. Relative changes, from the U.S. perspective and according to each criterion can be assigned a "rating" of either "positive," "negative," or "neutral,"

keeping the current 2021 status as a standard for the "neutral" rating. Given the inherently theoretical nature of the exercise undertaken in this study, the ability to ground the analysis against common benchmarks thus helps bound the methodology to the maximum extent practical. Additionally, two of these criteria – Strategic Stability and Cost – also have quantitative characteristics to constrain the analysis as well. The following paragraphs define these criteria in more detail, summarize why each was selected to frame this study's methodology, and discuss any important caveats or limitations.

Strategic Stability

Arguably one of the most important criteria in the context of the bilateral U.S.-Russia nuclear relationship, strategic stability in this study is understood to be comprised of both "first strike stability" and "arms race stability." The widely accepted definition of "first strike stability" is essentially the absence of an incentive to initiate a nuclear strike, while "arms race stability" refers to the absence of an arms race to pursue or maintain such a capability.[28] The category of strategic stability also provides a rough equivalence to deterrence, another key element of the strategic nuclear balance. Understanding that nuclear weapons inherently provide a significant advantage to the side that initiates war, a stabilizing deterrence posture should strongly disincentivize an adversary's first strike; when both sides are mutually deterred a level of strategic stability thus follows.[29] Further exploration of long-standing debates about deterrence, founded in Thomas Schelling's and Herman Kahn's canonical and competing views on the subject, is beyond the scope

[28] Two commonly cited sources for these definitions include Glenn A. Kent and David E. Thaler, *First-Strike Stability: A Methodology for Evaluating Strategic Forces*, RAND Corporation Publication R-3765-AF (Santa Monica, CA: RAND Corporation, 1989), p. v and Thomas Schelling and Morton H. Halperin, *Strategy and Arms Control* (Washington D.C.: Pergamon-Brassey's, 1985), 25-39 and 49-58.
[29] Schelling and Halperin, 9 and 50.

of this paper.[30] Where appropriate, however, potential differences in the analytical results or conclusions will be highlighted in the context of both of these schools of thought.

While the basic definitions and implications of stability have been frequently debated, the fundamental outlines of "first strike stability" and "arms race stability" are commonly understood enough to suffice for this theoretical and relative comparison.[31] Given the changing nature of the strategic environment, which includes China as a rising peer competitor, any relevant considerations beyond specific U.S.-Russian relations will be considered to determine any implications for strategic stability as used in this study. Similarly, the different Russian perspective on strategic stability – which includes broader political, economic, and military considerations as well as a narrower definition on the state of relations between competitors – will be noted as appropriate.[32]

Within the strategic stability criterion, first strike stability considers the relative probability that an adversary would possess the capability and motivation to attack in a manner that would decapitate or overwhelm U.S. forces and avoid a crippling retaliatory strike. This qualitative estimate will be complemented by results from the Arriving Weapons Sensitivity Model (AWSM).[33] This analytical model projects the number of surviving and arriving strategic nuclear weapons after absorbing a massive first strike under the various conditions of "Launch On

---

[30] See, for example, Keith B. Payne, *The Great American Gamble: Deterrence Theory and Practice from the Cold War to the Twenty-First Century* (United States: National Institute Press, 2008), 1-59.

[31] See, for example, Kroenig, 127-142. Additional discussions on the definitions of and relations between "deterrence" and "strategic stability" can be found in Elbridge Colby, "Defining Strategic Stability: Reconciling Stability and Deterrence," in *Strategic Stability: Contending Interpretations*, ed. Elbridge Colby and Michael Gerson (Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2013), 47-84 and Dan Smith, "Nuclear Deterrence and Strategic Stability," *Contemporary Security Policy*, Vol. 5, No. 2, 1984, 180-188.

[32] Brad Roberts, *The Case for U.S. Nuclear Weapons in the 21st Century* (Stanford, California: Stanford University Press, 2016), 121; Alexey Arbatov and Vladimir Dvorkin with Vladimir Evseev, *Beyond Deterrence: transforming the U.S.-Russia equation* (Washington D.C.: Carnegie Endowment for International Peace, 2006), 20-24.

[33] Grateful acknowledgment is made to James Scouras for use of his Arriving Weapons Sensitivity Model in this study. Dr. Scouras is not responsible for its use here or for any arguments in this paper. See James Scouras, *U.S. Strategic Forces Under the Prospective START Treaty*, RAND Corporation Note N-3913-AF, 1991 for initial model definition.

Warning" (LOW) and "Ride Out Attack" (ROA) in combination with a "day-to-day" or "generated" force posture.[34] The AWSM was used in recent studies by Stephen J. Cimbala to estimate the "deterrence stability and military viability" for U.S. and Russian forces under current and reduced strategic warhead limits.[35] A more complete discussion of AWSM results and implications follows in the Analysis and Results.

To complete this quantitative comparison, and better understand the qualitative implications stemming from each approach for strategic stability, specific force structures are required. This study presents projected force structures for the United States, Russia, and China that could result from each proposed arms control approach. These force postures were derived from the latest publicly available information, including reports from the Congressional Research Service (CRS), Congressional Budget Office (CBO), Department of Defense (DoD), and analysis from *The Bulletin of Atomic Scientists*. Three of the proposed approaches leverage force structures discussed in the previous studies by Cimbala, providing a common point of comparison with existing literature as well as published AWSM results. The AWSM estimates for the fourth approach, which abandons arms control as a policy tool, are presented in this study for the first time.

As a baseline, the current 2021 status quo and AWSM results at New START levels are assumed to be "neutral." The AWSM results are considered both in terms of total arriving warheads and the ratio of arriving warheads to the total deployed forces. Any relative changes that threaten first strike or arms race stability will contribute to a "negative" rating, while differences that potentially improve stability will be considered "positive."

---

[34] The "generated" force posture assumes a more robust deployment of nuclear forces, likely in response to a crisis or actual conflict.

[35] Stephen J. Cimbala, *Nuclear Deterrence in a Multipolar World – The U.S., Russia and Security Challenges* (New York: Ashgate Publishing, 2016) and "Nuclear Arms Control: A Nuclear Posture Review Opportunity," *Strategic Studies Quarterly*, Vol. 11, No. 3, Fall 2017, 95-114.

Extended Deterrence

Although there are overlapping considerations for strategic stability and deterrence, extended deterrence is unique enough to warrant its own category. Extended deterrence lacks an overarching definition due to the different regional factors affecting allies under the U.S. "nuclear umbrella."[36] This study will qualitatively consider relative impacts to U.S. extended deterrence security guarantees with respect to key relationships in Europe and East Asia. These guarantees are generally grounded in the capability and credibility of the United States to deter a nuclear or other large-scale attack on these allies. The qualitative status quo in 2021 is assumed as the baseline; increased ambiguity or decreased commitment compared to today would lead to a "negative" assessment, for example. Similarly, losing nuclear parity with Russia, or ceding superiority over a potential regional opponent, would also be assessed as "negative."[37] In this context, the relative force structures and AWSM results, which indicate potential impacts to both capability and credibility, will be referenced as needed. Regional stability will also be considered, given that conflict and escalation could challenge the credibility of U.S. extended deterrence guarantees.

Proliferation

Another topic potentially impacted by changes to extended deterrence is proliferation. A common consensus among nuclear weapons experts is that U.S. extended deterrence is an essential

[36] Steven Pifer, et al., *U.S. and Extended Deterrence: Considerations and Challenges*, Brookings Arms Control Series Paper 3, May 2010 (Washington: The Brookings Institution, 2010), pp. 1-3; Therese Delpech, *Nuclear Deterrence in the 21st Century*, RAND Monograph 1103 (Santa Monica, CA: RAND Corporation, 2012), 30-35.
[37] Arbatov et al., 34.

consideration in keeping other allied, latent nuclear powers from proliferating.[38] This implies impacts to extended deterrence will play some role when analyzing potential proliferation effects. Looking beyond U.S. alliances, this category will also include a qualitative assessment of the likelihood of new states pursuing nuclear weapons programs. Possible pressures on existing nuclear weapons states resulting from the assessed arms control pathways will be estimated as well. A key variable in this regard is the likely emergence of new proliferation pressures for existing programs (for declared states such as India and Pakistan as well as rogue regimes in North Korea and Iran) and the emergence of new nuclear aspirants. Another important factor is the strength of the current NPT regime. A full exploration of the NPT framework is beyond the scope of this study, but some of the principal drivers like commitment to Article VI responsibilities will help qualify impacts under this Proliferation criterion.

Cost

The costs for implementing each approach will be evaluated according to impacts to the U.S. budget. This assessment will be made quantitatively by estimating the potential deviations from the most recent projected budgets as a baseline; some published budget projections extend to 2046 but the analysis will focus on the 2026-2031 and 2031-2036 time periods to better parse impacts to more near-term program milestones. Any changes within approximately ±15% will be considered "neutral" while higher and lower excursions will be "negative" and "positive," respectively. Supporting analysis is provided by relevant CBO, DoD and Department of Energy

[38] Kenneth Waltz, "The Spread of Nuclear Weapons: More May Be Better," Adlephi Papers, No. 171 (London: International Institute for Strategic Studies, 1981); David Trachtenberg, "U.S. Extended Deterrence: How Much Strategic Force Is Too Little?" in *Tailored Deterrence: Influencing States and Groups of Concern*, eds. Barry Schneider and Patrick Ellis (Maxwell Air Force Base, AL: USAF Counter Proliferation Center, 2012), 275-279.

(DoE) reports on nuclear forces and missile defense. The estimated force postures under each arms control approach provide additional information to better bound this discussion on cost.

Competitive Advantage

This criterion considers the degree to which the theoretical arms control outcomes enable a U.S. advantage over great power competitors how the various approaches potentially affect the direction and velocity of that competition. This criterion will take a broader view than just strategic stability, considering non-nuclear strategic impacts and other facets of great power arms racing or geopolitical tensions. Using the global geopolitical situation between great powers today as a rough baseline, a decreased U.S. advantage or increased points of contention between great powers would lead to a negative assessment. For example, outcomes that enable China to more easily achieve strategic nuclear parity or increase regional hegemony would lead to a "negative" result. Implications from the cost analysis will also be included, assuming that reduced costs for nuclear forces could provide additional resources to better compete in non-nuclear strategic areas and vice-versa.

This criterion implies some similarity to the type of holistic analysis done under Net Assessment, particularly the attempt to estimate the pace and intensity of long-term competition.[39] However, the intent is to capture the broad outlines of competition outside of the nuclear-specific considerations analyzed in the other criteria. The deep analysis completed under Net Assessment techniques is beyond the purview and classification level of this study.

[39] James G. Roche and Thomas G. Mahnken, "What is Net Assessment?" from *Net Assessment and Military Strategy: Retrospective and Prospective Essays*, Thomas. G. Mahnken, ed. (Amherst, NY: Cambria Press, 2020), 20-21; Dmitry Adamsky, "The art of net assessment and uncovering foreign military innovations: Learning from Andrew W. Marshall's legacy," *Journal of Strategic Studies*, Vol. 43, No. 5, July 2020, 611-644.

Timelines and Feasibility

This study will consider the impacts from arms control through 2036 to focus on the decade following New START. During the period of the New START extension, from 2021 until 2026, this study assumes there will be minimal changes across the qualitative criteria. The exceptions are any projected force structure updates from ongoing U.S. and Russian modernization plans. China's modernization plans are not well known, but a range of possibilities is highlighted based on open-source reports.[40] These timescales were also selected as they align with potential start times for a new arms control agreement and map to rough milestones in the funding, production, and deployment of U.S. nuclear modernization programs. Examples include the B-21 Bomber, Ground Based Strategic Deterrent (GBSD, initial deployments in late 2020s), and Columbia-class Ballistic Missile Submarine (SSBN; initial patrol projected for 2031). A summary of the evaluation criteria and the relative changes that merit "positive," "neutral," or "negative" ratings are summarized below in Figure 1.

Although not part of the evaluation criteria, the feasibility or political likelihood of each approach is also important. These factors are considered when defining each of the proposed approaches below along with short discussion of potential steps that could bring each approach to fruition. Another factor not specifically covered by the evaluation is U.S. declaratory nuclear policy. Declaratory policy changes – such as U.S. acceptance of "no first use" or "sole purpose" doctrine – or other unilateral measures could affect U.S. force structures or the analytical results within any of the evaluation criteria. Similarly, an any changes to NPT support or an updated stance on the Nuclear Ban Treaty could also play a role in future nuclear-related outcomes.

[40] Hans M. Kristensen and Matt Korda, "Chinese nuclear forces, 2020," Bulletin of the Atomic Scientists, Vol. 76, No. 6, 443-445; U.S. Defense Department, *Military and Security Developments Involving the People's Republic of China 2020 – Annual Report to Congress*, Office of the Secretary of Defense, September 2020, 45, 51, 55-56, 87-88.

However, future trends in these policy areas through 2036 are difficult to predict; the arms control approaches in this study are thus evaluated independently of these potential changes to better define this analytical exercise.

Figure 1 – Summary of Evaluation Criteria

Category / Rating	Strategic Stability	Extended Deterrence	Proliferation	Cost	Competitive Advantage	Political Feasibility
Positive	More Stable	Improved capability, credibility or commitment	Decreased pressures	Decreased > 15%	Increased advantage or decreased intensity	Likely
Neutral	No change from status current quo			Up to ± 15% change	No change from current status quo	Less Likely
Negative	Less Stable	Decreased capability, credibility or commitment	Increased pressures	Increased > 15%	Decreased advantage or increased intensity	Unlikely

Literature Review

The unique challenges of today's dynamic security environment have prompted a large body of publications recommending future directions for nuclear arms control or competition. The authors for these publications – ranging from leaders with expertise in negotiating agreements, like Rose Gottemoeller, to leading thinkers representing U.S., Russian and Chinese perspectives such as Linton Brooks, Brad Roberts, Steven Pifer, James Acton, Dmitri Trenin, Alexey Arbatov and Tong Zhao – provide some of the most well-informed viewpoints on this topic available outside of the official government and military agencies engaged in the nuclear enterprise. Overall, these publications provide excellent recommendations for policymakers and offer a wealth of nuanced considerations regarding nuclear competition and cooperation with Russia and China.

However, these works often lack a more complete treatment of policy recommendations, such as comparing the potential impacts of different courses of action. Exceptions to this include Vince Manzo's *Nuclear Arms Control Without a Treaty? Risks and Options After New START*, which systematically compares different bilateral arms control options according to their difficulty and potential value and predicts future force postures in a post-New START regime.[41] In a similar vein, Stephen Cimbala's *Nuclear Deterrence in a Multipolar World: The U.S., Russia and Security Challenges* describes potential arms reduction options between the U.S. and Russia, adding AWSM estimates of large-scale nuclear exchanges between the two nations to quantify the impacts of these reductions on deterrence and stability.[42] Another comparable publication worth noting is a summary from a conference hosted by the Polish Institute for International Affairs, which graded hypothetical transparency and confidence building measures (CBMs) between NATO and Russia according to likelihood, costs and benefits.[43]

At a more theoretical level, Brendan Rittenhouse Green employs the lens of comparative constitutional fitness in his book *The Revolution that Failed* to re-evaluate the role of Mutually Assured Destruction (MAD) in U.S. Cold War policy and provide recommendations for nuclear strategy and arms control. In this context, the relative elements of power available to competing states provides a useful framework to consider optimal arms racing or arms control options.[44] In another review of historic test cases, Matthew Kroenig's *The Logic of American Nuclear Strategy* applies a number of qualitative and quantitative tools to test competing deterrence theories, ultimately synthesizing a new approach based on nuclear superiority and brinksmanship as critical

[41] Manzo.
[42] Cimbala, *Nuclear Deterrence*, Ch. 3, 6-8 for specific quantitative and comparative treatments.
[43] Jacek Durkalec and Andrei Zagorski, "Options for Transparency and Confidence-Building Measures Related to Non-Strategic Nuclear Weapons in Europe: Cost-Benefit Matrix," Post-Conference Report from the Polish Institute for International Affairs, 2014.
[44] Green, 55-58 and 254-264. Comparative constitutional fitness can be briefly described as the degree to which a state's political and social constitution supports an optimal projection of military power or arms control.

factor for nuclear force planning.[45] This work is not specifically focused on arms control but does offer some recommendations based on this superiority-brinksmanship framework.[46]

In summary, the there is an extensive collection of well-regarded academic and advocacy publications on the topic of nuclear arms control. These are complimented by a handful of other works which provide either comparisons of a few potential future agreements or insightful theoretical paradigms to help frame key questions of arms control, deterrence, and stability. This study leverages these expert opinions to provide a new and focused analysis, synthesizing and methodically comparing plausible arms control courses of action and their impacts through 2036. Based on a thorough review of the publications most relevant to the potential post-New START world, four distinct arms control approaches are proposed:

1. "Bilateral strategic arms limitations" – maintaining bilateral U.S.-Russian strategic arms limitations at similar New START levels.
2. "Long-term multilateral reductions" – pursuing major long-term nuclear warhead reductions in a legally binding multilateral framework.
3. "Bilateral non-ratified frameworks" – a set of bilateral U.S.-Russia and U.S.-China agreements based on non-ratified agreements covering a range of nuclear and non-nuclear topics.
4. "Pursue nuclear superiority" – abandoning arms control to pursue U.S. nuclear superiority.

The following section defines these approaches, discussing overall strategy, assumptions, and conditions for each. Estimated force structures which could result under each approach are also presented. Considerations for the plausibility of each agreement and potential steps which could make each approach a reality are also briefly summarized. Some of the supporting publications

[45] Kroenig. ibid
[46] Kroenig, 156-157 and 205-206.

for each approach are highlighted in the following sections. A more complete list of potential conditions for each approach and more extensive references can be found in Appendix A.

Arms Control Approaches – Strategies, Assumptions and Conditions

Approach 1 "Bilateral strategic arms limitations"

- **Strategy:** This approach prioritizes U.S.-Russian bilateral strategic stability in a framework like New START. Leveraging this existing framework presumably maximizes the probability of legal ratification. The New START follow-on does not make any reductions but achieves a freeze on current active stockpiles with an updated verification and monitoring regime.[47] Some tradeoffs on non-strategic issues are made to meet priority issues for both sides. For example, Russian BMD concerns could be met through transparency steps to confirm the purely defensive nature of these systems in addition to other data sharing and confidence-building measures.[48] To meet U.S. concerns on NSNWs, Russia agrees to some mix of transparency measures, inspections, or portal monitoring.[49]
- **Assumptions:** Further strategic reductions are not possible due to domestic pressures favoring the current force structure and continued execution of existing modernization plans. The

[47] James E. Doyle, "How Biden can achieve a first in arms control: A verifiable nuclear warhead freeze," *Bulletin of the Atomic Scientists*, December 15, 2020, https://thebulletin.org/2020/12/how-biden-can-achieve-a-first-in-arms-control-a-verifiable-nuclear-warhead-freeze/.
[48] This falls short of previous Russian demands for *legally* binding limits on American BMD systems but is supposed to be sufficient in the context of this new agreement. See, for example, Steven Pifer, *Missile Defense in Europe: Cooperation or Contention?*, Brookings Arms Control Series Paper 8 (May 2012), 1-3; Andrew Futter and Benjamin Zala, "Advanced US conventional Weapons and Nuclear Disarmament – Why the Obama Plan Won't Work," *Nonproliferation Review*, Vol. 20, No. 1, 2013, 112; Tom Countryman and Kingston Reif, "Intermediate-range missiles are the wrong weapon for today's security challenges," *War on the Rocks*, August 13, 2019, https://warontherocks-.com/2019/08/intermediate-range-missiles-are-the-wrong-weapon-for-todays-security-challenges/; Trimbie, 197-199; Perkovich and Vaddi, 87-89.
[49] Perkovich and Vaddi, 87-89.

agreement thus retains New START limits but adds verifiable freeze on active stockpiles. Planned U.S. and Russian modernization programs would continue with new systems covered by the verification regime and New START-like limits. The existing verification regime would continue with additions to support the warhead freeze and transparency measures for BMD and NSNWs; the full details of these updated verification measures would be finalized by a collaborative joint commission.[50] Intermediate-range forces are not explicitly addressed, however the transparency measures on NSNWs help blunt concerns over the continued lapse of an INF treaty replacement. Strategic non-nuclear technology areas – such as space and cyberspace – are not addressed. China continues to refuse to take part in any strategic arms discussions with the United States and Russia.[51]

- **Conditions:** This approach would maintain New START limits for deployed strategic warheads and delivery systems. It would also accommodate new systems fielded on or after 2026, which would include planned U.S. and Russian modernized systems and totally new launchers such as boost glide missiles with strategic range.[52] A new feature would be an active stockpile freeze at current numbers with a mix of new mutual declarations and supporting verification measures. The United States would agree to transparency measures and data

[50] Gustav Gressel, "Under the Gun: Rearmament for Arms Control in Europe," European Council on Foreign Relations Policy Brief, November 2018. https://www.ecfr.eu/page/-/under_the_gun_rearmament_for_arms_control_in_europe5.pdf.

[51] See, for example, Zhao Lijian, Foreign Ministry Spokesperson Regular Press Conference, Embassy of the People's Republic of China in the United States, July 20, 2020, http://www.chinaembassy.org/eng/fyrth/t1-796815.htm. Accessed October 1, 2020.

[52] Rose Gottemoeller, "Rethinking Nuclear Arms Control," *The Washington Quarterly*, Vol. 43, No. 3, Fall 2020, 155; Anya Loukianova Fink and Olga Oliker, "Russia's Nuclear Weapons in a Multipolar World: Guarantors of Sovereignty, Great Power Status & More," *Daedalus*, Vol. 149, No. 2, Spring 2020, 53-54; Pranay Vaddi and James M. Acton, *A ReSTART for U.S.-Russian Nuclear Arms Control: Enhancing Security Through Cooperation*, Carnegie Endowment for International Peace Working Paper, October 2020, 2; Brad Roberts (ed.), *Major Power Rivalry and Nuclear Risk Reduction: Perspectives from Russia, China, and the United States*, Center for Global Security Occasional Paper, Lawrence Livermore National Laboratory (May 2020), 8, 10-11; Dmitry Stefanovich, "U.S. Inspection of New Russian Missile May Revive Stalled Arms Control Talks," *Moscow Times*, December 2, 2019, https://www.themoscowtimes.com/2019/12/02/us-inspection-of-new-russian-missile-may-revive-stalled-arms-control-talks-a68437.

exchanges for European-based BMD sites, including notifications of new deployments and/or invitations to observe actual test events or share a selection of telemetry data.[53] In exchange, Russia could extend the proposed warhead freeze to NSNW with additional transparency measures such as storage site inspections, portal monitoring and/or ensuring separate basing of nuclear and non-nuclear delivery vehicles.[54] Additional concerns regarding heavy bomber conversions (a Russian point of contention) and counting rules for future deployed bombers (U.S. B-21 and Russian PAK-DA) could be resolved by agreeing to separate basing measures for nuclear and non-nuclear bombers or related declarations.[55]

- **Feasibility:** A treaty closely following New START's conditions is thought to be most the most politically feasible path to a ratified agreement.[56] Even so, a continuation of the New START-like regime would face pressures internationally and domestically that will complicate ratification. The most contentious international issues would include U.S. EPAA systems in Europe and Russia's unaccountable NSNWs.[57] Approach 1 would not completely resolve concerns in these areas but presents a pathway for compromise based on transparency steps in these areas. As a counterpoint, Russia could still demand additional, binding limits on

[53] See, for example, James M. Acton, Thomas D. Macdonald, and Pranay Vaddi, "Revamping Nuclear Arms Control: Five Near-Term Proposals," Carnegie Endowment for International Peace Working Paper, December, 2020, 16-20; James Timbie, "A Way Forward," *Daedalus*, Vol. 149, No. 2, Spring 2020, 198-199 and Perkovich and Vaddi, 87-89.
[54] Pavel Podvig, Ryan Snyder and Wilfred Wan, "Evidence of absence: Verifying the removal of nuclear weapons," United Nations Institute for Disarmament Research Publication, 2018, 15-27; Brooks, 93-94. Note that portal monitoring for warheads would be technically challenging given the size and weight of these components; the specific technical steps to accomplish this monitoring would need to be worked out in detail.
[55] Vaddi and Acton, 24-25. This type of basing agreement helped reassure Russia that U.S. B-1's were no longer part of the nuclear fleet. However, the basing options for future bombers may be limited, prompting push back from U.S. and Russian Air Force leaders or other domestic stakeholders on such an option.
[56] Brooks, 86-92; Gottemoeller, 155.
[57] Note that other non-nuclear technical and political issues exist as well. These include Russian concerns regarding overall U.S. intentions, impact of precision strike capabilities on stability, and potential fielding of space-based weapons; see, for example, Brooks, 84-87.

European-based BMD systems or refuse any transparency steps on NSNWs.[58] Similarly, basing agreements and inspection or verification measures for these systems, which go beyond the New START agreement, would be controversial for both sides. To overcome some of these obstacles, a multi-step approach could be pursued, beginning with simple verification that key NSNW storage sites are empty and then grow to a more encompassing system of checks or monitoring.[59]

Despite the trend of worsening U.S.-Russian relations, this proposed approach could grow out of continued dialogues during the New START extension. This would also require that neither side makes any foreign policy steps to antagonize the overall security situation in Europe. Looking at U.S. domestic prospects, continued support for long-planned triad modernization plans and the addition of new measures for NSNWs would foster support from more conservative U.S. leaders, while the verifiable warhead freeze could help shore up tensions from politicians on the left advocating for nuclear reductions. The most feasible pathway to making Approach 1 a reality for U.S. Senate ratification would be continued dialogue and hands-on expectation management of the different factions along the political spectrum.

- **Estimated Force Postures:** Tables 1-3 below summarize estimated force postures under Approach 1 conditions; the primary limits are like New START with 1550 deployed warheads and 700 deployed strategic delivery vehicles. New START counting rules would continue to apply, counting total warheads and missiles for ICBMs and SLBMs while bombers are considered as single launchers and warheads regardless of their carrying capacity. Note that

[58] Brooks, 88; Dmitri Trenin, "Stability amid Strategic Deregulation: Managing the End of Nuclear Arms Control," *The Washington Quarterly*, Vol. 43, No. 3 (Fall 2020), 164.
[59] Acton, McDonald and Vaddi, 18-20; Perkovich and Vaddi, 87-89, Podvig, Snyder and Wan, 21-27.

any predictions for China's nuclear forces come with a high degree of uncertainty due to the nation's strategic ambiguity on its force postures. The estimates shown in Table 3 assume a rough "doubling" of Chinese nuclear forces based on open-source DoD reporting.[60] Recent discussions by senior military leaders indicate that China may be seeking either greater nuclear arsenal increases in the upcoming decade or a focus on other weapons systems, such as stealth aircraft and road-mobile missiles, that could complicate U.S. deterrence.[61]

[60] U.S. Defense Department, *Military and Security Developments Involving the People's Republic of China 2020 – Annual Report to Congress*, Office of the Secretary of Defense, September 2020, 45, 51, 55-56, 87-88.
[61] See, for example, U.S. Strategic Command, Admiral Charles Richard Interview with Mitchell Institute for Aerospace Studies Web Series, July 30, 2020, https://www.stratcom.mil/Media/Speeches/Article/-2300365/interview-with-mitchell-institute-for-aerospace-studies-web-series/

Table 1 – Approximate U.S. deployed force structure: Approach 1 "Bilateral Strategic Arms Limitations"

Time Frame: 2026-2031	Total Launchers	Deployed Launchers	Deployed Warheads	Time Frame: 2031-2036	Total Launchers	Deployed Launchers	Deployed Warheads
ICBMs	450	400	400	ICBMs	450	400	400
SLBMs	240	200	1000	SLBMs	196	196	980
Strategic Bombers	66	Up to 60	50	Strategic Bombers	66	Up to 60	50
Total Active Stockpile	3800			Total Active Stockpile	3800		
Total Accountable	788	676	1450	Total Accountable	768	640	1430

Notes for Table 1:

- Baseline totals are from latest 2020 estimates; see Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2020."[62] Estimates for future years draw from Kristensen and Korda commentary and "restricted" cases discussed in Manzo.[63] Estimates in specific weapons categories are based on the following details:
- ICBMs and Bombers: Over this timeframe the only projected changes to U.S. deployed forces are initial deployments of B-21 bombers (sometime on/after 2026) and GBSD (on/after 2029) which are assumed to replace current strategic bombers and ICBMs on a one-for-one basis.

- SLBMs:

  2026-2031 – According to the Navy's latest projections, the SSBN force will decline to 12 boats in FY2029 due to Ohio-class retirements prior to the first Columbia delivery, scheduled for 2031.[64] The estimated force structure reflects 10 SSBNs deployed; impacts to overall deployed warhead numbers are mitigated by increasing warhead loads on SLBMs from an average of 4.5 to 5.0.

  2031-2036 – Continued transition to Columbia-class and retirement of Ohio-class reduces total fleet to 6 Columbia-class and 5 Ohio-class SSBNs by 2036.[65] The deployed forces are assumed to comprise all 11 SSBNs while maintaining warhead loads at 5.0 per SLBM to keep overall deployed warhead numbers near New START levels.

[62] Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 1, 46-48.
[63] Kristensen and Korda, 50-55; Manzo, 50-52.
[64] Congressional Research Service, *Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress*, Congressional Research Service Report R41129, January 15, 2021, 5-7.
[65] CRS R41129, ibid.

Table 2 – Approximate Russian deployed force structure: Approach 1 "Bilateral Strategic Arms Limitations"

Time Frame: 2026-2031	Deployed Launchers	Deployed Warheads	Time Frame: 2031-2036	Deployed Launchers	Deployed Warheads
ICBMs	302	900	ICBMs	280	950
SLBMs	Up to 160	475	SLBMs	Up to 160	539
Strategic Bombers	50	50	Strategic Bombers	50	50
Total Active Stockpile	4310		Total Active Stockpile	4310	
Total Accountable	512	1425	Total Accountable	490	1539

Notes for Table 2:

- Baseline totals are from latest 2020 estimates; see Hans M. Kristensen and Matt Korda, "Russian nuclear forces, 2020."[66] The exact breakdown of ICBM and SLBM loading is unknown as Russia does not report detailed information regarding specific launcher deployments. The numbers used in this analysis are thus approximate based on Kristensen and Korda and future options discussed in Manzo.[67] Estimates in specific weapons categories are based on the following details:
- ICBMs:
  - 2026-2031: Manzo estimates 930 warheads under the "Constrained Force" description, while Kristensen and Korda estimate only about 812 warheads are deployed; this analysis assumes the actual number is between these two estimates.[68]
  - 2031-2036: Following Manzo, the numbers reflect replacing 72 SS-25 ICBMs with 50 SS-27 Mod 2 ICBMs (potential gain of up to 128 warheads) and replacing SS-18 with SS-29 on a one-for-one basis (no net warhead change).[69]
- SLBMs:
  - 2026-2031 – Given that Russia's entire SSBN fleet consists of 10 ships (6x Delta IV, 1x Delta III and 3x Borei) with 16 launch tubes each, the total deployed number is likely less than 160. The total available warheads (including in storage) is likely around 720.[70]
  - 2031-2036 – Increased warhead numbers reflect planned replacements of Delta III/Delta IV SSBNs with Borei-class armed with 6-warhead SS-N-32 SLBMs (maximum possible net gain of 64 warheads).
- Bombers:

  Russia has indicated plans to deliver 10 new Tu-160M2 aircraft in 2027 with a goal of 50 deliveries through the mid-2030s and next-generation PAK-DA bomber sometime after 2029.[71] For this analysis it is assumed these aircraft replace legacy bombers at a one-for-one basis.

[66] Hans M. Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 2, 102-105.
[67] Ibid., 102-108; Manzo, 52-56.
[68] Manzo, 52-53; Kristensen and Korda, "Russian," 104.
[69] Manzo, 52-54.
[70] Kristensen and Korda, "Russian," 104.
[71] Ibid., 110-111.

Table 3 – Approximate Chinese deployed force structure: Approach 1 "Bilateral Strategic Arms Limitations"

Time Frame: 2026-2031	Launchers	Warheads	Time Frame: 2031-2036	Launchers	Warheads
ICBMs	280	258	ICBMs	350	350
SLBMs	72	72	SLBMs	96	96
Strategic Bombers	20	20	Strategic Bombers	50	50
Total Active Stockpile	350		Total Active Stockpile	500	
Total	372	350		496	496

Notes for Table 3:

- Baseline totals are from latest 2020 estimates; see Hans M. Kristensen and Matt Korda, "Chinese nuclear forces, 2020."[72] The indicated numbers include projected deployments of new DF-41 ICBMs and 2 additional SSBNs in the early 2020's.

- Future projections are based on estimates from U.S. Defense Department.[73] Specific references include an overall assertion that China could "double" its arsenal in the next decade, add an additional 100 ICBMs, and increase its SSBN fleet to 8 via concurrent fielding of new Type 096 ships.[74] Strategic bomber estimates are hypothetical based references in this report to roughly doubling the current H-6N fleet and potentially adding several new H-20 bombers.

- Chinese officials indicate that their nuclear forces are kept in a "moderate alert" status with many of their launchers, missiles and warheads maintained in separate storage. The numbers in Table A.3 indicate potential force postures in case of a conflict or crisis understanding that current, day-to-day forces are potentially much lower.[75]

[72] Hans M. Kristensen and Matt Korda, "Chinese nuclear forces, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 6, 443-445.
[73] U.S. Defense Department, *Military and Security Developments Involving the People's Republic of China*, 45, 51, 55-56, 87-88.
[74] Note that in discussions with the House Strategic Forces Subcommittee on February 23, 2021, STRATCOM Commander Admiral Richard indicated that China could double or triple its nuclear arsenal. These estimates are currently not supported in the available open-source reports; the "double" predictions from the referenced DoD report will thus be used to estimate China's force posture for this analysis but potential discursions will be discussed. See, for example, Steve Liewer, "Russia, China could pose nuclear threat if arsenal isn't rebuilt, StratCom chief says," *Omaha World-Herald*, March 28, 2021, https://omaha.com/news/state-and-regional/govt-and-politics/russia-china-could-pose-nuclear-threat-if-arsenal-isnt-rebuilt-stratcom-chief-says/article_d6094ca0-7607-11eb-963d-8f9430339ec8.html.
[75] Kristensen and Korda, "Chinese," 446-447.

Approach 2 "Long term multilateral reductions"

- **Strategy:** This approach describes a long-term effort aimed at achieving major reductions in the number and role of nuclear weapons. This process would start with legally binding U.S. and Russian cuts in a treaty replacing New START, then make further reductions to "multilateralize" this regime with P5 nations including China. Another central part of this approach would include stockpile reductions to significantly reduce nuclear weapons risks and program costs.
- **Assumptions:** Domestic interest in mutual U.S.-Russian nuclear risk reductions, nuclear program cost savings, and easing international tensions combine to support major arms limitations in a two-step process. Step 1 (in 2026-2031) would see the implementation of a similar New START replacement as Approach 1 that includes further reductions (down to 1,000 deployed strategic warheads) as well as an active stockpile warhead freeze.[76] Step 2 (in 2031-2036) would follow with a U.S.-Russia agreement for additional reductions to a limit of 500 deployed warheads.[77] These major cuts are assumed to help foster an expanded effort with P5 nations for a multilateral legally binding agreement. The focus for Approach 2 is on strategic nuclear weapons but includes some necessary steps to limit INF-range systems. Strategic non-nuclear technologies are not explicitly addressed.
- **Conditions:** A New START replacement along the lines of Approach 1 is ratified that reduces deployed warheads to 1,000 and deployed launchers to 600 in 2026-2031. After this period, both U.S. and Russian limits are reduced to 500 strategic warheads and 500 delivery systems.

[76] Steven Pifer, "THE NEXT ROUND: The United States and Nuclear Arms Reductions After New START," *Brookings Arms Control Series Paper 4*, December 2010, https://www.brookings.edu/wpcontent/uploads/-2016/06/12_arms_control_pifer.pdf, 3-4, 25. Reductions to 1000 deployed warheads were also strongly considered during President Obama's administration and will likely come up again amongst like-minded national security staff in the incoming Biden administration; Kaplan, 229-234.
[77] Cimbala, *Nuclear Deterrence*, 37-47.

These continued reductions would be done in concert with expanded P5 engagement to foster a new multilateral treaty on or after 2036. This multilateral effort would set the deployed warhead limit to 350 for China, 300 for France and 215 for the U.K.[78] A verifiable active stockpile limit would also be set, potentially around 2,500 warheads for the U.S. and Russia. In the non-strategic realm, Approach 2 would feature some breakthrough on missile defenses and NSNWs (similar to Approach 1) plus a return to a bilateral (U.S.-Russian) ban on intermediate range ground launched missiles in Europe with 300 launcher limits for INF-range systems for U.S., Russia and China in Asia as a starting point for that region.[79]

- **Feasibility:** This approach encompasses substantial nuclear weapons reductions that do not appear feasible in the current international environment. A breakthrough in international relations and a corresponding significant reduction in global tensions would realistically be required to precipitate such a treaty, but the proposed two-step process could help stimulate such an environment for nuclear weapons specifically. In this context any improved trends from today's tense security environment would be boosted by initial U.S.-Russia steps down to the 1,000-warhead limit. Such a limit has been previously discussed independently in U.S. and Russian think-tank circles, indicating some plausibility, though actual defense officials on both sides are more skeptical of any further reductions.[80] More significant progress on the

[78] Alexei Arbatov and Vladimir Dvorkin with Vladimir Evseev, *Beyond Deterrence: transforming the U.S.-Russia equation* (Washington D.C.: Carnegie Endowment for International Peace, 2006), 156-157.
[79] Tong Zhao, "Opportunities for Nuclear Arms Control with China," *Arms Control Today*, Vol. 50, No. 1 (2020), https://www.armscontrol.org/act/2020-01/features/opportunities-nuclear-arms-control-engagement-china. Zhao recommends an overall limit at 600 launchers as a near-term goal and then scaling down. Given the scope of arms reductions in this Approach 2, a more aggressive goal similar in relative scope is assumed.
[80] See, for example, Perkovich and Vaddi, 84-85; Alexey Arbatov and Vladimir Dvorkin, "The Great Strategic Triangle," Carnegie Moscow Center, April 1, 2013, https://carnegie.ru/-2013/04/01/great-strategic-triangle-pub-51362.

major issues of missile defense, NSNW and potentially conventional forces in Europe could also be required to foster additional reductions.[81]

Given the current disparity between the two nuclear superpowers' arsenals and the rest of the P5 nations, a major cut to a 500-warhead limit at the second stage of this new regime could prompt a breakthrough multilateral agreement. This type of multilateral engagement could also unlock additional interest from China in joining this framework.[82] The polarized domestic political context for the United States offers other major obstacles to this approach. However, renewed public interest in disarmament – not unlike the anti-nuclear movements of the 1970s and 1980s – could combine with pressures from fiscal conservatives to spur the needed support for this approach.

- **Estimated Force Postures:** Tables 4-5 below summarize estimated force postures under Approach 2 conditions. For comparison, counting rules similar to New START are assumed. There are many options to reach the new limits under this proposed framework, but the estimated postures assume both the United States and Russia would maintain a triad to balance survivability and response options. Particularly for the United States, these strategic concerns would be augmented by strong domestic pressures to sustain a triad to avoid base closures and other impacts to the defense industry.

[81] Michah Zenko, *Toward Deeper Reductions in U.S. and Russian Nuclear Weapons*, Council on Foreign Relations Special Report No. 57, November, 2010, 20-23.
[82] Anna Peczeli et. al., "Nuclear Risk Reduction In An Era of Major Power Rivalry," Center for Global Security Research Workshop Summary, Lawrence Livermore National Laboratory, Feb 19-20 2020, 8-11; Austin Long, "Russian Nuclear Forces and Prospects for Arms Control," Testimony presented before the House of Representatives Committee on Foreign Affairs, Subcommittee on Terrorism, Nonproliferation, and Trade, June 21, 2018, RAND Testimony CT495.

Table 4 – Approximate U.S. deployed force structure: Approach 2 "Long term multilateral reductions"

Time Frame: 2026-2031	Total Launchers	Deployed Launchers	Deployed Warheads	Time Frame: 2031-2036	Total Launchers	Deployed Launchers	Deployed Warheads
ICBMs	330	300	300	ICBMs	130	115	115
SLBMs	240	200	650	SLBMs	176-196	176-196	335
Strategic Bombers	66	Up to 60	50	Strategic Bombers	66	Up to 60	50
Total Active Stockpile		3000		Total Active Stockpile		2500	
Total Accountable	700	576	1000	Total Accountable	428	335	500

Notes for Table 4:

- Initial totals remain at New START limits as new legally binding treaties are finalized and ratified. After 2026 the U.S. would draw down to the 1,000 warhead limit. There are multiple possible approaches to reduce the arsenal to this number; the force structure here is based on current modernization plans and simulated limits considered in Cimbala.[83]
- These reductions assume the U.S. continues fielding a triad due to political obstacles against closing ICBM bases and other military strategic considerations. Estimates in specific weapons categories are based on the following details:
- SSBNs:

  2026-2031 – According to the Navy's latest projections, the SSBN force will decline to 12 boats in FY2029 due to Ohio-class retirements prior to the first Columbia delivery, scheduled for 2031[84]. The estimated force structure reflects 10 SSBNs deployed; warhead loads per SLBM are reduced to just over 3.0 to meet new treaty limitations.

  2031-2036 – Continued transition to Columbia-class and retirement of Ohio-class reduces total fleet to 6 Columbia-class and between 4 and 5 Ohio-class SSBNs by 2036.[85] Under Approach 2 limits, the United States could consider retiring an Ohio-class SSBN early to reduce costs. The deployed forces are assumed to comprise all available SSBNs while decreasing the warhead loads on each SLBM to stay within the new treaty limits. Final Columbia-class purchases could also be capped at 10 in this new force structure as an additional cost savings measure.
- ICBMs:

  2026-2031 – total silos are reduced to 330 total with 300 operational day-to-day, maintaining a similar ratio to the currently fielded system. The ICBMs remain mated with 1 warhead only.

  2031-2036 – further reductions to 130 total and 115 operational ICBMs to meet new treaty limits while maintaining the ratio of total to operational systems.
- Bombers: Over this timeframe the only projected changes to U.S. deployed forces are initial deployments of B-21 bombers (sometime on/after 2026) which are assumed to replace current strategic bombers on a one-to-one basis.

[83] Cimbala, *Nuclear Deterrence*, 105-111 and "Nuclear Arms Control," 100-106.
[84] CRS Report R41129, 5-7.
[85] CRS Report R41129, 5-7.

Table 5 – Approximate Russian deployed force structure: Approach 2 "Long term multilateral reductions"

Time Frame: 2021-2026	Deployed Launchers	Deployed Warheads	Time Frame: 2026-2031	Deployed Launchers	Deployed Warheads
ICBMs	250	550	ICBMs	250	260
SLBMs	Up to 160	400	SLBMs	Up to 160	190
Strategic Bombers	50	50	Strategic Bombers	50	50
Total Accountable	460	900	Total Accountable	460	500

Notes for Table 5:

- Initial totals remain at New START limits as new legally binding treaties are finalized and ratified. After 2026 Russia would draw down to the 1,000 warhead limit by 2031 and the 500 warhead limit by 2036. There are a wide range of possible approaches to reduce the arsenal to this number; the force structure here is based on simulated limits considered in Cimbala.[86]

Table 6 – Approximate Chinese deployed force structure: Approach 2 "Long term multilateral reductions"

Time Frame: 2021-2026	Launchers	Warheads	Time Frame: 2026-2031	Launchers	Warheads
ICBMs	280	258	ICBMs	280	258
SLBMs	72	72	SLBMs	72	72
Strategic Bombers	20	20	Strategic Bombers	20	20
Total Accountable	372	350	Total Accountable	372	350

Notes for Table 6:

- There is no certainty on the actual size of China's arsenal. The current projections, based on Kristensen and Korda, are already at the proposed 350 limit under Approach 2.[87] If this approach were to be accepted, it is assumed China would continue modernization plans but replace legacy systems at a one-to-one rate to stay at the new binding 350 warhead limit. To reiterate, any actual estimates on China's arsenal are subject to potentially significant uncertainties.

[86] Cimbala, *Nuclear Deterrence*, 105-111 and "Nuclear Arms Control," 100-106.
[87] Kristensen and Korda, "Chinese," 443-445.

Approach 3 "Bilateral non-ratified frameworks"

- **Strategy:** This approach would side-step ratification issues to pursue a more flexible framework, potentially better suited to meet the challenges of great power competition. Such an approach would concede some of the transparency and predictability provided by legally binding regimes. However, this approach would also allow for greater U.S. freedom of action while possibly opening the aperture of cooperation with Russia and China. The primary goals would be to reduce major risks through political agreements and new communication channels, providing mutual transparency on priority nuclear topics and reinforcing agreed-upon norms in space and cyberspace. Separate, bilateral arrangements with Russia and China would accomplish these goals. This framework could enable more transparent management of future arms racing for nuclear weapons and developing technologies by reducing ambiguity between great powers in these areas.
- **Assumptions:** After the 2026 New START expiration, both the United States and Russia would remain interested in maintaining force levels similar to the now-expired New START-like limits. This interest would be motivated by strategic risk reduction considerations, NPT commitments, cost savings, or some combination of all three factors.[88] Restraint could also be supported by continued dialogue or declarations related to forces previously covered under New START. In place of a binding agreement, Washington and Moscow agree to continue to cooperate in a bilateral and non-legally binding framework.[89] China would refuse to join any

[88] Manzo, 80-88.
[89] Manzo, 69-71; Gressel, 30; Moscow also previously indicated it would support "interagency, high-level dialogue" on a range of security topics; see Kremlin transcript, "Statement by President of Russia Vladimir Putin on a comprehensive program of measures for restoring the Russia – US cooperation in the field of international information security," September 25, 2020, http://en.kremlin.ru/events/president/news/64086, accessed November 6, 2020.

trilateral agreements but is amenable to separate bilateral discussions with the United States. Inspection and verification measures under a non-legally binding agreement would be limited, particularly in the Chinese case. Some tailored, mutually agreeable risk reduction and transparency measures would be defined by bilateral commissions. To help differentiate this flexible framework from Approach 1 in this study, it is assumed that such risk reduction steps would focus on data exchanges and declarations for non-nuclear strategic technologies – hypersonics or activities in space and cyberpace. The assumed timing would include a new U.S.-Russia bilateral pledges or political agreement negotiated during the New START extension to start on or soon after 2026. A possible U.S.-China agreement would take longer to negotiate and would be implemented on or after 2031.

- **Conditions – U.S.-Russia:** Both parties would opt to remain near New START limits for strategic systems after 2026. This mutual restraint would be reinforced through data exchanges, pre-notification standards, or by leveraging National Technical Means (NTMs) and other technological means to essentially emulate inspections remotely.[90] These informational efforts could be further supported by a reiteration of the Reagan-Gorbachev statement, a PNI-like or interim restraint policy, or other diplomatic initiatives. These post-New START mutual transparency efforts would be flexible enough to incorporate discussions on other topics like BMD, NSNWs and hypersonics. For the purpose of a more distinct comparison to the other proposed approaches, Approach 3 is presumed to encompass mutual restraint declarations related to National Command, Control and Communication (NC3), space, and cyberspace.[91]

[90] Manzo, 68-78; Gottemoeller, 149-155.

[91] Christopher S. Chivvis, Andrew Radin, Dara Massicot, and Clint Reach, "Strengthening Strategic Stability with Russia", RAND publication PE234, 2017, 2-5; James M. Acton (ed.), Alexey Arbatov, Vladimir Dvorkin, Petr Topychkanov, Tong Zhao, Li Bin, *Entanglement – Russian and Chinese Perspectives on Non-Nuclear Weapons and Nuclear Risks,* (Washington D.C.: Carnegie Endowment for International Peace, 2017), 6; Erik Gartzke and Jon R. Lindsay, *Thermonuclear Cyberwar*, Journal of Cybersecurity, Vol. 3, No. 1, January 2017, 46; Sarah Bidgood, "Risky Business: Four Ways to Ease U.S.-Russian Nuclear Tension," *Arms Control Today*, Vol. 49, No. 7,

These declarations could be followed up by additional steps to define "red lines" for space and cyber domains and clarification of expected norms to avoid inadvertent escalation or accidental impacts to nuclear forces entangled with conventional ones.[92] The dialogues could expand to include agreement on separate basing for INF-range systems and nuclear forces, or limits on the geographic placement of these systems, keeping them out of Europe in the case of NATO and east of the Urals for Russia.[93]

- **Conditions – U.S.-China:** The novelty of a U.S.-China agreement implies that it would start with a much smaller scope than a comparable U.S.-Russian treaty. China's reticence regarding verification would limit actual caps on nuclear forces, so this agreement would instead capitalize on mutual interests in minimizing risks of accident or inadvertent escalation. This would result in mutual transparency efforts, expanded communication channels, and confidential declarations or data exchanges for a range of nuclear and strategic non-nuclear technologies.[94] Following the precedent set between superpowers in the Cold War, more specific steps could include bilateral pre-launch missile notifications and a Washington-Beijing nuclear "hot line."[95] China also harbors concerns about U.S. BMD systems, while Washington would prioritize receiving additional information on Beijing's capabilities and intentions with regional offensive missile systems. These interests could provide a framework

September 2019, 5; James M. Acton, "Cyber Warfare and Inadvertent Escalation," *Daedalus*, Vol. 149, No. 2, 143-145.

[92] King Mallory, "New Challenges in Cross-Domain Deterrence," RAND Corporation publication PE259, 20-21; Brooks, "End of Arms Control," 95; Theresa Hitchens, "Multilateralism in Space: Opportunities and Challenges for Achieving Space Security," Space and Defense, Vol. 4, No. 2, Summer 2010, 19-20.

[93] Ulrich Kuhn, "Uncharted Waters: Europe and the End of Nuclear Arms Control," *Turkish Policy Quarterly*, Vol. 19, No. 2, Summer 2020, 101-109.

[94] Peczeli et. al., 7; Trenin, 164; Manzo, 94-95 and 110.

[95] These measures were previously proposed by Frank Rose during his tenure as the Assistant Secretary of State for Arms Control, Verification, and Compliance; see also Caitlin Talmadge, "The US-China Nuclear Relationship: Why Competition is Likely to Intensify," Brookings Institute Publication, September 2019, 9; Nina Tannenwald, "Life After Arms Control: Moving Toward a Global Regime and Restraint and Responsibility," *Daedalus*, Vol. 149, No. 2, Spring 2020, 215.

for a mutually beneficial agreement on certain "non-deployment" zones for specific offensive and defensive systems to avoid undermining China's nuclear deterrent or U.S. extended deterrence guarantees.[96]

- **Feasibility:** The basic steps to make Approach 3 a reality are possible based on historic precedents. The United States and Russia have a history of mutual restraint and political pledges that could be repeated to initiate a new, post-New START regime. Vladimir Putin has indicated a willingness for bilateral discussions to support continued communication and risk reduction steps on nuclear and cyber-related issues.[97] Russia has also outlined potential categories related to reducing risk in space-based activities.[98] Admittedly, such offers typically come with additional expectations that serve the Kremlin's ends or ignores Russia's own provocative military activities, but the concept indicates the potential for further bilateral work in this area.

  Whether or not both the United States and Russia would continue the required mutual restraint to retain the parity currently defined by New START is less clear. Although the mutual steps undertaken by Bush and Gorbachev during the PNIs of 1991 and 1992 provide some precedent, the strategic context today is much different than in the immediate aftermath of the Soviet Union's collapse. These differences may make mutual restraint or interest in politically binding agreements less likely today. The lack of verification measures, which would cease after New START without a ratified replacement, would also undermine incentives for mutual restraint. However, some combination of continued non-interference in

[96] Christian Alwardt, "US Missile Defence Efforts and Chinese Reservations in East Asia," *Asian Affairs*, Vol. 51, No. 3, September 2020, 605-620.
[97] Kremlin transcript, *Statement by President of Russia Vladimir Putin on a comprehensive program of measures for restoring the Russia – US cooperation in the filed of international information security*, September 25, 2020, http://en.kremlin.ru/events/president/-news/64086, accessed November 6, 2020.
[98] Hitchens, 19-20.

NTMs and use of new commercially available or open-source or crowd-sourced measures could help fill this gap and support this new post-New START regime.[99] Additional domestic and budget concerns, pressuring both Washington and Moscow, could also motivate these governments to limit deployed strategic forces at similar levels to today.

Collaboration with China presents greater challenges, yet outreach from Washington could play into Beijing's pursuit of acknowledged global power status..[100] China may also see the mutual benefit in cooperation to help manage crises and avoid escalation, particularly if similar U.S.-Russian efforts were already well underway.[101] The joint U.S.-Russian restraint on INF-like forces could also help foster interest in dealing with both Washington and Moscow to avoid a regional arms buildup in Beijing's backyard.[102] China's stance on arms control could also quickly change if directed from the Communist Party leadership or General Secretary.

Other questions remain regarding the long-term sustainability of these types of agreements. The complicated history of the Joint Comprehensive Plan of Action (JCPOA), a politically binding deal struck to restrain Iran's nuclear program, illustrates how non-ratified agreements could come under duress as U.S. presidential administrations change hands between opposing political parties. Presumably, the long-lasting autocratic regimes in Russia and China would not face this problem, but the immense influence of a single leader like Vladimir Putin or Xi Jinping implies that future deals could be made at their behest. Such flexible regimes could survive these potential hurdles if they contained sufficient benefits to appeal to as many detractors as possible, motivating continued engagement and restraint.

---

[99] Gottemoeller, 152-155. Note that National Technical Means is a term that came into usage during U.S.-Soviet discussions leading up to the ABM treaty and refers to intelligence satellites.
[100] Li Bin, "Chinese Thinking on Nuclear Weapons," *Arms Control Today*, Vol. 45, No. 10, December 2015, 6-7.
[101] Ankit Panda, "The United States, China, and the Future of Arms Control", The Diplomat, July 8, 2020. https://thediplomat.com/2020/07/the-united-states-china-and-the-future-of-arms-control/, accessed November 10, 2020.
[102] Gottemoeller, 147-149.

Estimated Force Postures: This approach is aimed at tackling a more expansive set of non-strategic nuclear issues and thus could have minimal impacts on future strategic force postures. The presumed mutual restraint for the United States and Russia would maintain forces at similar levels to those projected under Approach 1 and summarized in Tables 1 and 2. China's forces would not be subject to any limits and would be predicted to evolve to similar levels shown on Table 3, acknowledging the major uncertainty for any estimates of deliberately ambiguous Chinese nuclear program details.

Approach 4 "Pursue nuclear superiority"

- **Strategy:** Under this approach, the United States would pursue the proposed benefits of strategic nuclear superiority with a more robust force structure. A benchmark for such an approach could be to achieve credible counterforce targeting against combined threats from Russia, China, and North Korea; the number of estimated deployed warheads to meet this goal at present would be about 2,300.[103] The budget impacts of such an approach would vary widely depending on the scope of increased forces and weapons programs. For illustrative purposes, a mix of potential choices under this approach will be considered. Potentially significant increases in missile defense and space-based programs will be considered in addition to larger deployed strategic nuclear forces.
- **Assumptions:** New START would not be replaced after 2026. Barriers to a legally binding agreement, combined with Russian violations of previous agreements and deepening tensions between great powers, are assumed to promote sufficient U.S. domestic support for this new

[103] Kroenig, 198-205.

treaty-less paradigm. Additional funds would have to be appropriated or re-prioritized to support expanded weapon development and deployment plans.

- **Conditions:** Minimal changes would be likely in the near term due to budget and planning constraints, but the United States and Russia both make modest increases after 2026 in daily deployed strategic and non-strategic nuclear forces based on currently available warheads and launchers. Current triad modernization plans would continue, augmented by maximizing available ICBM silos and warhead loads on ICBMs and SLBMs. Washington would also pursue other qualitative advantages in submarine- and ground-launched cruise missiles, hypersonics, and ISR. The United States would also field expanded missile defense capabilities, including additional Ground Based Interceptor (GBI) silos at Ft. Greely, an additional continental U.S. ABM site located somewhere like Ft. Drum, and additional Theater High Altitude Area Defense (THAAD) deployments.

To present a full range of options, and corresponding budget impacts, more elaborate and technologically challenging programs such as an air launched boost phase interceptor and constellation of space-based interceptors are also considered. These more exquisite options vary widely in terms of technical feasibility and costs. The air-launched interceptors, for example, could be paired with either 4th or 5th generation aircraft for intermittent patrols with existing fleets, or have dedicated F-35s for more persistent defense capabilities.[104] The options for a space-based systems vary even more widely; some estimates predict a limited constellation of roughly 24 satellites could provide some kind of partial boost phase intercept coverage, while global coverage could demand up to 960 satellites.[105] Technical and political

[104] Congressional Budget Office, *Costs of Implementing Recommendations of the 2019 Missile Defense Review*, Congressional Budget Office Publication 56949, January 2020, 15-16
[105] CBO Publication 56949, 15-16.

hurdles to these space systems would likely be significant, even for the longer horizon (2031-2036) considered in this paper.

- **Feasibility**: Approach 4 presents a hypothetical future that some may view as a radical departure from the decades-old practice of nuclear arms control between the two major powers. In the U.S. domestic context, the "grand bargain" that approved a major triad modernization was reached with bipartisan support in the context of a continued commitment to arms control.[106] Turning away from arms control could thus undermine previous bipartisan support for U.S. nuclear plans. Internationally, multiple U.S. allies have similar stances, exchanging their support for specific nuclear policies with the understanding that arms control agreements will also be a critical part of limiting overall nuclear risks. The public reaction from allies like Germany could force influential partners to also push back against this new direction in U.S. policy.

  From another perspective, however, this approach is a pragmatic or even likely extension of the current trend that has seen the ABM and INF Treaties unravel. A realistic appraisal of the increased tensions between the great powers could lead to the conclusion that important arms control conditions may not be enforceable or could be too constraining for the United States to adequately address global security concerns from both near-peer and asymmetric threats.[107]

- **Estimated Force Postures:** Tables 7 and 8 on the following pages and the associated notes summarize potential strategic force posture changes in a world unconstrained by a binding U.S.-Russian agreement. Given the timeframe for this study, which extends to 2036,

[106] Kaplan, 242-243 and 247-248.
[107] Steven E. Miller, "A Nuclear World Transformed: The Rise of Multilateral Disorder," *Daedalus*, Vol. 149, No. 2, Spring 2020, 35.

significantly diverging postures from today would not be fully possible due to the time required to develop and field new weapons systems. The approximate force postures mostly make use of available systems and warheads, some refurbished and put back into service after being in storage, and additional modifications maximizing the capacity of currently fielded strategic launchers. The most dramatic changes could take place outside of strategic weapons. Potential changes in Russia's NSNW posture, easily achievable based on its large arsenal currently in storage, are not specifically shown but are considered against the analytical criteria. Potential U.S. advances in BMD, precision strike, and other non-nuclear strategic technologies are similarly discussed but are not explicitly shown. Despite potential impacts to China's modernization plans, this study assumes Beijing would continue on a trajectory like that shown in Table 3 in the case of Approach 4 but could accelerate or augment its plans.

Table 7 – Approximate U.S. deployed force structure: Approach 4 "Pursue nuclear superiority"

Time Frame: 2026-2031	Total Launchers	Deployed Launchers	Deployed Warheads	Time Frame: 2031-2036	Total Launchers	Deployed Launchers	Deployed Warheads
ICBMs	450	450	800-1100	ICBMs	450	450	800-1100
SLBMs	240	200	1000-1200	SLBMs	212	212	1060-1272
Strategic Bombers	66	Up to 55	Up to 55	Strategic Bombers	96	Up to 80	Up to 80
Total	788	788	1955-2355	Total	798	720	1950-2462

Notes for Table 7:

- Changes in the near-term include reactivating four launch tubes on the Ohio-class SSBNs and re-deployment of up to all 50 ICBMs currently in storage.[108] For 2031-2036, updated changes are again based on Manzo and include converting 30 conventional B-52 bombers back to nuclear status.[109] Estimates in specific weapons categories are based on the following details:
- SSBNs:

  2026-2031 – According to the Navy's latest projections, the SSBN force will decline to 12 boats in FY2029 due to Ohio-retirements prior to the 1st Columbia delivery, scheduled for 2031.[110] The estimated force structure reflects 10 boats remaining operational with a range of potential increased total warhead deployments by varying average warhead loads per SLBM from 5.0 to 6.0.

  2031-2036 – The projected reduction in overall fleet size due to the Ohio to Columbia transition (predicted to reduce the entire SSBN fleet to 11 boats) is mitigated by accelerating the planned procurement for the second or third SSBN sometime FY24-FY26.[111] The deployed forces are assumed to comprise all 7 Columbia-class and 5 Ohio-class SSBNs. A range of warhead deployments is again shown with augmented force postures averaging between 5.0 and 6.0 warheads per SLBM.
- ICBMs:

  2026-2031 – The 50 non-operational/vacant silos are put back into operational status and ICBMs are armed with multiple warheads using the total available stockpile of 600 W78 and 200 W87 warheads; the higher numbers indicate an additional increase over the "unconstrained" posture described in Manzo by returning a large number of the 340 W87s currently in storage back into service.[112]

  2031-2036 – ICBM forces remain similar to the increased 2026-2031 levels; GBSD missiles are assumed to replace Minuteman III's at a one-to-one basis.
- Bombers: Some combination of reconfiguring B-52H bombers (30 aircraft are currently in service which were previously converted to conventional status as part of New START) and replacing B-2s with nuclear-capable B-21s is undertaken to increase the fleet by 30 launchers.

[108] Manzo, 51-53; Kristensen and Korda, "United States," 46-48.
[109] Manzo, ibid.
[110] Congressional Research Service, CRS41129, 6-7.
[111] Ibid.
[112] Manzo, ibid.; Kristensen and Korda, ibid.

Table 8 – Approximate Russian deployed force structure: Approach 4 "Pursue nuclear superiority"

Time Frame: 2026-2031	Deployed Launchers	Deployed Warheads	Time Frame: 2031-2036	Deployed Launchers	Deployed Warheads
ICBMs	302	1226	ICBMs	300 - 350	1226 - 1476
SLBMs	Up to 160	600-720	SLBMs	Up to 160	600-720
Strategic Bombers	55	55	Strategic Bombers	60	60
Total	517	1881-2001	Total	520+	1886 - 2256

Notes for Table 8:

- Changes in the near-term follow Manzo and include maximizing ICBM warhead loading, a modest increase in SLBM warhead loads and deployment of additional Borei-class SSBNs.[113] For 2031-2036, the lower bound reflects changes again based on Manzo noting continued increases to deployed SLBM warheads (up to 720 based on current arsenal estimates) as well as making more bombers in the inventory operationally ready.[114]

- The upper bound in 2031-2036 considers an extra 50 ICBM launchers mixing single-warhead and multiple warhead systems for a total increase in approximately 250. The additional ICBMs are based on Kristensen and Korda, which quotes a Russian official stating a total of 400 ICBM launchers were available, likely referring to the total inventory. The numbers here assume some fraction of these 400 are not deployed for maintenance and sparing.[115]

[113] Manzo, 52-54.
[114] Manzo, 52-54.
[115] Kristensen and Korda, "Russian," 105-106.

Analysis and Results

An evaluation of each approach against the five criteria is summarized below. Due to the qualitative nature of this exercise, different perspectives, theoretical frameworks, or assumptions could lead to different conclusions. Potential points of contention and important caveats that highlight these different perspectives are noted throughout the discussion to provide as balanced of a consideration as possible. Tables 9 – 12 provide a summary and additional details of the analysis results for each approach. Table 13 presents AWSM comparisons of total arriving warheads in hypothetical strategic force exchanges between the United States and Russia under the assumed force structures in each arms control approach. This information provides some additional quantitative perspective to help shape the results, particularly Strategic Stability and Extended Deterrence considerations.[116] The overall results from this exercise are summarized in the Conclusion in Table 15.

Approach 1 "Bilateral strategic arms limitations"

- **Summary:** This approach presents one of the more politically feasible paths and maintains strategic stability with Russia as currently understood. However, continued adherence to a New START-like paradigm potentially fails to address other important considerations, including worrying trends related to other technologies, nuclear-conventional entanglement and China's expanding and modernizing arsenal.
- **Strategic Stability – Positive.** As designed, the focus of this approach on maintaining existing bilateral strategic stability with Russia would likely hold the line on this criterion as currently defined. Additionally, the verifiable warhead freeze and increased transparency on Russian

[116] As a reminder, for continuity with previous studies, the force postures for Approach 1 and Approach 2 closely follow cases presented by Cimbala, *Nuclear Deterrence* and "Nuclear Arms Control." The AWSM results for this paper match results from these two studies in these similar cases.

NSNWs (exchanged for similar measures on the EPAA BMD systems in Europe) would improve on noted shortcomings with New START. The continued incorporation of data exchanges and accountability for new strategic systems would also maintain or even improve stability in the years ahead, helping to mitigate future arms race issues related to future weapons with strategic range. The AWSM results support this status quo approach; under a potential worst-case strategic exchange with Russia, where the United States is in a typical "day-to-day" force posture and elects to "ride out" the attack, the arriving U.S. warheads in retaliation would number just under 700 (see Table 13), indicating a secure second strike capability.[117] Assuming that the current situation is "neutral" as a baseline, the continued maintenance of stability through a secure second strike, the verifiable warhead freeze and incorporation of some considerations for NSNWs warrant a "positive" rating.

Caveats to this "positive" rating are based on two principal issues – the role of China in future strategic stability considerations and the impact of continued developments of non-nuclear technologies. These caveats are discussed in more detail in the Conclusions, which notes how these dynamic areas could impact traditional notions of secure, second strike capability and arms race or crisis stability. A key takeaway is that there are considerations for strategic stability in a changing and multipolar world that current working definitions may not fully address as the United States, for the first time in history, competes concurrently with two potential near peer nuclear powers. The "positive" rating for this approach is, by definition, grounded in a more traditional perspective on stability. However, the two important caveats underscore that more creative deliberation on this topic is likely necessary. Other impacts from

[117] See also, Cimbala, *Nuclear Deterrence*, 72-78 and "Nuclear Arms Control," 100-105.

these types of considerations will also be weighed under Extended Deterrence and Global Competition categories.

- **Extended Deterrence – Neutral.** For European allies, the new transparency on Russian NSNWs would positively impact regional stability and extended deterrence. However, the caveats related to non-nuclear technologies indicate these benefits could be negated by other concerns. Specifically, Approach 1 would not address pressures on stability from non-nuclear technologies and potential escalation pathways between NATO and Russia stemming from "grey zone" operations or actions in cyberspace.[118] The U.S.-Russian collaboration required to make Approach 1 a reality would offset some of the risks in this regard, but the overall trend would likely be more tenuous than in the present due to growing reliance on cyber and space domains and continued introduction of new technologies through 2036 that would not be captured under the more narrow construct of this New START-like regime.

  Meanwhile, U.S. allies in East Asia could face increased security dilemmas based on China's nuclear and conventional force increases (see Table 3). Since this approach does nothing to improve communication or risk-mitigation paths between Washington and Beijing, any increases in China's forces could prompt similar changes in the U.S. footprint in the region to continue to reassure allies. Such a scenario could degrade U.S.-Chinese great power relations or initiate a tense action-reaction cycle. Conversely, the stability provided by this regime could help the United States better focus on regional deterrence against China, even though the approach itself does nothing to change the current dynamic between these nations. These potential issues with Russia and China offset the notable gains otherwise accomplished

[118] George Koblentz, "Strategic Stability in the Second Nuclear Age," Council on Foreign Relations Report, November 2014, 3-5, 37; North Atlantic Treaty Organization, "Warsaw Summit Communique," Press Release, July 9, 2016, https://www.nato.int/cps/en/natohq/official_texts_133169.htm.

under Approach 1, indicating a "neutral" rating is a reasonable compromise between competing factors.

- **Proliferation – Neutral.** As with Extended Deterrence, Approach 1 would lead to competing positive and negative effects on proliferation. On the positive side of the ledger, continued, legally binding limits on the top two nuclear powers – boosted by a new freeze on total stockpiles – would support NPT Article VI.[119] U.S.-Russian collaboration in this Approach could also foster teamwork to restrain other proliferators as with the recent JCPOA. The negative impacts again would primarily result from China's nuclear program. If China's forces grow under the predicted trajectory (Table 3), or indeed if Beijing undertakes a more aggressive nuclear program, then India would likely to augment its nuclear programs, for example. This would prompt secondary effects in Pakistan, for example, increasing proliferation risks across Asia.[120] This mix of positive and negative steps in supporting non-proliferation again indicates no real net change from today's status quo and a "neutral" rating.
- **Cost – Neutral.** At face value, this approach would have no major deviations from projected U.S. modernization plans, substantiating a "neutral" change by default. The CBO reports that a combination of improving estimates for maturing DoD and DoE programs and historical cost increases on analogous weapons efforts could increase the nuclear budget by $62B (or 14%) through 2028.[121] Projecting out over the timespan considered in this study, these increasing cost trends could be exacerbated as major milestones for GBSD are met, DoE infrastructure and warhead programs mature, and Columbia SSBNs and B-21 bombers enter production and fielding. However, these cost increases would not result from this arms control approach

[119] Brooks, 90.
[120] See, for example, Koblentz, 27-30.
[121] Congressional Budget Office, *Projected Costs of U.S. Nuclear Forces 2019-2028*, Congressional Budget Office Report 54914, January 2019, https://www.cbo.gov/system/-files/2019-01/54914-NuclearForces.pdf, 1, 6-8, 12.

specifically, and are more of a general risk associated with any large DoD program. The baseline "neutral" rating is thus warranted in this case.

- **Competitive Advantage – Negative to Neutral.** Although the impacts from unchecked Chinese defense programs and continued advances in non-nuclear technologies are difficult to predict for strategic stability, these factors are likely to increase the intensity of overall geopolitical competition. This type of competition could favor China given current economic trends and the relative resources at Beijing's disposal to augment its regional capabilities. If U.S. nuclear modernization programs continue projected cost over-runs, Washington would be further limited in allocating resources to compete equally in important non-nuclear technologies. Under this approach, some U.S.-Russian competition could be blunted due to continued mutual engagement on strategic limitations. However, Russia would still be likely to find other ways to combat U.S. technological superiority through its suite of exotic programs, like the *Burestevnik* cruise missile or *Poseidon* nuclear-unmanned submersible, while carrying on destabilizing trends in cyberspace and "grey zone" activities. These efforts from Russia could erode U.S. advantages in traditional domains or at least put additional pressures on the America as it competes multilaterally. Assuming no significant improvements in U.S. economic growth over recent, more turbulent cycles, it is difficult to see how the overall contours of competition would improve under an approach that essentially tries to maintain the status quo in the face of increasing competitive pressures for a "negative" relative change.

  One caveat is that the United States could potentially take advantage of these trends for positive outcomes. For example, U.S.-Russian cooperation on strategic arsenals and the growing threat from China could be leveraged to defuse additional bilateral U.S.-Russia tensions in other areas, opening ways to collaborate better to constrain or pressure China.

Additionally, the case could be made that an extended New START like regime would provide a foundation to provide transparency on, or even limit, some of the Russian systems that are currently not accountable. These developments would at least maintain the status quo in this era of great power competition for an upper bound "neutral" rating.

Table 9 – Analysis summary for Approach 1 "Bilateral strategic arms limitations"

Approach	Strategic Stability	Extended Deterrence	Proliferation	Cost	Competitive Advantage	Political Feasibility
Approach 1: Bilateral strategic arms limitations	**Positive**	**Neutral**	**Neutral**	**Neutral**	**Neutral** / **Negative**	**Likely**
Summary & Justification	- Focuses on maintaining strategic stability and accountability for new strategic systems as understood today - Verifiable warhead freeze and measures for Russian NSNW improve on status quo - Net positive, but impact of China and non-nuclear tech trends TBD	- New transparency on Russian NSNW improves extended deterrence for NATO and European allies - No check on China's military and nuclear modernization stress stability and deterrence in E. Asia - Non-nuclear strategic competition increases escalation pathways	- New US-Russian agreement supports NPT Article VI - China's growing arsenal has secondary impacts in India and then Pakistan - Net neutral change	- Neutral rating as defined; no deviations from current modernization plans - Trends and analogies to similar programs indicate potential for cost growth independent of this arms control approach	- China defense programs and relative resources for regional capability improvements indicate negative impacts to US advantage - Potential for improvement if US-Russia cooperation used to better constrain China - Extending current bilateral regime with Russia could maintain status quo	- Narrow, New START-like treaty is most feasible path to ratification - Provides trade space on priority issues for US and Russia - Management of US partisan issues and positions key

Approach 2 "Long term multilateral reductions"

- **Summary:** Approach 2 would be difficult to achieve without a breakthrough in international relations, but the proposed two-step process provides a possible pathway. Without assuming the more benign security environment required to make this approach a reality, the resulting arms control outcomes would result in negative changes across evaluated criteria. Specifically, the vast reductions in the U.S. nuclear forces would present risks to Strategic Stability and

Extended Deterrence, while the focus on nuclear arsenals may not adequately address new technologies in a way that positively affects U.S. Competitive Advantage

- **Strategic Stability – Negative to Neutral.** Approach 2 retains U.S.-Russian stability while bringing China into an official framework.[122] Strategic exchange calculations show a secure second-strike capability remains for both the United States and Russia with little relative change from the percentage of arriving forces compared to today's New START-limited regime (Tables 13 and 14), supporting a "neutral rating." One possible destabilizing trend can be considered under Russia's worst-case scenario (day-to-day forces and electing to "ride out" the attack under the 500 warhead limit), in which "only" 39 warheads would reach targets in the United States. At this low number, Moscow could argue that U.S. BMD systems and conventional prompt strike capabilities present a destabilizing "splendid" first strike capability. The potential erosion of Russia's second-strike capability could also foster a "use them or lose them" scenario in a major crisis.

From the U.S. perspective, the vastly reduced warheads could also generate vulnerabilities beyond the primary U.S.-Russian dynamic from China or rogue regimes. USSTRATCOM leaders have highlighted the command has built in "margin" at New START levels for deterrence beyond bilateral competition; at a 500-warhead limit and facing both Russian and Chinese arsenals with rough numerical parity, this margin would clearly be severely challenged.[123] These considerations warrant the inclusion of a "negative" lower bound.

Hypothetically the new geopolitical environment required to foster such a multilateral treaty regime would be characterized by reduced risks of conflict, supporting strategic stability

[122] Estimated first- and second-strike responses under a range of deployed forces at limits similar to those proposed in Approach 3 show that in all cases nations would have a secure second-strike capability; see Stephen J. Cimbala, *Nuclear* Deterrence, 89-93.
[123] U.S. Strategic Command, Adm. Richard interview with the Mitchell Institute.

in a more holistic sense despite these smaller nuclear force margins. Looking beyond strategic stability, this theorized regime would strongly reduce the incentive for arms racing if the parties abide by the agreement's conditions. Assuming Russia continues to view strategic stability as a barometer reflecting bilateral relations, Moscow could see the limits under Approach 2 as being positive changes if accompanied by increased détente with Washington. However, these considerations violate the methodology of this study, which focuses on comparing potential impacts relative to today's status quo resulting from each arms control approach. These more holistic considerations will be considered in the Conclusion but are beyond the bounds of this methodology and should not be used to adjudicate the potential impacts. The overall relative changes to strategic stability directly related to Approach 2 thus range from "neutral" to "negative."

- **Extended Deterrence – Negative.** The reduced role of nuclear weapons and collaboration with potential adversaries are steps in Approach 2 that could reassure allies and reduce risks to extended deterrence. In comparison with the contemporary status quo, however, the degraded ability of the U.S. to concurrently deter Russia and China would generate concerns from allies about the credibility or effectiveness of U.S. deterrence guarantees. The United States could make up for these concerns with expanded conventional force deployments. Yet such an increased American footprint could also spur additional tensions or escalation possibilities, again damaging extended deterrence in a self-fulfilling security dilemma. From today's perspective, these concerns would be severe enough to warrant a solidly "negative" rating regarding the perception of U.S. extended deterrence capabilities.
- **Proliferation – Neutral.** The major reductions in U.S. and Russian arsenals and caps on other P5 nations could heavily dampen some proliferation pressures. The necessary multilateral

cooperation for this Approach could also open additional pathways to address proliferation threats in North Korea and Iran. This regime would also significantly bolster the NPT for continued multinational non-proliferation cooperation. However, if extended deterrence were perceived to be weaker due to the relatively reduced margins of U.S. nuclear forces, latent powers could proliferate in order to secure their own stability. These competing trends would likely cancel each other out for a tenuous "neutral" rating compared to proliferation threats today.

- **Cost – Neutral to Positive.** As summarized in Table 4, a potential force structure under the major reductions in Approach 2 would still field a triad but would draw down U.S. ICBMs. Ignoring some of the costs required for decommissioning silos and missiles, the initial phase for this approach (2026-2031; a 1000 deployed warhead limit with 300 ICBMs) would result in an average annual savings of $500M in the mid-2020s, growing to $4.4B later in the decade even without reducing planned GBSD purchases at that time.[124] Around this same time, Washington could also cancel the last two planned Columbia SSBN purchases, saving an additional $21B, spread over several years.[125] In the second phase (2031-2036; a 500 deployed warhead limit with 115 ICBMs), these savings would increase as ICBMs continue to be retired and savings from operating and sustaining a smaller triad are realized. Looking at CBO predictions of annual costs – which are broken down by operations, sustainment, and modernization – and scaling the first two categories down by the new relative force sizes,

[124] Congressional Budget Office, "Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046," Congressional Budget Office Publication 53211, October 2017, 46-49. The larger number results from combined savings of retiring legacy systems and a smaller purchase of new GBSD missiles. Note that the costs for decommissioning are much lower than the annual savings amounts quoted here. For example, the Air Force estimated that removing missiles from silos and putting them into storage costed $20M between 2014 to 2018, see Congressional Budget Office, "The Potential Costs of Expanding U.S. Strategic Nuclear Forces if the New START Treaty Expires," Congressional Budget Office Publication 56475, August 2020, 13.
[125] CBO Publication 53211, 40. 54914

additional savings would add up to approximately $800M annually for SSBNs and $1.1B annually for ICBMs.[126] By that point, the GBSD purchases would also be curtailed. This reduction would not affect the budget allocated for research, development, initial production, and some non-recurring DoE costs. These GBSD savings can be roughly estimated by multiplying the average unit costs of $53M per missile against a decrease of roughly 450 planned purchases for an additional $23.8B savings spread out over the early 2030s.[127]

The CBO estimated total nuclear budget over the two phases considered in this study is approximately $240B (2026-2031) and $254B (2031-2036). Combining all the savings outlined above, the total over entire 10-year period is roughly $80B or just over 16% of the $494B total. Although these rough estimates indicate a "positive" cost impact for Approach 2, Washington could instead be forced to dramatically increase spending on conventional forces to make up for any instability resulting from nuclear force reductions. The budget impacts in this regard are difficult to estimate, but could offset any cost savings for a lower bound "neutral" rating.

- **Competitive Advantage – Neutral to Positive.** Even with a more benign geopolitical environment in Approach 2, competition in non-nuclear technologies would certainly continue. Cost savings from nuclear program cuts could ensure the United States is better positioned to maintain competitive advantage by increasing funds for key non-nuclear technologies. There is also a strong constructivist argument that U.S. leadership in achieving this new multilateral arms control regime could increase its prestige and strengthen America's ability to compete in

[126] CBO Publication 54914, 3 and supplemental data. The quoted amounts are similar to other independent calculations which reviewed costs through 2046; see Kingston Reif and Alicia Sanders-Zakre, "U.S. Nuclear Excess: Understanding the Costs, Risks, and Alternatives," Arms Control Association Report, April 2019, 34-36.
[127] CBO Publication 53211, 40, 53-55. The 450-missile decrease is estimated by scaling the planned purchase – 642 missiles to support a total active force of 450 silos per New START limits or a ratio of 1.4 – down to match the 130-missile force proposed under Approach 2 and maintaining the same ratio for a new planned lifetime buy of roughly 185 missiles.

reinvigorated alliances and international institutions. This type of benefit is difficult to gauge and would require deft diplomatic leadership beyond the scope of this analytical methodology in this study. More pragmatic security concerns, discussed in Strategic Stability and Extended Deterrence above, could overwhelm these positive developments in any case. These complicated resulting dynamics offer mixed impacts, but assuming the United States can better capitalize on reduced nuclear competition and international prestige, impacts ranging from "neutral" to "positive" are logical.

Table 10 – Analysis summary for Approach 2 "Long term multilateral reductions"

Approach	Strategic Stability	Extended Deterrence	Proliferation	Cost	Competitive Advantage	Political Feasibility
Approach 2: Long term multi-lateral reductions	Neutral / Negative	Negative	Neutral	Positive / Neutral	Positive / Neutral	Unlikely
Summary & Justification	- Secure second-strike capability even at 500 warhead limit - Degraded margins vs. Russia and China concurrently would be an issue; low margins for any side could incentivize "use them or lose them" thinking in a crisis	- Degraded margins vs. Russia and China could cause Allies concern on extended deterrence capabilities and U.S. credibility	- Significant, multilateral weapons reductions would strengthen NPT - Some regional proliferation concerns remain, potential new latent proliferators in response to degraded extended deterrence	- Reduction in ICBM force, GBSD purchases and SSBN numbers result in production and operations cost savings - Est. $80B savings over 10-year period out of current $494B planned budget - Potential for increased conventional programs could offset nuclear cost savings	- US potentially better positioned to maintain competitive advantage thru nuclear program cost savings, though competitors would have similar savings - Positive change from status quo	- Major breakthrough in international relations likely needed - Proposed 2-step process describes a potential path with multilateral effort - Environment needed to make approach possible indicates reduced great power competition likely

Approach 3 "Bilateral non-ratified frameworks"

- **Summary:** This approach would side-step some of the political obstacles to a fully ratified treaty and provide flexibility for the United States to adjust programs and force postures in response to changing international dynamics. The conditions for Approach 3 would aim to

provide transparency to support mutual restraint on strategic nuclear forces while also expanding dialogues on non-nuclear technologies. This improved dialogue could address significant issues that are not typically covered under more orthodox strategic stability frameworks. Risks abound without the backing of a legally binding regime, but these could be somewhat offset by the flexibility U.S. leaders would have to respond in kind to any negative developments from Russia or China.

- **Strategic Stability – *Neutral** to *Positive*.*** As defined, Approach 3 presumes there would be some mutual interest between the United States and Russia to maintain parity at approximate New START limits. Even without a formal verification framework, mutual interest in strategic risk reduction, NPT commitments, or cost savings could make continued maintenance of roughly New START levels possible. Even if this proves untrue, both sides would still have interest in keeping up communication channels that could be leveraged to preserve some degree of strategic stability and avoid any major force posture changes. These channels could be used to set up a range of potential exchanges, including additional pre-notification standards, remote emulation of inspections via NTMs, aggregate force level declarations, or more in-depth data transfers to strengthen mutual restraint despite the lack of more thorough inspections.[128] Emerging technologies and publicly available information could also offer creative ways to support this new post-verification regime as well.[129] Taking a page from the PNI precedent or the interim restraint policy employed during SALT II discussions, U.S. and Russian leaders could work on executive agreements, public pronouncements, or a non-denial pledges to mitigate risks of arms racing in a post-New

[128] Manzo, 68-78.
[129] Gottemoeller, 149-155.

START world.[130] If these non-treaty measures proved insufficient for maintaining parity or stability, the United States would retain the ability and the freedom to respond accordingly, thus hedging against risks to upholding a secure second strike capability.

Approach 3 is also designed to mitigate risks in other areas not explicitly covered under traditional strategic stability definitions. The conditions summarized in Table A.3 list a range of risk reduction measures that would be pursued under the more flexible framework, targeting areas such as space, cyberspace, and NC3. Increased dialogue on these strategic but non-nuclear technology could help mitigate a destabilizing arms race while addressing risks and escalation in new areas.

The flexibility in this approach is also intended to finally bring China into bilateral discussions with the United States, further reducing tensions that could otherwise affect both regional and strategic stability. Given that the United States has never had to concurrently deter two near-peer nuclear rivals, any sort of opening to build discussion channels or actual arms control agreements with China could prove to be positive developments. Arms control proved to be useful in avoiding risks and channeling competition during the ebbs and flows of the multi-decade relations with the Soviet Union and Russia, and thus may prove critical in this dynamic new era. Overall, the impacts from Approach 3 are more ambiguous to estimate through more traditional strategic stability considerations as used in this paper, but the continued dialogues with Russia, expanded relations with China, and flexibility to respond to any major changes in the strategic landscape imply this approach would do no worse than maintaining today's status quo for a "neutral" rating while offering benefits that could prove "positive" as well. These ratings are noted with a relative "asterisk" to acknowledge the

[130] Manzo, 72-81.

assumptions regarding mutual U.S.-Russian restraint around New START levels, which although plausible, still go beyond specific assumptions that impact the other analyzed approaches.

- **Extended Deterrence – Neutral to Positive.** Assuming the U.S. and Russia adhere to the spirit of the agreement regarding strategic forces, this approach would offer increased transparency on non-nuclear strategic technologies for both Russia and China and remove ambiguity to help clarify escalation pathways. The net effect on extended deterrence from these new bilateral U.S.-Russia and U.S.-China dialogues could prove a "positive" development. Conversely, relying on mutual restraint to maintain the overall stability currently provided by New START entails some risks – noted in the previous section – that allies could see as a negative trend. These impacts offset for a lower bound "neutral" impact.
- **Proliferation – Negative to Neutral.** Executive agreements and ongoing dialogues to aid mutual U.S.-Russian restraint would minimize certain proliferation risks, but these may not be enough to fully support NPT Article VI commitments without a legally binding regime. The expanded discussions on non-nuclear technologies, though important for overall escalation management, would similarly have limited impacts on the NPT regime or other regional proliferation issues. Although the new framework proposed under Approach 3 could positively affect the calculus of latent powers allied with the United States, this treaty regime would be more limited in influencing other potential proliferators in Southwest Asia or the Middle East. Without a binding treaty securing U.S.-Russian cooperation, multilateral steps to address other proliferators could also be limited. The net effect would likely be "neutral" but some of these impacts warrant a "negative" consideration as a realistic floor.

- **Cost – Neutral to Negative.** Similar to Approach 1, there would be no major deviations from projected U.S. modernization plans, keeping these costs "neutral." In the case where mutual restraint and the proposed additional measures proved unsuccessful at fully blunting an arms race, the United States could pursue its own additional forces as appropriate with potentially increased budget impacts. The lack of a thorough verification regime, which would expire in this scenario along with New START, could require increased spending on intelligence collection and analysis.[131] These potential changes are difficult to quantify, but the overall potential for increased spending in these areas indicate Approach 3 could have a "neutral" to "negative" effect on defense costs.
- **Competitive Advantage – Neutral to Positive.** The transparency measures and dialogue on non-nuclear technologies could play an important role in managing competition in these areas and help rein in multi-domain competition. This approach also enables new discussions in the case of the U.S.-Russia dynamic and an entirely new framework in general for U.S.-China relations. These connections could foster a positive working relationship that would dampen competition or build pathways for new legally binding agreements. Noting the potentially significant caveats and risks in a regime that lacks full legal ratification, if even a handful of the major conditions proposed under Approach 3 (see Table A.3 and A.4) are adhered to, the result would have "positive" changes in the velocity and direction of great power competition. The inclusion of a "neutral" lower bound acknowledges the significance of these caveats and risk potential.

[131] Manzo, 41-43.

Table 11 – Analysis summary for Approach 3 "Bilateral non-ratified frameworks"

Approach	Strategic Stability	Extended Deterrence	Proliferation	Cost	Competitive Advantage	Political Feasibility
Approach 3: Bilateral non-ratified frameworks	*Positive** / *Neutral**	Positive / Neutral	Neutral / Negative	Neutral / Negative	Positive / Neutral	Likely / Less Likely
Summary & Justification	- Mutual restraint and political pledges required to maintain stability and rough parity at current levels - Many potential paths to mitigate risks of imbalance; US would have the flexibility to respond in kind in case of Russian violations / hedging - New dialogues w/ China potentially beneficial	- Additional transparency and discussions on strategic non-nuclear pathways could reduce risks more relevant to regional escalation - Frameworks with both Russia and China would benefit allies in both hemispheres - Reliance on mutual restraint could negate some benefits	- Lack of ratified treaty not enough to fully support NPT commitments - Limited impact or influence on other proliferation pressures in Southwest Asia or Middle East	- Future budget impacts would be highly dependent on new strategic situation - Potential for no deviations from current plans, costs may increase based on projected trends - Increased budget pressures if mutual restraint falters or for additional intel to compensate for end of verification regime	- New transparency and dialogue on non-nuclear strategic technologies could help manage competition in these areas - Lack of ratified / legal commitment could limit impacts - Potential positive changes with enough risks to warrant "neutral" lower bound	- Basic steps for US-Russia bilateral framework possible, mutual restraint for strategic stability debatable - Larger questions for US-China agreement, but potential way forward based on mutual risk reduction

Approach 4 "Pursue nuclear superiority"

- **Summary:** If geopolitical tensions continue to worsen and obstacles to a ratified treaty remain, there could be pressures for augmented strategic competition proposed under Approach 4. This approach would undoubtedly increase costs while potentially undermining key aspects of Strategic Stability, Extended Deterrence and Non-Proliferation. The outcome regarding U.S. Competitive Advantage would likely be mixed.
- **Strategic Stability – Negative.** Approach 4 would depart from the current thinking on strategic stability and seek to replace it through nuclear superiority. Under traditional definitions, mutual U.S.-Russian vulnerability would still be valid, but the lack of the framework provided by arms control would increase the potential for action-reaction cycles. The associated effects from this change could not only expand the scope of possible arms

racing but also present new risks to crisis stability and, in a worst-case scenario, introduce new pathways for first strike incentives.

Specific AWSM estimates (Tables 13 and 14) under likely future force postures (Tables 7 and 8) also show negative trends through 2036 for the United States under this proposed regime.[132] Strategic exchange calculations under the augmented force postures for Approach 4 result in a larger relative percentage of arriving Russian warheads than under New START and a smaller relative percentage of arriving U.S. warheads as well (see Tables 13 and 14) in two specific scenarios. These results stem from two intersecting trends in this scenario. On one hand, U.S. SSBN modernization results in a reduced number of available submarines in the mid-2030s, negatively impacting an area where the United States currently has a marked advantage. Simultaneously, Russia would be able to make the most of either warheads in storage or warheads available through production rates that have been maintained in recent years to potentially make larger increases to MIRVed ICBM forces. This net change, negative for the United States and positive for Russia, results in the degraded surviving weapons ratios relative to an exchange under New START limits in future exchanges under Approach 4 (Table 14). Looking beyond force structures, Russia's broader considerations of stability, which account for the intensity and velocity of competition with the United States, would result in similarly negative views of strategic stability even if Moscow did gain a slight advantage in deployed forces. These results substantiate a "negative" relative change to strategic stability when compared to today's status quo.

There are arguments for the stabilizing effects of a more robust nuclear force posture, such as the positive impacts to credibility, the ability to hold more of a competitor's targets at risk,

[132] Kroenig, 127-143.

and improved capabilities along the escalation "ladder" in a crisis. However, the predicted force structures, AWSM results, increased risks from arms racing or degraded crisis stability indicate these effects would not be easily realized under Approach 4. The result is an overall "negative" change to strategic stability.

- **Extended Deterrence – Negative.** Approach 4 would field larger nuclear forces, indicating a more capable and credible U.S. extended deterrence guarantee. However, the lack of an associated arms control framework would exacerbate cross-cutting domestic and international pressures amongst NATO and East Asian allies on nuclear issues, undermining U.S. deterrence. Some allies would potentially welcome additional BMD deployments and a larger U.S. nuclear force posture possible under this approach, but this would likely only constitute the minority opinion.[133] Further, resulting force posture increases in Russia and China would exacerbate regional security issues for European and Asian allies, putting U.S. extended deterrence at more of a disadvantage rather than improving it. In the more competitive environment under Approach 4, Russia could easily more aggressively posture its large NSNW arsenal, for example, further complicating deterrence and escalation management for the United States. These considerations imply overall "negative" changes from today's already complicated extended deterrence situation.
- **Proliferation – Negative.** The lack of non-proliferation efforts from the nuclear superpowers and the corresponding larger force postures from the United States, Russia and China would exacerbate regional issues and proliferation pressures. The impact of these changes would prompt secondary and tertiary effects among current declared states and potential proliferators

[133] Manuel Lafont Rapnouil, Tara Varma, and Nick Witney, "Eyes Tight Shut: European Attitudes Towards Nuclear Deterrence", European Council of Foreign Affairs, December 2018. https://www.ecfr.eu/page/-ECFR_275_NUCLEAR_WEAPONS_FLASH_SCORECARD_update.pdf;

in a cascading effect. These trends, and the lack of U.S.-Russian leadership in arms control, would severely challenge the NPT as well. These effects could conceivably threaten the continued existence of this multinational agreement. Advocates of nuclear superiority would contend that the larger U.S. arsenal could be used to for more effective coercive or compellent strategies to combat potential proliferators.[134] However, the United States already enjoys a marked advantage over rogue regimes in North Korea and Iran and this has proved to be limited in curbing their nuclear ambitions. These impacts highlight another "negative" change from the U.S. perspective.

- **Cost – Neutral to Negative.** As summarized in Table 7, there are a range of total deployed force structures the United States could pursue under a push to achieve nuclear superiority simply by maximizing available forces. The CBO estimates that expanding U.S. forces through such steps would not increase DoD costs relative to current plans.[135] One minor caveat is that the proposed force structure in Table 7 accelerates a Columbia SSBN purchase, shifting these funds left by 2 to 4 years but otherwise not affecting the total budget considered through 2036.

Although the negligible cost impacts support the plausibility of an improved force posture under Approach 4, the AWSM results (discussed under Strategic Stability above and summarized in Tables 13 and 14) show that increases to even 2,400 deployed warheads may not be enough to achieve a desirable margin for nuclear superiority. In this case, expanded measures would be required to aim for 2,700 or even 3,900 deployed warheads, returning the U.S. arsenal to START II or START I levels, respectively. The CBO estimates a return to START II-like levels would have relatively modest cost impacts, adding $100M in one-time

[134] Kroenig, 114-126.
[135] CBO Publication 56475, 11-13.

costs and an additional $5B in annual operating costs over the timeframe considered for this study.[136] On the other hand, implementing START I-like forces would "nearly triple" what the DoD is planning to spend on modernization in upcoming years, putting significant pressures on defense budgets.[137]

Missile defense would be another important budget consideration for Approach 4. Currently, U.S. missile defense plans are postured against threats from rogue regimes. Yet these systems would potentially have a much more important role in helping the United States compete against great power rivals in a world where nuclear superiority was a top priority. Even more so than the possible routes for increased strategic nuclear forces, missile defense options present a diverging range of potential costs. A modest set of new BMD programs, such as adding 20 silos to Ft. Greely, installing a new ground-based interceptor base in a location such as Ft. Drum, and fielding four additional THAAD systems total in Europe and Asia would increase the missile defense budget by roughly $12B in procurement costs and another $1B in operating costs through 2036.[138] These steps could be complimented by more technologically challenging and costly programs, encompassing anything from a new air-launched boost-phase interceptor (with or without dedicated aircraft for varying degrees of patrol coverage) to a space-based boost-phase interceptor supported by anywhere from 24 to 960 satellites.[139] The cost excursions along this spectrum of options are fairly significant as the CBO summarizes, increasing from tens of billions to hundreds of billions of dollars over the next 20 years. At the lower end, such programs would be under the 15% increase to planned

[136] CBO Publication 56475, 16-21.
[137] CBO Publication 56475, 16-21.
[138] CBO Publication 56949, 13-19.
[139] CBO Publication 56949, 19-22.

budgets which aligns with a "neutral" cost impact yet could scale much more for a solidly "negative" rating as well.

- **Competitive Advantage – Negative.** The preceding categories for Approach 4 tangentially considered other important considerations in this post-arms control treaty regime, namely, Russian advantages in NSNWs and near-term warhead production timelines. Moscow could choose to quickly field a large number of dual-capable INF-range systems and make use of its inventory of approximately 2,000 NSNWs to achieve a robust regional deterrence posture that would be difficult for the United States to overcome. Combined with challenges from rapidly modernizing Chinese arsenals, the path for the United States to gain a clear competitive advantage in this multipolar competition is not clear. Potentially, the more extreme missile defense and strategic nuclear arsenal increases noted in the preceding cost discussion could achieve a U.S. force posture that surpasses the capabilities fielded by great power adversaries. Aside from the cost impacts, even pursuing these options would certainly accelerate the velocity and intensity of competition and arms racing across multiple domains. The aggressive U.S. efforts in this manner, without any arms control agreements, would also heavily incentivize already budding Russian-Chinese cooperation to further complicate great power competition. Overall, these "negative" trends indicate the strong likelihood that the United States would be relatively worse off in this future regime compared to today.

Table 12 – Analysis summary for Approach 4 "Pursue nuclear superiority"

Approach	Strategic Stability	Extended Deterrence	Proliferation	Cost	Competitive Advantage	Political Feasibility
Approach 4: Pursue nuclear superiority	Negative	Negative	Negative	Neutral / Negative	Negative	Less Likely / Unlikely
Summary & Justification	- Basic strategic stability principles still valid, but increased potential for action-reaction cycles or decreased crisis stability - Force structure changes likely favor Russia; negative trends in strategic weapon exchange models compared to New START limits - Russia's NSNW arsenal would also be a bigger risk	- Cross-cutting domestic and international pressures amongst NATO and East Asian allies could undermine extended deterrence - Potential risk reduction via expanded BMD deployments, but Russia / China response could increase regional security issues	- Larger force postures from US, Russia and China would exacerbate regional issues and proliferation pressures - NPT severely weakened by lack of US-Russia agreements	- Significant cost deviations possible - US could field larger forces up to ~2000 deployed warheads w/ min cost impact - Models indicate even larger deviations necessary to attain real superiority → larger budget impacts - BMD / space systems could drive significant costs	- Russia NSNW advantages and continued China force increases create difficult multipolar environment; incentivizes Russia-China cooperation - US ability to compete further constrained by increased funds for nuclear forces or BMD systems - Multiple negative trends	- Potentially radical departure based on domestic pressures and allies' perspectives - More likely if current geopolitical trends continue

AWSM Results and Comparisons

Tables 13 and 14 below compare the AWSM results for a hypothetical strategic nuclear exchange between the United States and Russia under the force structures derived for each arms control approach. This analytical tool is a decremental model that works by assuming an initial, all-out attack is launched by the opposing side. The surviving and arriving weapons for the retaliatory second strike (after "launching on warning" or "riding out" this attack) are then estimated by decrementing initial available forces by multiple ratios in sequence. These ratios roughly account for the survivability, reliability, and accuracy of each weapon system to estimate the final results of this second-strike attack by the side under question. In Tables 13 and 14, the results under the "United States" column show U.S. second strike effectiveness after an attack initiated by Russia. The results under the "Russia" column show the arriving Russian warheads

after a U.S. first strike. Approaches 1, 2 and 4 are considered in this analysis; Approach 3 "Bilateral non-ratified frameworks" presumes some mutual restraint to maintain roughly New START-like force limits – which would equate to Approach 1 – and was not evaluated independently.

This simplified model shows that both sides have a deterrent second-strike capability under all scenarios. One potential exception is for Russia under Approach 2 "Long term multilateral reductions" where the combination of major reductions and a Day-to-Day posture after riding out an attack result in a scenario where 39 total strategic warheads launched by Moscow reach designated U.S. targets. Although this number represents significant devastation and would likely suffice for a secure second strike, Russia could argue the low number leaves it vulnerable to a combination of U.S. BMD and conventional precision attacks that could resemble a "splendid first strike." As discussed in the Approach 2 summary, this line logic would undermine strategic stability from Russia's perspective or could prompt risk-prone "use them or lose them" thinking in a crisis.

A more nuanced consideration of the AWSM results is displayed in Table 14. Since the current 2021 "baseline" is used to help adjudicate *relative* differences stemming from each approach in this study, Table 14 shows the ratio of arriving warheads compared to this "baseline" exchange under New START limits. These ratios were first normalized against the total deployed warheads for a more equivalent comparison across the disparate force structures summarized in Tables 1-8. The highlighted areas show where Russia is relatively stronger, and the United States is relatively weaker, and only arise in Approach 4. That is, compared to the New START baseline, these are cases where there are large swings which favor Moscow with over three times as many arriving warheads on U.S. targets versus what Russia would achieve under today's New START-

limited baseline. These same cases disfavor the United States, where the calculated strike is only about two-thirds as effective proportionally compared to the same attack under New START limits. Again, the raw numbers of arriving warheads in Table 13 show both sides still have secure second-strike capabilities, but the relative comparison points to a more nuanced comparison versus today's New START-limited status quo.

The driver in these highlighted cases, Day-to-Day (DTD) posture and "ride out attack" (ROA) under Approach 4, stem from the *relative* advantages Moscow acquires during the period under consideration in this regime. In the mid-2030s, U.S. SSBN modernization plans leave this leg of the U.S. triad at a nadir in available submarines while, under Approach 4, Russia can make relatively larger increases to MIRVed ICBM forces (see Tables 7 and 8 for a summary of these potential force postures). As discussed in the Approach 4 analysis, these results indicate if the United States truly wanted to achieve nuclear superiority, a larger and more expensive nuclear force expansion would be required. If such plans were determined to be cost prohibitive, these two specific scenarios are potential future situations where the relative differences in U.S.-Russian survivability have given the latter a potentially strategic advantage compared to today's status quo. Whether or not this would be destabilizing would be a point of debate that would have to incorporate additional nuclear and non-nuclear considerations for a more holistic picture of the U.S.-Russian balance. At the very least, these two specific scenarios strengthen "negative" impacts stemming from Approach 4. These results also highlight some hard thinking and careful planning is required before selecting into a world where relatively unconstrained strategic nuclear competition with Russia is a national priority.

Table 13 – AWSM comparison of strategic force exchanges

Total Arriving Warheads for U.S. and Russia under various deployed force limits		
Approach 1: Deployment Limit - 1550		
	U.S. in response to Russia 1st strike	**Russia in response to U.S. 1st strike**
	U.S.	**Russia**
GEN - LOW	1275	1062
GEN - ROA	911	607
DAY - LOW	955	591
DAY - ROA	615	101
Approach 2 (2026-2031) Deployment Limit - 1000		
	U.S.	**Russia**
GEN - LOW	830	830
GEN - ROA	563	538
DAY - LOW	622	401
DAY - ROA	379	78
Approach 2 (2031-2036) Deployment Limit - 500		
	U.S.	**Russia**
GEN - LOW	411	424
GEN - ROA	293	213
DAY - LOW	286	262
DAY - ROA	192	39
Approach 4 (2026-2031) Maximum Forces		
	U.S.	**Russia**
GEN - LOW	2114	1729
GEN - ROA	1223	1205
DAY - LOW	1530	977
DAY - ROA	639	454
Approach 4 (2031-2036) Maximum Forces		
	U.S.	**Russia**
GEN - LOW	2199	1959
GEN - ROA	1308	1232
DAY - LOW	1562	1204
DAY - ROA	671	476

Table 14 – Relative AWSM exchange results

Results shown as a percentage of initially deployed forces arriving on target, baselined against this ratio for the current New START postures.

New START / Approach 1 Deployment Limit - 1550		
Percent of initial deployed warheads arriving		
	U.S. in response to Russia 1st strike	**Russia in response to U.S. 1st strike**
	U.S.	**Russia**
GEN - LOW	82%	69%
GEN - ROA	60%	39%
DAY - LOW	62%	38%
DAY - ROA	40%	7%
Ratio comparing percentage of initial deployed warheads arriving		
in each scenario to that same metric in current 1550 limit baseline		
Approach 2 (2026-2031) Deployment Limit - 1000		
	U.S.	**Russia**
GEN - LOW	1.01	1.21
GEN - ROA	0.93	1.37
DAY - LOW	1.01	1.05
DAY - ROA	0.96	1.20
Approach 2 (2031-2036) Deployment Limit - 500		
	U.S.	**Russia**
GEN - LOW	1.00	1.24
GEN - ROA	0.97	1.09
DAY - LOW	0.93	1.37
DAY - ROA	0.97	1.20
Approach 4 (2026-2031) Maximum Forces		
	U.S.	**Russia**
GEN - LOW	1.09	1.26
GEN - ROA	0.86	1.54
DAY - LOW	1.05	1.28
DAY - ROA	0.68	3.48
Approach 4 (2031-2036) Maximum Forces		
	U.S.	**Russia**
GEN - LOW	1.09	1.27
GEN - ROA	0.88	1.40
DAY - LOW	1.13	1.40
DAY - ROA	0.69	3.24

Conclusions and Recommendations

Table 15 presents a summary of the potential impacts from all four proposed approaches. Note that the political feasibility of each approach was not specifically adjudicated like the other criteria but was discussed in some detail when defining each approach. This discussion on feasibility enumerated many major obstacles to each approach regardless of the overall likelihood summarized in Table 15 below. Looking at the five primary criteria, the results appear mixed for Approaches 1 and 3. Conversely, Approach 2 and Approach 4 result in more overall negative outcomes. The following paragraphs will consider these two negative approaches – Approach 2 and Approach 4 – before discussing the potentially complementary aspects of Approach 1 and Approach 3.

Table 15 – Analysis summary for all approaches

Approach	Strategic Stability	Extended Deterrence	Proliferation	Cost	Competitive Advantage	Political Feasibility
Approach 1: Bilateral strategic arms limitations	Positive	Neutral	Neutral	Neutral	Neutral / Negative	Likely
Approach 2: Long term multi-lateral reductions	Neutral / Negative	Negative	Neutral	Positive / Neutral	Positive / Neutral	Unlikely
Approach 3: Bilateral non-ratified frameworks	*Positive** / *Neutral**	Positive / Neutral	Neutral / Negative	Neutral / Negative	Positive / Neutral	Likely / Less Likely
Approach 4: Pursue nuclear superiority	Negative	Negative	Negative	Neutral / Negative	Negative	Less Likely / Unlikely

As previously discussed, Approach 2 results in negative impacts for Stability and Extended Deterrence based on a comparison using the contemporary geopolitical context. However, a global

security paradigm marked by the type of cooperation required for the leading nuclear powers to agree to major reductions would have to be more stable and feature less competition than today. In such an environment, the potentially negative repercussions that a reduced U.S. strategic posture could have on strategic stability and extended deterrence could be mitigated by the more benign international security environment. In such a world, the benefits of Approach 2 could be realized without the negative repercussions. A constructivist-based approach to arms control and disarmament would also argue that pursuing these reductions could cultivate a feedback loop and actually bring such an environment into being. Dynamic cooperation between the two nuclear powers in this manner could be initiated from reduced international tensions while also catalyzing these same trends to reduce global risks, reduce nuclear program costs, and help channel competition into other non-nuclear areas.

A new multilateral agreement like Approach 2 could be made possible even in a tense geopolitical environment. In this scenario, the leading powers could decide to collectively sideline strategic nuclear competition at some level of mutual stability to mitigate the existential risks of this particular branch of arms racing while still actively engaged in other great power struggles. Notably, the limited historical success from unilateral actions in fostering such reductions indicates a bilateral or multilateral effort would be critical to make these hypothetical situations more plausible.[140] Even with multilateral buy-in, the long-term durability of such a dichotic approach – collaborative on one topic yet still competitive in others – would be heavily dependent on its legal conditions or require a breakthrough in the perceptual issues that typically drive hedging or

[140] Micheala Dodge, "History Shows U.S. Nuclear Restraint Is A One-Way Street," *War on the Rocks*, November 18, 2020, https://warontherocks.com/2020/11/history-shows-u-s-nuclear-restraint-is-a-one-way-street/; Christopher A. Ford, "To Tango Alone: Problems of Theory and Practice in the Sociology of Arms Control, Nonproliferation, Disarmament and Great Power Competition," *Arms Control and International Security Papers*, Vol. 1, No. 14, July 30, 2020, 1-5.

outright cheating.[141] This review of additional considerations for Approach 2 highlights some real considerations for future disarmament discussions and supports that major nuclear reductions by themselves entail potentially negative impacts to security.

The negative changes potentially resulting from Approach 4 are more attributable to the approach itself rather than any underlying assumptions. No major hypothetical assertions are required to project how aggressive nuclear posture changes from the United States or Russia would have negative reverberations in an increasingly tense international security environment. However, this analysis has ignored the potential for the overt pursuit of nuclear superiority to help auger an improved arms control agreement. Echoing NATO's Dual Track efforts in the 1980s, many of the negative projected impacts from Approach 4 could be turned to positives if done in conjunction with persuasive arguments to foster an improved bilateral or multilateral arms control agreement. Again, history shows that multilateral engagement is key to such an undertaking. Without buy-in from NATO or Asian allies who could be directly affected by such an approach, its chances of success would be limited. Domestic or constitutional fitness factors for each competitor in such a scenario would play a significant role as well, considering how the moribund Soviet economy proved crucial to the ultimate success of the arms racing-arms control dynamic of the 1980s.[142]

Even assuming a united front from the United States and its allies and weaknesses in Russia's domestic economic or political foundation, today's geopolitical context indicates Approach 4 is unlikely to repeat the Dual Track success. The projected force postures (see Tables 7 and 8) and potential strategic exchanges (see Tables 13 and 14) do not point to a clear enough

[141] See, for example, S. Plous, "The Nuclear Arms Race: Prisoner's Dilemma or Perceptual Dilemma?" *Journal of Peace Research*, Vol. 30, No. 2, May 1993, 163-179.
[142] Amy Woolf, "Bargaining With Nuclear Modernization: Does it Work?" *Arms Control Today*, October 2020, https://www.armscontrol.org/act/2020-10/features/bargaining-nuclear-modernization-does-work; Green, 247-260.

asymmetry that would motivate Russia to seek a new bargain. Statements by Putin possibly indicate the opposite case is true and that Russia's leaders feel their pursuit of destabilizing new systems like the Status-6 *Poseidon* autonomous submarine or *Avangard* hypersonic glide vehicle have put Washington in a disadvantage.[143] Even more distressing, Moscow could choose to rapidly employ a large fraction of its NSNWs with intermediate or short-range systems, increasing its leverage while directly threatening NATO allies.

Some caveats to this logic are needed, particularly looking beyond the 2036 horizon considered in this paper. Russia's apparently strong hand would be dependent on the continued long-term stability of its economy and society. Russia is challenged by its reliance on a predominantly oil-based economy, endemic corruption, and declining demographic trends. A significant drop in oil prices or other domestic instability resulting from these pressures could quickly change Russia's ability to field the types of forces presumed in Table 8 or continue competing with the United States. Yet the scale of these structural changes would need to be massive to revert Russia back to anything like the situation faced by the Soviet Union in the early 1980s and drive the nation to again earnestly negotiate on major nuclear weapon reductions.

With no clear advantage for either side in this scenario in the near term, the chances for a successful Dual Track-like version of Approach 4 require more in-depth analysis of the full range of nuclear and non-nuclear force structure options, some of which are captured in Table A.5. As discussed in the previous section, the U.S. nuclear forces shown in Table 7 could be fielded with relatively minor deviations to the currently planned modernization budget. To pursue the type of superiority necessary for an edge in negotiations, either expensive increases in nuclear forces or

[143] Kremlin transcript, Presidential Address to the Federal Assembly, March 1, 2018, http://en.kremlin.ru/events/-president/news/56957; Kremlin transcript, Meeting with representatives of Russian news agencies and print media, February 20, 2019, http://en.kremlin.ru/events/president/news/59865.

unique BMD or conventional systems would need to be considered. Some mix of measures like those listed in A.5 – missile defense and precision strike are candidates – could help channel competition toward U.S. strengths. The lens of constitutional fitness also reminds that other factors in this type of competition, such as the domestic palatability of these efforts and their ability to prompt negotiations rather than further arms racing, would also be crucial.[144]

Turning attention to Approach 1 and Approach 3, the analysis indicates how these paradigms should be considered in tandem to make the most of their competing strengths and weaknesses. Extending the current New START-like regime provides a feasible approach to maintain strategic bilateral stability, for example, but fails to address potentially destabilizing trends related to non-nuclear strategic technologies and China's modernizing forces. Approach 3 provides necessary flexibility to make some headway on these issues, offering pathways for dialogue on a broad range of topics that could reduce risks or strengthen stability beyond the purview of a more traditional bilateral regime. Yet such a flexible approach has its own shortcomings, grounded in the lack of ratified legal backing and potentially tenuous maintenance of strategic parity through mutual restraint.

Looking more closely at the potentially changing nature of strategic stability, Table 3 shows how China could field a mix of strategic and INF-range systems by 2036 that add up to roughly a third of the New START-like limits constraining U.S. and Russian forces in Approach 1. Under a potential worst-case strategic exchange with Russia, where the United States is in a typical "day-to-day" force posture and elects to "ride out" the attack, the arriving U.S. warheads in retaliation would number just under 700 (see Table 13).[145] If the strategic situation called for the United States to deter or retaliate against China as well in such conditions, some would argue

[144] Green, 55-58 and 257-260.
[145] See also, Cimbala, *Nuclear Deterrence*, 72-78 and "Nuclear Arms Control," 100-105.

that this warhead number would not be sufficient. These arguments would be stronger if China surpasses current estimates and fields even larger forces. The situation grows even more complicated if Russia and China continue to collaborate to present a combined, coherent, and possibly coercive threat to U.S. interests. An unofficial component of U.S. nuclear policy has been the motivation to be "second to none."[146] Yet in a future world where competition has increased with both China and Russia, strategic and extended deterrence could depend instead on a U.S. nuclear force that is "second to no combination" of strategic competitors. If so, the margins highlighted in Tables 1 – 3 and Table 13 may not provide the necessary margin that USSTRATCOM currently relies on. This possible reconsideration of strategic stability hints at the potential pressures to a construct that is primarily defined bilaterally when a third party begins to field relatively large numbers of forces.

Additional impacts to Approach 1 from non-nuclear strategic forces are harder to estimate. Potentially destabilizing dual-use systems, like the Russian *Avangard* hypersonic glide missile, would likely be captured under an ongoing New START-like regime.[147] However, the future proliferation of other ground-launched hypersonic missiles or air-launched glide vehicles is difficult to predict, as is the best approach to incorporate such weapons under a verifiable control regime.[148] In the context of Russia's INF-violating 9M729 testing and deployment, there is reason to think some arms racing is possible with or without a specific agreement over new sub-strategic classes of weapons.[149] Yet even these hypersonics-related questions are likely easier to take into consideration than more exquisite and diffuse technologies leveraging space, cyberspace, or

[146] Brooks, 90.
[147] Gottemoeller, 155; Perkovich and Vaddi, 84-85.
[148] George Perkovich, "A Brittle Nuclear Order," in Revitalizing Nuclear Arms Control and Nonproliferation, International Luxembourg Forum on Preventing Nuclear Catastrophe, 2017, https://carnegieendowment.org/2017/12/18/brittle-nuclear-order-pub-75057; 128-129.
[149] Ford, 1-3; Long, ibid.

artificial intelligence.[150] The narrow and traditional definition of strategic stability in this paper is not well-suited to consider the impacts of these various new technologies. By extension, Approach 1, grounded in this orthodox perspective, does little to address these technologies as well.

Notably, Approach 1 and Approach 3 were made disparate by definition in this paper to enable more distinct analysis. The shortcomings for Approach 1 in addressing China and non-nuclear technologies could be addressed in reality by combining a more traditional arms control agreement with the broader terms captured in this paper under Approach 3. Taking the best elements of each illustrates a potentially fruitful path looking forward. The ratified nature of a New START-like regime with its accompanying verification measures benefits traditional strategic stability and keeps extended deterrence guarantees and proliferation pressures at least at the levels they are at today. Meanwhile, the additional topics addressed through separate bilateral measures aimed at Russia and China provide pathways to ameliorate other important risks. Indeed, the advantages of keeping New START while working to improve it by adding further topics to independent bilateral agendas with Russia and China appear to be animating the arms control agenda for the recently inaugurated Biden administration.[151] The analysis in this paper supports the logic behind such a course of action. The more "extreme" arms control scenarios pursuing major reductions (Approach 2) or nuclear superiority (Approach 4) complement this thinking with further considerations to frame a broader scope of U.S. options for arms control.

These hypothetical approaches and the methodology employed in this study can also augment contemporary deterrence analysis. For the past several years, USSTRATCOM leaders have indicated their command has been integrating considerations across domains and capabilities

[150] See, for example, Christopher F. Chyba, "New Technologies & Strategic Stability," *Daedalus*, Vol. 149, No. 2, Spring 2020, 150-170.
[151] Kingston Reif and Shannon Bugos, "U.S., Russia Extend New START for Five Years," *Arms Control Today*, Vol. 51, No. 2, https://www.armscontrol.org/act/2021-03/news/us-russia-extend-new-start-five-years.

for a broader strategic deterrence posture.[152] More recently, USSTRATCOM has emphasized additional analytical tools to assess "Risks of Strategic Deterrence Failure" (ROSDF) to better inform deterrence thinking.[153] Although the details of this revised assessment process are not publicly available, there is likely some utility in pairing the type of qualitative analysis from this study with ROSDF considerations to shape options for arms control and deterrence. Doing so could help maximize the utility of arms control in protecting and advancing national security interests.

In summary, the analysis points out the following notable conclusions and associated recommendations:

- **Conclusion 1:** Extending the current New START-like regime provides a feasible approach to maintain traditional strategic stability, however, such an approach fails to address potentially destabilizing trends related to non-nuclear strategic technologies and China's modernizing forces.
- **Recommendation 1:** Elements of Approach 1 and Approach 3 as defined in this paper can be combined for a more comprehensive framework for related concerns of stability, extended deterrence, proliferation, and global competition. Military and political leaders should investigate the interplay of both traditional and new aspects of strategic stability to shape the priorities for expanded conditions in a post-New START regime that potentially encompasses multiple agreements. This investigation should also be paired with relevant aspects of USSTRATCOM-specific analysis of risks of strategic deterrence failure to understand the best role that arms control can serve in advancing national security. Analysis

[152] C. Robert Kehler, "Nuclear Weapons & Nuclear Use," *Daedalus* Vol. 145, Issue 4, Fall 2016, p. 52.
[153] Admiral Charles A. Richard, "Forging 21st-Century Strategic Deterrence," *U.S. Naval Institute Proceedings*, February, 2021, 12-14.

into parallel bilateral agreements with Russia and China should be prioritized as a feasible and flexible path to such an expanded strategic stability regime.

- **Conclusion 2:** Analyzing the political feasibility of each approach revealed potentially significant hurdles to each alternative. Comparing approaches indicates there are potential alternatives to a traditionally ratified agreement in the form of political agreements coupled with sufficiently motivated mutual restraint.
- **Recommendation 2:** Given the major international and domestic obstacles to a new, fully ratified agreement, arms control discussions at all levels should include a review of measures that can be taken as backups or "off ramps" from ratification that still secure as binding of an agreement as possible. Technical exchanges, mutual declarations, remote site inspections supported by National Technical Means or other technologies, and other such means should be discussed as a secondary option to support a politically binding agreement should ratification fall short. An agreement, even non-ratified, that addresses priority issues and helps motivate mutual restraint may prove to an effective paradigm for major arms control breakthroughs in the future.

- **Conclusion 3:** An approach that seeks significant reductions in nuclear forces would entail serious risks in the contemporary security environment. If the risks and tensions between major powers begin to decrease, arms control could help catalyze a more benign geopolitical situation, especially if supported in a binding, multilateral framework.
- **Recommendation 3:** Strategic leaders should look for indicators that the international geopolitical context is trending toward being more benign. If such indicators are present,

leaders should be prepared to look for opportunities to leverage expanded, multilateral arms control or disarmament options to help catalyze these trends in a way that advances the ability of the United States, its allies and competitors to pursue common interests.

- **Conclusion 4:** Pursuing nuclear superiority without a supporting arms control framework leads to negative repercussions across evaluated criteria. Even if a force build up is pursued as a negotiating tactic for an improved arms control agreement, the analysis completed in this study indicates the United States cannot achieve a clear advantage without significant nuclear and/or non-nuclear budget increases through 2036. This is due to the readily available strategic and non-strategic nuclear arsenal that Russia could leverage in response to U.S. arms racing efforts over this period.
- **Recommendation 4:** An across-the-board arms race with Russia, even if leveraged as a negotiating tool, appears to have low likelihood of success in the next 15 years. This type of approach, if employed, should instead study and identify narrow areas of competition that can be leveraged for similarly exact impact. Similarly, "mirroring" strategies should be avoided to instead focus on extending areas where U.S. qualitative advantages offer the best course of action – potential examples include missile defense, precision guidance, and spaced-based technologies.

Appendix A: Detailed Conditions for Arms Control Approaches

Table A.1: Detailed Assumptions, Conditions, and Implications for Approach 1 "Bilateral Strategic Arms Limitations"

"Bilateral Strategic Arms Limitations" Assumption	Implication(s) or Related Follow-On Assumptions
New START extended to 2026.	• The full five-year window of New START extension is used to shape and approve a related replacement treaty. • No new measures implemented until replacement treaty enters into force in 2026. This also provides the required time to negotiate and finalize a new formal treaty.
China continues to refuse to take part in strategic arms agreements with the U.S. and Russia.[154,155]	• Post-New START agreement negotiated between U.S. and Russia only.
Post-New START agreement provides legal and/or politically binding measures addressing most U.S. and Russian top priorities.	• Maintains current limits for strategic deployed warheads (1550) and total/deployed delivery systems (800/700). • Mutual declaration for a warhead freeze with verification/authentication measures.[156] • Limits and verification measures include novel strategic systems in development today that could be fielded on/after 2031. Specific examples for each side include: ○ Russia: Sarmat heavy ICBM, Avangard hypersonic glide vehicle, and future air or sea-launched boost glide missiles with sufficient 'strategic' range[157]

[154] See, for example, Zhao Lijian, Foreign Ministry Spokesperson Regular Press Conference, Embassy of the People's Republic of China in the United States, July 20, 2020, http://www.china-embassy.org/eng/fyrth/t1796815.htm. Accessed October 1, 2020.
[155] Trenin, 163-164.
[156] See, James E. Doyle, "How Biden can achieve a first in arms control: A verifiable nuclear warhead freeze," *Bulletin of the Atomic Scientists*, December 15, 2020, https://thebulletin.org/2020/12/how-biden-can-achieve-a-first-in-arms-control-a-verifiable-nuclear-warhead-freeze/. Potential measures will be discussed but the specific details are beyond the scope of this analysis.
[157]George Perkovich and Pranay Vaddi, *Proportionate Deterrence: A Model Nuclear Posture Review* (Washington D.C.: Carnegie Endowment for International Peace, 2021), 84-85; Rose Gottemoeller, "Rethinking Nuclear Arms Control," *The Washington Quarterly*, Vol. 43, No. 3 (Fall 2020), 155; Anya Loukianova Fink and Olga Oliker, "Russia's Nuclear Weapons in a Multipolar World: Guarantors of Sovereignty, Great Power Status & More," *Daedalus*, Vol. 149, No. 2, Spring 2020, 53-54; Pranay Vaddi and James M. Acton, A ReSTART for U.S.-Russian Nuclear Arms Control: Enhancing Security Through Cooperation, Carnegie Endowment for International Peace Working Paper (October 2020), 2; Brad Roberts (ed.), *Major Power Rivalry and Nuclear Risk Reduction:*

"Bilateral Strategic Arms Limitations" Assumption	Implication(s) or Related Follow-On Assumptions
	○ U.S.: Ground Based Strategic Deterrent (GBSD) ballistic missiles, new Ohio-class SLBM and B-21 Raider strategic bombers[158] • To avoid current issues regarding heavy bomber conversions and counting for future deployed bombers (U.S. B-21 and Russian PAK-DA), both sides agree to separate basing measures for nuclear and non-nuclear bombers.[159] • Russian concerns about U.S. ABM plans are allayed by additional transparency measures to confirm purely defensive nature of missiles, on-going data sharing and technical exchanges, and political pledges that these systems are not directed toward Russia.[160] • U.S. concerns about Russian NSNWs are satisfied by some mix of transparency measures and/or portal monitoring; conditions covered under the measures implemented for the overall warhead freeze.[161]
New START verification regime would continue with the follow-on treaty, plus a reasonable mix of new transparency	• The full details of these measures are beyond the scope of this analysis but are assumed to be finalized during the negotiations via a joint commission.[162]

Perspectives from Russia, China, and the United States, Center for Global Security Occasional Paper, Lawrence Livermore National Laboratory (May 2020), 8, 10-11; Dmitry Stefanovich, "U.S. Inspection of New Russian Missile May Revive Stalled Arms Control Talks," *Moscow Times*, December 2, 2019, https://www.themoscowtimes.com/2019/12/02/us-inspection-of-new-russian-missile-may-revive-stalled-arms-control-talks-a68437.

[158] Christopher Ford, "US Priorities for 'Next-Generation Arms Control", Arms Control and International Security Papers, Vol. 1, No. 1 (April 6, 2020), 1-3.

[159] Vaddi and Acton, 24-25.

[160] This falls short of previous Russian demands for *legally* binding limits on American ABM systems but is supposed to be sufficient in the context of this new agreement. See, for example, Steven Pifer, *Missile Defense in Europe: Cooperation or Contention?*, Brookings Arms Control Series Paper 8 (May 2012), 1-3 and Steven Pifer, *Nuclear Arms Control Choices for the Next Administration*, Brookings Arms Control and Non-Proliferation Series, No. 13 (October 2016), 2-3; Andrew Futter and Benjamin Zala, "Advanced US conventional Weapons and Nuclear Disarmament – Why the Obama Plan Won't Work," *Nonproliferation Review*, Vol. 20, No. 1, 2013, 112; Tom Countryman and Kingston Reif, "Intermediate-range missiles are the wrong weapon for today's security challenges," *War on the Rocks*, August 13, 2019, https://warontherocks-.com/2019/08/intermediate-range-missiles-are-the-wrong-weapon-for-todays-security-challenges/; and James Timbie, "A Way Forward," *Daedalus*, Vol. 149, No. 2, Spring 2020, 198-199; Perkovich and Vaddi, 87-89.

[161] Another specific transparency example could include reciprocal inspections of empty facilities at key locations to underscore neither side is seeking to deploy these NSNWs, from this point an expanded verification regime could be pursued; Perkovich and Vaddi, 87-88.

[162] Gustav Gressel, "Under the Gun: Rearmament for Arms Control in Europe," European Council on Foreign Relations Policy Brief, November 2018. https://www.ecfr.eu/page/-/under_the_gun_rearmament_for_arms_control_in_europe5.pdf.

"Bilateral Strategic Arms Limitations" Assumption	**Implication(s) or Related Follow-On Assumptions**
measures and inspections to support verification of the new treaty limits.	
Multi-lateral agreements related to nuclear proliferation, such as the Nuclear Nonproliferation Treaty (NPT) and Comprehensive Test Ban Treaty (CTBT), remain as currently configured and enforced.	• The U.S. and China remain as states that have not ratified the CTBT. • Potential impacts from all approaches on the NPT and CTBT will be considered as part of the final analysis.
No specific new agreements related to non-nuclear topics.	• The status of the Outer Space Treaty and United Nations' Biological Weapons Convention and Chemical Weapons Convention remains unchanged. • Additional non-strategic nuclear technologies, such as space and cyberspace, are not specifically included in the politically binding agreement.

Table A.2: Detailed Assumptions, Conditions, and Implications for Approach 2 "Long term multilateral reductions"

"Long term, multilateral reductions" Assumption	Implication(s) or Related Follow-On Assumptions
New START extended to 2026.	• The full five-year window of New START is used to shape and approve a related replacement treaty. • No new measures implemented until replacement treaty enters into force in 2026. This also provides the required time to negotiate and finalize a new formal treaty. • Replacement treaty covers a 10-year period; initial reductions are made over 2026-2031, followed by more aggressive cuts over 2031 thru 2036.
U.S. and Russia agree to phased approach for major reductions to deployed warheads/delivery systems and overall active warheads.	• New START replacement reduces strategic warhead limits to 1000 and strategic delivery systems to 600 for 2026-2031.[163] • Deployed strategic limits reduced further to 500 warheads and 500 delivery systems beginning in 2031.[164] • Initial bilateral freeze on active warheads for 2026-2031, followed by total active stockpile reductions to 2,500 warheads.[165] • New START verification regime is extended to include new measures supporting initial warhead freeze and following total stockpile reductions. • U.S. agrees to transparency and data sharing for European BMD systems (see Approach 1 and supporting references). • Russia agrees to some mix of transparency measures and portal monitoring for NSNW; conditions covered under the measures for the overall warhead freeze (see Approach 1 and supporting references).
U.S.-Russian leadership fosters expanded P5 processes; China, France and the U.K. agree to join a legally	• Multilateral agreement negotiated as U.S.-Russian cuts continue; new treaty ratified after 2036 resulting in a cap of 350 total strategic warheads for China, 300 for France, 215 for the U.K.

[163] Steven Pifer, "THE NEXT ROUND: The United States and Nuclear Arms Reductions After New START," *Brookings Arms Control Series Paper 4*, December 2010, https://www.brookings.edu/wp-content/uploads/2016/06/12_arms_control_pifer.pdf, 3-4, 25. Reductions to 1000 deployed warheads were also strongly considered during President Obama's administration and will likely come up again amongst like-minded national security staff in the incoming Biden administration; Fred Kaplan, *The Bomb: Presidents, Generals and the Secret History of Nuclear War* (New York: Simon and Schuster, 2020), 229-234; and Perkovich and Vaddi, 84. Russian officials have also discussed this number as a feasible target that would not dramatically impact strategic stability; Alexey Arbatov and Vladimir Dvorkin, "The Great Strategic Triangle," Carnegie Moscow Center, April 1, 2013, https://carnegie.ru/-2013/04/01/great-strategic-triangle-pub-51362.

[164] Stephen J. Cimbala, *Nuclear Deterrence in a Multipolar World: The U.S., Russia and Security Challenges* (New York: Ashgate Publishing, 2016), 37-47.

[165] Pifer, "NEXT ROUND," 3-4, 25.

"Long term, multilateral reductions" Assumption	Implication(s) or Related Follow-On Assumptions
binding framework limiting total nuclear weapons.[166]	
New multilateral treaty reinstitutes a ban on U.S.-Russian INF-range missiles in European theater and limits deployment of U.S., Russian and China systems in Asia.	• U.S. and Russia initially agree upon politically binding moratorium on intermediate range ground-launch missiles during New START extension period (2021-2026); followed by return to INF-like ban for European theater thereafter. • U.S., Russia and China agree to limit INF-range launchers in Asia to 300 in multilateral treaty.[167] • All parties agree on separate basing measures to isolate INF-range systems from nuclear warheads.

[166] Alexei Arbatov and Vladimir Dvorkin with Vladimir Evseev, *Beyond Deterrence: transforming the U.S.-Russia equation* (Washington D.C.: Carnegie Endowment for International Peace, 2006), 156-157.
[167] Tong Zhao, "Opportunities for Nuclear Arms Control with China," *Arms Control Today*, Vol. 50, No. 1 (2020), https://www.armscontrol.org/act/2020-01/features/opportunities-nuclear-arms-control-engagement-china. Zhao recommends an overall limit at 600 launchers as a near-term goal and then scaling down. Given the scope of arms reductions in this Approach 2, a more aggressive goal similar in relative scope is assumed.

Table A.3: Detailed Assumptions, Conditions, and Implications for Approach 3 "Bilateral political framework" for U.S.-Russia

"Bilateral political framework" Assumption (U.S.-Russia)	Implication(s) or Related Follow-On Assumptions
New START extended to 2026.	• Both U.S. and Russia remain open for continued coordination in a bilateral, non-legally binding framework.[168]
China will not join in tri-lateral arms control discussions with the U.S. and Russia.[169]	• No hypothetical trilateral framework possible in the near future[170] • Assume China is amenable to bi-lateral discussions and non-binding measures with the U.S. (summarized in Table 4).[171]
With no legal framework, mutual reductions in overall warheads or deployed warheads from New START limits are not plausible.[172]	• If mutual reductions are not plausible, then neither U.S. nor Russia will consider unilateral reductions as well. • Mutual restraint pledges maintain New START limits.

Inspection and verification measures under a non-legally binding agreement between the U.S. and Russia will be limited.[173]
 	
(See Table A.4 below for transparency measures assumed for a U.S.-China agreement under Approach 3.)
	• Verification under bi-lateral approaches will be limited to reciprocal data exchanges, notifications, and declarations.[174]
	• Mutual data exchanges will cover the following:
	  ○ Aggregate numbers of:[175]
	  ▪ total deployed strategic nuclear warheads
	  ▪ total deployed strategic delivery vehicles
	  ▪ deployed/non-deployed launchers
	  ○ Deployed weapons at declared bases[176]

[168] Vince Manzo, *Nuclear Arms Control Without a Treaty? Risks and Options After New START*, Center for Naval Analyses report, March (2019), 69-71.
[169] Zhao Lijian, Foreign Ministry Spokesperson Regular Press Conference, Embassy of the People's Republic of China in the United States, July 20, 2020, http://www.china-embassy.org/eng/fyrth/t1796815.htm. Accessed October 1, 2020; Vaddi and Acton, 22.
[170] Trenin, 163-164; Peczeli et. al., 1.
[171] Zhao, Press Conference; Peczeli et. al., 8; Caitlin Talmadge, *The US-China Nuclear Relationship: Why Competition is Likely to Intensify*, Brookings Institution Report (September 2019), 9; Frank G. Klotz, John Lauder, William Courtney, *Negotiating with Great Powers on Nuclear Arms*, The RAND Blog (August 3, 2020). **https://www.rand.org/blog/2020/08/negotiating-with-great-powers-on-nuclear-arms.html**.
[172] Christopher S. Chivvis, Andrew Radin, Dara Massicot, and Clint Reach, *Strengthening Strategic Stability with Russia*, RAND Publication PE234 (Santa Monica, CA: Rand Corporation, 2017), 2.
[173] Vaddi and Acton, 7.
[174] Christopher Ford, "US Priorities for 'Next-Generation Arms Control", *Arms Control and International Security Papers*, Vol. 1, No. 1 (April 6, 2020), 6; Manzo, 69-76; Gottemoeller, 151-153; Trimbie, 192-199.
[175] *Ibid.,* 71-73. **also mentioned in Steven Pifer, "Nuclear Arms Control Choices for the Next Administration," Brookings Report, October 2016, 28-29.
[176] *Ibid.*

"Bilateral political framework" Assumption (U.S.-Russia)	Implication(s) or Related Follow-On Assumptions
	○ Number of non-strategic nuclear warheads in storage and number in the dismantlement queue[177] ○ Notifications on changes to additional delivery vehicles, changes to strategic delivery and launcher status[178] ○ Unilateral and confidential data exchanges on U.S. Homeland and Regional Ballistic Missile Defenses and notifications for any major changes to these systems[179]
The U.S. and Russia would agree upon a new commission or working group to facilitate data exchanges and other transparency steps or issues under this new regime.[180]	• This joint commission would facilitate concurrence on the mutual transparency and data exchange efforts described above, resolving key verification issues for both sides. • New measures could include verification that warheads are mated to delivery systems only per treaty conditions. Some mutual agreement on transparency for warheads in storage is also assumed due to concerns on the intrusiveness needed to fully verify.[181]
Concerns over INF-range systems are mediated through mutual dialogue and restraint.	• Mutual moratorium on deploying INF-range systems is enacted for near-term (2021-2026). • Moratorium is supplanted by a mutual agreement on geographical limits on deploying INF-range systems and separate basing from nuclear weapons systems.[182]
Risk reduction communications covered by previous U.S.-Russia agreements remain in place.	• The Ballistic Missile Launch Notification Agreement, U.S.-Russian leadership nuclear 'hot line' and other measures remain in effect.

[177] Evgeny Buzhinsky, "The Russian Political and Security Context for Limits on Non-Strategic Nuclear Weapons," *Center for Strategic and International Studies Track-II Dialogue on Non-Strategic Nuclear Weapons* (Washington D.C.: Center for Strategic and International Studies, 2015), 16-18.
[178] Manzo, 71.
[179] Ibid.
[180] Gressel, 30; Moscow also previously indicated it would support "interagency, high-level dialogue" on a range of security topics; see Kremlin transcript, "Statement by President of Russia Vladimir Putin on a comprehensive program of measures for restoring the Russia – US cooperation in the field of international information security," September 25, 2020, http://en.kremlin.ru/events/president/news/64086, accessed November 6, 2020.
[181] James M. Acton and Michael S. Gerson, *Beyond New START: Advancing U.S. National Security Through Arms Control With Russia*, (Washington D.C., Center for Strategic and International Studies, 2011), 29-30; Jacek Durkalec and Andrei Zagorski, Options for Transparency and Confidence-Building Measures Related to Non-Strategic Nuclear Weapons in Europe: Cost-Benefit Matrix, Post-Conference Report from the Polish Institute for International Affairs, 2014, 9-11.
[182] Ulrich Kuhn, "Uncharted Waters: Europe and the End of Nuclear Arms Control," *Turkish Policy Quarterly*, Vol. 19, No. 2, Summer 2020, 107-109

"Bilateral political framework" Assumption (U.S.-Russia)	Implication(s) or Related Follow-On Assumptions
New framework includes initial risk reduction measures for non-nuclear strategic technologies.	• Mutual declaration of non-aggression against nuclear command and control centers, satellites, and related infrastructure, to include cyber-attacks.[183] • New bilateral and confidential data exchanges on weapon systems of interest: Types of Non-Strategic Nuclear Forces, Dual-use missile system developments, hypersonic glide systems, and autonomous delivery systems.[184] • Mutual declaration of continued support for 1967 Outer Space treaty.[185]

[183] Chivvis et al., 2-5; James M. Acton (ed.), Alexey Arbatov, Vladimir Dvorkin, Petr Topychkanov, Tong Zhao, Li Bin, *Entanglement – Russian and Chinese Perspectives on Non-Nuclear Weapons and Nuclear Risks,* (Washington D.C.: Carnegie Endowment for International Peace, 2017), 6; Erik Gartzke and Jon R. Lindsay, *Thermonuclear Cyberwar*, Journal of Cybersecurity, Vol. 3, No. 1, January 2017, 46; Sarah Bidgood, "Risky Business: Four Ways to Ease U.S.-Russian Nuclear Tension," *Arms Control Today*, Vol. 49, No. 7, September 2019, 5; James M. Acton, "Cyber Warfare and Inadvertent Escalation," *Daedalus*, Vol. 149, No. 2, 143-145.
[184] Heather Williams, "Asymmetric arms control and strategic stability: Scenarios for limiting hypersonic glide vehicles," *Journal of Strategic Stability*, 804-806; Manzo, 69-71; Durkalec et al., 9-11;
[185] Roberts, 12; Pifer (2016), 41.

Table A.4: Detailed Assumptions, Conditions, and Implications for Approach 3 "Bilateral political framework" for U.S.-China

"Bilateral political framework" Assumption (U.S.-China)	Implication(s) or Related Follow-On Assumptions
Building off success of the new U.S.-Russia framework, China is amenable to initial bilateral discussions with the U.S.	• Initial U.S.-China discussions begin at a working level roughly in parallel with U.S.-Russia post-New START progress. • Initial agreement initiated following start of new U.S.-Russian regime after 2026 and consists largely of setting up new data exchanges and communication channels. Politically binding framework in place on/after 2031.

Inspection and verification measures under a non-legally binding agreement between the U.S. and China will be even more limited than in the Russian case, due to the specifics of U.S.-Chinese relations.[186]	• U.S.-China agreement would be based on new communication channels for mutual understanding and risk reduction.
	• Mutual data exchanges would begin, consisting of:[187]
	  ○ U.S. confidential declarations of aggregate number of deployed ICBMs, SLBMs, nuclear-capable bombers
	  ○ Warheads mated with these "covered" systems
	  ○ China confidential declarations of aggregate size of nuclear stockpile, aggregate number of nuclear-capable delivery vehicles and breakdown by delivery type
	  ○ Mutual notifications similar to other aspects of the New START regime, including strategic delivery launcher notifications and notification of additional delivery vehicles
	  ○ A mutual agreement on "non-deployment zones" for specific offensive and defensive systems to avoid threatening China's second strike capability or undermining U.S. extended deterrence guarantees; this could also include some limit on total numbers of INF-range systems.[188]
	  ○ Mutual pledge for separate basing of INF-range systems from nuclear warheads/delivery systems.
	• Bilateral pre-launch missile notifications for long range missile systems.[189]

[186] Manzo, 94-95.
[187] Ibid., 110.
[188] Christian Alwardt, "US Missile Defence Efforts and Chinese Reservations in East Asia," *Asian Affairs*, Vol. 51, No. 3, September 2020, 605-620; Perkovich and Vaddi, 89-92.
[189] These measures were previously proposed by Frank Rose during his tenure as the Assistant Secretary of State for Arms Control, Verification, and Compliance; see also Talmadge, 9; Tannenwald, 215.

"Bilateral political framework" Assumption (U.S.-China)	Implication(s) or Related Follow-On Assumptions
	• Establish a U.S.-China direct communications link, mirroring the U.S.-Russia nuclear "hotline".[190]
The U.S. and China would agree upon a new commission or working group to facilitate data exchanges and other transparency steps or issues under this new regime.[191]	• This joint commission would facilitate concurrence on the mutual transparency and data exchange efforts described above. • The commission would also begin confidential data exchanges on new nuclear systems or major changes to overall force posture. This would include additional information on U.S. regional ballistic missile defenses.[192]
Initial risk reduction measures for non-nuclear strategic technologies are agreed upon.	• Mutual declaration of non-aggression against nuclear command and control centers, satellites, and related infrastructure, to include cyber-attacks.[193] • New bilateral and confidential data exchanges on weapon systems of interest: Types of Non-Strategic Nuclear Forces, Dual-use missile system developments, hypersonic glide systems, and autonomous delivery systems.[194]

[190] Peczeli et al., 7; Trenin, 174.
[191] Manzo, 110.
[192] Ibid. 110-111; Williams, 804-806.
[193] Acton et al., 6; Gartzke and Lindsay, 46; Bidgood, 5.
[194] Manzo, 69-71; Durkalec et. al., 9-11.

Table A.5: Detailed Assumptions, Conditions, and Implications for Approach 4 "Pursue nuclear superiority"

"Pursue nuclear superiority" Assumptions	Implication(s) or Related Follow-On Assumptions

New START is renewed until 2026 but not replaced; U.S. and Russia no longer bound by previous limits.	• Due to budget constraints and timelines for development and planning, U.S. and Russia make modest changes to existing nuclear modernization plans immediately after New START expiration (2026-2031); increased force postures are predominantly based on increasing warhead loads on currently deployed missiles.
	• Strategic warheads – both the U.S. and Russia field larger strategic nuclear forces from available stockpiles, starting after 2026:
	  ○ U.S. Bombers and Submarines: due to impacts on range and targeting flexibility, the U.S. makes modest increases to deployed weapons on bombers and submarines, increasing warhead numbers on day-to-day forces by a maximum of ~10%.[195] After 2031, bomber forces are increased by returning previously de-nuclearized B-52s (up to 30) back to nuclear status
	  ○ Russian Bombers and Submarines: similar changes as in the U.S. case, with the exception of a larger (~50%-100%) increase in SLBMs as planned Borei-Class SSBNs (which carry SLBMs with additional warheads vice current Delta III/IV submarines)[196] are deployed
	  ○ U.S. ICBMs: maximize available ICBM force and MIRV capabilities to field 800-1100 warheads.[197]
	  ○ Russia ICBMs: maximize available ICBM force and MIRV capabilities to field 1,200 warheads after 2026. After 2031, additional ICBMs are fielded by leveraging additional launchers which Russian officials have previously claimed are in storage.[198]
	• Non-strategic nuclear warheads (NSNW) – U.S. and Russia diverge based on differences in available warheads:

[195] Manzo, 51-53.
[196] Ibid., 52-54.
[197] Ibid., 51-53; Hans M. Kristensen and Matt Korda, "United States nuclear forces, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 1, January 2020, 47-49.
[198] Manzo, 53-55; Hans M. Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 2, 102-105.

"Pursue nuclear superiority" Assumptions	Implication(s) or Related Follow-On Assumptions
	○ U.S. steps could include the following: ▪ modest increases (~10%) to deployed gravity bombs in Europe from existing stockpiles ▪ continues fielding 'low yield' W76-2 warheads to current plans; expanded deployments limited by budget priorities ▪ expands / accelerates SLCM plans, fielding initial versions widely by 2031 ▪ expands GLCM plans, pursues some combination of increased fielding of Army Precision Strike Missiles (PrSM), ground-launched Tomahawks and/or IRBMs on/after 2026.[199] ▪ Offensive capability added to Aegis Ashore systems in Europe and Asia with to increase regional deterrence capabilities[200] ○ Russia steps could include the following: ▪ transitions its large supply of NSNWs to the field, paced by available delivery vehicles; results in deploying up to 500 non-strategic warheads by 2031 ▪ Supports NSNW deployments by maximizing projected modernization trends, including fielding 50 additional warheads via Kalibr and Tsirkon sea-launched cruise missile upgrades, fielding additional 140 warheads with new SS-26 Iskander-M deployments.[201]
Existing New START verification and data exchange regime ends in 2026.	• U.S. forced to leverage additional NTM assets to stay apprised of Russian force developments. Overall intelligence picture potentially reduced compared to 2026 as time goes on. • Expanded space-based ISR programs undertaken by U.S. Space Force.

[199] Dmitry Stefanovich, "How to address the Russian post-INF initiatives," *European Leadership Network Commentary*, January 20, 2020, https://www.europeanleadershipnetwork.org/commentary/how-to-address-the-russian-post-inf-initiatives/, accessed November 6, 2020.
[200] Paul McLeary, "The Rest Of The Story: Trump, DoD & Hill Readied INF Pullout For Years," *Breaking Defense*, October 22, 2018, https://breakingdefense.com/2018/10/the-rest-of-the-story-trump-dod-hill-readied-inf-pullout-for-years/.
[201] Kristensen and Korda, "Russian," 103-105.

"Pursue nuclear superiority" Assumptions	Implication(s) or Related Follow-On Assumptions
	• Pre-New START communication agreements, such as the 'hotline' and Ballistic Missile Launch Notification agreement, remain in place.
In line with what it sees as increased security threats in Europe and Asia, the U.S. expands currently fielded ABM systems.	• Potential new deployments and programs could include the following (listed in order of increasing cost and complexity) o Expand Ft. Greely from 44 to 64 silos as early as 2023.[202] o An additional CONUS ground-based interceptor (GBI) site is installed sometime over 2031-2036, potentially at Ft. Drum.[203] o Additional THAAD systems are procured and deployed to Europe and Asia. o Air-launched boost phase interceptor developed and integrated with 4th or 5th generation Air Force aircraft; additional F-35s dedicated to this mission could also be purchased.[204] o A space-based boost phase interceptor constellation is fielded after 2031; this could include either a limited constellation of roughly 24 satellites for partial global coverage or a full constellation of up to 960 satellites.[205]
China continues current modernization plans with no major changes in line with its history of reticence toward arms races but takes a more aggressive stance with nuclear weapons to better meet what it sees as a rising U.S. regional threat.	• China continues to current plans to expand and modernize their nuclear arsenal, increasing warheads to ~500 by 2031.[206] • Begins MIRVing and decreases use of storing warheads separately from missiles.
Due to budget constraints and lack of domestic support, the U.K. and France make no major changes to nuclear force posture.	• France continues with current modernization plans to field 3rd generation SSBNs, nuclear capable 6th-generation aircraft and next-generation aircraft carrier in the mid- to late-2030s.[207] • The U.K. continues with plans field new Drednought-class SSBNs equipped with W93 warheads by mid-2030.

[202] Thomas Karako and Ian Williams, *Missile Defense 2020 – Next Steps for Defending the Homeland*, Center for Strategic and International Studies Report, April 2017, 62.
[203] Congressional Budget Office, *Costs of Implementing Recommendations of the 2019 Missile Defense Review*, Congressional Budget Office Publication 56949, January 2020, 15-16.
[204] CBO Publication 56949, 19.
[205] CBO Publication 56949, 20-22.
[206] Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2020*, Annual Report to Congress (September 1, 2020), vii, 55-56.
[207] Hans M. Kristensen and Matt Korda, "French nuclear forces, 2019," *Bulletin of the Atomic Scientists*, Vol. 75, No. 1 (January 2019), 54-55.

"Pursue nuclear superiority" Assumptions	**Implication(s) or Related Follow-On Assumptions**
The lack of a U.S.-Russia treaty and resulting plans place additional strain on the NPT and CTBT.	Decreased transparency and increased strategic and non-strategic deployments possibly increase pressures on latent nuclear powers to pursue weapons development.

Bibliography

Books

Adamsky, Dmitry, "Strategic Stability and Cross-Domain Coercion: The Russian Approach to Information (Cyber) Warfare," from *The End of Strategic Stability? Nuclear Weapons and the Challenge of Regional Rivalries*, Lawrence Rubin and Adam N. Stulberg, eds. (Washington D.C.: Georgetown University Press, 2018), 148-168.

Arbatov, Alexey, "Mad Momentum Redux? The Rise and Fall of Nuclear Arms Control," *Survival*, Vol. 61, No. 3, May 2019, 7-38.

Arbatov, Alexey and Vladimir Dvorkin with Vladimir Evseev, *Beyond Deterrence: transforming the U.S.-Russia equation* (Washington D.C.: Carnegie Endowment for International Peace, 2006).

Cimbala, Stephen, *Nuclear Deterrence in a Multi-Polar World: The U.S., Russia and Security Challenges* (London: Taylor and Francis Group, 2016).

Croft, Stuart, *Strategies of arms control: A history and typology* (Manchester University Press: New York, 1996).

Gavin, Francis, *Nuclear Weapons and American Grand Strategy* (Washington, D.C.: Brookings Institution Press, 2020).

Green, Brendan Rittenhouse, *The Revolution that Failed: Nuclear Competition, Arms Control and the Cold War* (Cambridge, UK: Cambridge University Press, 2020).

Goodby, James, *Approaching the Nuclear Tipping Point : Cooperative Security in an Era of Global Change* (Lanham, Rowman and Littlefield: Lanham, MD, 2017).

Kaplan, Fred, *The Bomb: Presidents, Generals, and the Secret History of Nuclear War* (New York: Simon and Schuster, 2020).

Kroenig, Matthew, *The Logic of American Nuclear Strategy: Why Strategic Superiority Matters* (United States: Oxford University Press, 2018).

Payne, Keith B., *The Great American Gamble: Deterrence Theory and Practice from the Cold War to the Twenty-First Century*, (United States: National Institute Press, 2008).

Roberts, Brad, *The Case for U.S. Nuclear Weapons in the 21st Century* (Stanford, California: Stanford University Press, 2016).

Schelling, Thomas and Morton H. Halperin, *Strategy and Arms Control* (Washington: Pergamon-Brassey's, 1985).

Reports, Articles and On-Line Publications

Acton, James M., "Cyber Warfare and Inadvertent Escalation," *Daedalus*, Vol. 149, No. 2, Spring, 2020, 133-150.

Acton, James M. and Michael S. Gerson, *Beyond New START: Advancing U.S. National Security Through Arms Control With Russia*, Center for Strategic and International Studies Next Generation Working Group On U.S.-Russian Arms Control (Washington, D.C.: Center for Strategic & International Studies, 2011).

Acton, James M. (ed) with Alexey Arbatov, Vladimir Dvorkin, Petr Topychkanov, Tong Zhao, Li Bin, *Entanglement – Russian and Chinese Perspectives on Non-Nuclear Weapons and Nuclear Risks*, Carnegie Endowment for International Peace report (2017).

Acton, James M., Thomas D. Macdonald and Pranay Vaddi, *Revamping Nuclear Arms Control: Five Near-Term Proposals*, Carnegie Endowment for International Peace Working Paper, December, 2021.

Adamsky, Dmitry, "From Moscow with coercion: Russian deterrence from theory and strategic culture," *Journal of Strategic Studies*, Vol. 41, Nos. 1-2, 2018, 33-60.

Adamsky, Dmitry, "The art of net assessment and uncovering foreign military innovations: Learning from Andrew W. Marshall's legacy," *Journal of Strategic Studies*, Vol. 43, No. 5, July 2020, 611-644.

Akiyama, Nobumasa, "Nuclear Weapons: arms-control efforts need China," *Nature*, Vol. 584, August 6, 2020, 40-42.

Albertson, Michael, *Negotiating with Putin's Russia: Lessons Learned from a Lost Decade of Bilateral Arms Control*, Livermore Papers on Global Security No. 9, March 2021.

Alwardt, Christian, "US Missile Defence Efforts and Chinese Reservations in East Asia," *Asian Affairs*, Vol. 51, No. 3, September 2020, 605-620.

American Physical Society and Center for Strategic and International Studies, *U.S.-Russian Nuclear Reductions After New START: Summary of a Workshop Exploring Next Steps*, June 2013, https://www.aps.org/policy/reports/popa-reports/upload/nuclear-reductions.pdf

Arbatov, Alexei, "A Russian Perspective on the Challenge of U.S. NATO, and Russian Non-Strategic Nuclear Weapons," from *Reducing Risks in Europe: A Framework for Action*, a Nuclear Threat Initiative Report, November 17, 2011, https://www.nti.org/analysis/reports/reducing-nuclear-risks-europe-framework-action/.

Arbatov, Alexei, "Nuclear Deterrence: A Guarantee or Threat to Strategic Stability?," *Carnegie Moscow Center Article*, March 22, 2019, https://carnegie.ru/2019/03/22/nuclear-deterrence-guarantee-or-threat-to-strategic-stability-pub-78663#_ednref39.

Arbatov, Alexei and Vladimir Dvorkin with Vladimir Evseev, *Beyond Deterrence: transforming the U.S.-Russia equation* (Washington D.C.: Carnegie Endowment for International Peace, 2006).

Arbatov, Alexey and Vladimir Dvorkin, "The Great Strategic Triangle," Carnegie Moscow Center, April 1, 2013, https://carnegie.ru/2013/04/01/great-strategic-triangle-pub-51362.

Berejikian, Jeffrey D., "A Cognitive Theory of Deterrence," *Journal of Peace Research*, Vol 39, No 2 (2002).

Bernstein, Paul, "Contemporary Deterrence Challenges," from *The Return of Deterrence: Credibility and Capabilities in a New Era*, William G. Braun III, Stefanie von Hlatky, and Kim Richard Nossal (eds.) (Ontario: Queen's University Centre for International and Defence Policy, 2018).

Bidgood, Sarah, "Risky Business: Four Ways to Ease U.S.-Russian Nuclear Tension," *Arms Control Today*, Vol. 49, No. 7, September 2019.

Bin, Li, "Chinese Thinking On Nuclear Weapons," *Arms Control Today,* December 2015, https://www.armscontrol.org/act/2015-12/features/chinese-thinking-nuclear-weapons.

Bin, Li, "The Revival of Nuclear Competition in an Altered Geopolitical Context: A Chinese Perspective," *Daedalus*, Vol. 149, No. 2, Spring 2020, 56-69.

Bothwell, Heather M., "Grey Is the New Black: A Framework to Counter Gray Zone Conflicts," *Joint Forces Quarterly*, Vol. 101, March 31, 2021, 25-30.

Braun III, William G., Stefanie von Hlatky, and Kim Richard Nossal (eds.), *The Return of Deterrence: Credibility and Capabilities in a New Era*, The Kingston Conference on International Security Series (Ontario: Centre for International and Defence Policy, 2018).

Brooks, Linton, "Can the United States and Russia Reach a Joint Understanding of the Components, Prospects and Possibilities of Strategic Stability?" in *Revitalizing Arms Control and Nonproliferation, International Luxembourg Forum on Preventing Nuclear Catastrophe*, 2017, http://www.luxembourgforum.org/media/documents/Revitalizing_Nuclear_Arms_Control-_and_Non-Proliferation-Moscow-2017.pdf

Brooks, Linton, "The End of Arms Control?" *Daedalus*, Vol. 149, No. 2, Spring 2020, 84-100.

Brustlein, Corentin, "NATO's Nuclear Posture and Arms Control," *Whitehall Papers*, Vol. 95, No.1, 2019, 120-129.

Bureau of Arms Control, Verification and Compliance, U.S. Department of State, "The W76-2 Low-Yield Option," *Arms Control and International Security Papers*, Vol. 1, No. 4, April 22, 2020.

Buzhinsky, Evgeny, "The Russian Political and Security Context for Limits on Non-Strategic Nuclear Weapons," *Center for Strategic and International Studies Track-II Dialogue on Non-Strategic Nuclear Weapons*, Center for Strategic and International Studies (September 4, 2015).

Cameron, James, "What History Can Teach," *Daedalus*, Vol. 149, No. 2, Spring 2020, 116-132.

Chalmers, Malcolm and Dmitry Stefanovich, "Is This the End of Nuclear Arms Control?," *Royal United Services Institute Newsbrief*, Vol. 38, No. 10, November/December 2018, https://rusi.org/sites/default/files/20181107_newsbrief_vol38_no10_chalmers_and_stefanovich_web.pdf.

Charap, Samuel, Jeremy Shapiro, and Alyssa Demus, "Rethinking the Regional Order for Post-Soviet Europe and Eurasia," RAND Publication PE297, 2018.

General Kevin Chilton, USAF and Greg Weaver, "Waging Deterrence in the Twenty-First Century," *Strategic Studies Quarterly*, Spring 2009, 31-35.

Chivvis, Christopher S., Andrew Radin, Dara Massicot, and Clint Reach, *Strengthening Strategic Stability with Russia*, RAND publication PE234 (2017).

Chyba, Christopher F., "New Technologies & Strategic Stability," *Daedalus*, Vol. 149, No. 2, Spring 2020, 150-170.

Cimbala, Stephen J., "Nuclear Arms Control: A Nuclear Posture Review Opportunity," *Strategic Studies Quarterly*, Vol. 11, No. 3, Fall 2017, 95-114.

Colby, Elbridge, "Defining Strategic Stability: Reconciling Stability and Deterrence," in *Strategic Stability: Contending Interpretations*, eds. Elbridge Colby and Michael Gerson (Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2013), 47-84.

Congressional Budget Office, *Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046*, Congressional Budget Office Publication 53211, October 2017.

Congressional Budget Office, *Projected Costs of U.S. Nuclear Forces 2019-2028*, Congressional Budget Office Report 54914, January 2019.

Congressional Budget Office, *Costs of Implementing Recommendations of the 2019 Missile Defense Review*, Congressional Budget Office Publication 56949, January 2020.

Congressional Research Service, *Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress*, Congressional Research Service Report R41129, January 15, 2021.

Cooper, David. A, "Globalizing Reagan's INF Treaty," *The Nonproliferation Review*, Vol. 20, No.1, 145-163.

Countryman, Tom and Kingston Reif, "Intermediate-range missiles are the wrong weapon for today's security challenges," *War on the Rocks*, August 13, 2019, https://warontherocks-.com/2019/08/intermediate-range-missiles-are-the-wrong-weapon-for-todays-security-challenges/.

Crawford, Timothy and Khang Vu, "Arms Control and Great Power Politics," *War On The Rocks,* November 4, 2020, https://warontherocks.com/2020/11/arms-control-and-great-power-politics/, accessed November 10, 2020.

Davis, Paul K. *et. al.*, *Exploring the Role Nuclear Weapons Could Play in Deterring Russian Threats in the Baltic States* (Santa Monica, CA: RAND Publication, 2019).

Delpech, Therese, *Nuclear Deterrence in the 21st Century*, RAND Monograph Report MG1103 (2012).

Department of Defense transcript, *Adm. Richard Discusses USSTRATCOM Operations With Reporters*, September 14, 2020, https://www.defense.gov/Newsroom/Transcripts/-Transcript/Article/2347223/adm-richard-discusses-usstratcom-operations-with-reporters/

Derleth, James, "Russian New Generation Warfare – Deterring and Winning the Tactical Fight," Military Review, Vol. 100, No. 5, September-October 2020, 82-94.

James E. Doyle, "How Biden can achieve a first in arms control: A verifiable nuclear warhead freeze," *Bulletin of the Atomic Scientists*, December 15, 2020, https://thebulletin.org/2020/12/how-biden-can-achieve-a-first-in-arms-control-a-verifiable-nuclear-warhead-freeze/.

Dodge, Micheala, "History Shows U.S. Nuclear Restraint Is A One-Way Street," *War on the Rocks*, November 18, 2020, https://warontherocks.com/2020/11/history-shows-u-s-nuclear-restraint-is-a-one-way-street/.

Durkalec, Jacek and Andrei Zagorski, "Options for Transparency and Confidence-Building Measures Related to Non-Strategic Nuclear Weapons in Europe: Cost-Benefit Matrix," Post-Conference Report from the Polish Institute for International Affairs (2014).

Erlanger, Steven, "Are We Headed for Another Expensive Nuclear Arms Race? Could Be," *New York Times*, August 8, 2019, https://www.nytimes.com/2019/08/08/world/europe/arms-race-russia-china.html.

Ford, Christopher A., "U.S. Priorities for 'Next-Generation Arms Control," *Arms Control and International Security Papers*, Vol. 1, No. 1, April 6, 2020.

Ford, Christopher A., "Security Assistance and U.S. Competitive Strategy: Improving Our Game," *Arms Control and International Security Papers*, Vol. I, No. 3, April 21, 2020

Ford, Christopher A., "Competitive Strategy vis-à-vis China and Russia: A View from the 'T-Suite,'" *Arms Control and International Security Papers*, Vol. 1, No. 6, May 11, 2020.

Ford, Christopher A., "Strengthening Deterrence and Reducing Nuclear Risks, Part II: The Sea-Launched Cruise Missile-Nuclear (SLCM-N)," *Arms Control and International Security Papers*, Vol. 1, No. 11, July 23, 2020.

Ford, Christopher A., "Arms Control in Outer Space: History and Prospects," *Arms Control and International Security Papers*, Vol. 1, No. 12, July 24, 2020.

Ford, Christopher A., "To Tango Alone: Problems of Theory and Practice in the Sociology of Arms Control, Nonproliferation, Disarmament and Great Power Competition," *Arms Control and International Security Papers*, Vol. 1, No. 14, July 30, 2020.

Ford, Christopher A., "International Security in Cyberspace: New Models for Reducing Risk," *Arms Control and International Security Papers*, Vol. 1, No. 20, October 20, 2020.

Futter, Andrew and Benjamin Zala, "Advanced US conventional Weapons and Nuclear Disarmament – Why the Obama Plan Won't Work," *Nonproliferation Review*, Vol. 20, No. 1, 2013, 107-122.

Garamone, Jim, "Top U.S., Russian Military Leaders Meet to Improve Mutual Communication," U*.S. Department of Defense News*, December 18, 2019, https://www.defense.gov/Explore/-News/Article/Article/2043133/top-us-russian-military-leaders-meet-to-improve-mutual-communication/.

Garamone, Jim, "Esper Discusses Moves Needed to Counter China's Malign Strategy," *U.S. Department of Defense News*, August 27, 2020, https://www.defense.gov/Explore/News/-Article/Article/2326863/esper-discusses-moves-needed-to-counter-chinas-malign-strategy/.

Gartzke, Erik and Jon R. Lindsay, "Thermonuclear Cyberwar," *Journal of Cybersecurity*, Vol. 3, No. 1 (2017).

Gavin, Francis, "Nuclear Weapons and the Future of American Grand Strategy," *SAIS Review of International Affairs*, Vol. 39, No. 2 (2019).

General Kevin Chilton (USAF) and Greg Weaver, "Waging Deterrence in the Twenty-First Century," *Strategic Studies Quarterly* (Spring 2009).

Gottemoeller, Rose, "Rethinking Nuclear Arms Control," *The Washington Quarterly*, Vol. 43, No. 3 (September 2020).

Gotz, Elias, "Putin, the State, and War: The Causes of Russia's Near Abroad Assertion Revisited," *International Studies Review*, Vol. 19, No. 2, 2017; 228-247.

Götz, Elias and Camille-Renaud Merlen, "Russia and the Question of World Order," European Politics and Society, Vol. 20, No. 2, 2018.

Gressel, Gustav, "Under the Gun: Rearmament for Arms Control in Europe," European Council on Foreign Relations Policy Brief, November 2018, https://www.ecfr.eu/page/under_the_gun_rearmament_for_arms_control_in_europe5.pdf

Hitchens, Theresa, "Multilateralism in Space: Opportunities and Challenges for Achieving Space Security," *Space and Defense*, Vol. 4, No. 2, Summer 2010, 3-26.

Hudson Institute Transcript, "The Arms Control Landscape featuring DIA Lt. Gen Robert P. Ashley, Jr.," May 29, 2019, https://s3.amazonaws.com/media.hudson.org/-Hudson%20Transcript%-20-%20The%20Arms%20Control%20Landscape.pdf

Jervis, Robert, "Why Nuclear Superiority Doesn't Matter," *Political Science Quarterly*, Vol. 94, No. 4, Winter 1979-1980, 617-633.

Johnson, Kaitlyn, "A Balance of Instability – Effects of a direct-ascent anti-satellite weapons ban on nuclear stability," *International Security at the Nuclear Nexus*, Center for Strategic and International Studies, October 2020.

Joseph, Robert and Eric Edelman, *New Directions in Arms Control*, The National Review, April 29, 2019.

Kehler, C. Robert, "Nuclear Weapons & Nuclear Use," *Daedalus* Vol. 145, Issue 4, Fall 2016, p. 50-61.

Kendall-Taylor, Andrea and Jeffrey Edmonds, "The Evolution of the Russian Threat to NATO," *Whitehall Papers*, Vol. 95, No. 1, 2019, 52-60.

Kent, Glenn A. and David E. Thaler, *First-Strike Stability: A Methodology for Evaluating Strategic Forces*, RAND Corporation Publication R-3765-AF (Santa Monica, CA: RAND Corporation, 1989)

Klare, Michael, "The Challenges of Emerging Technologies," *Arms Control Today*, Vol. 48, No. 10 (December, 2018).

Klotz, Frank, "Extending New START is in America's National Security Interest," *Arms Control Today*, Vol. 49, No. 1 (January/February 2019).

Klotz, Frank, John Lauder, William Courtney, "Negotiating with Great Powers on Nuclear Arms," RAND Organization Blog, August 2020. https://www.rand.org/blog/2020/08/negotiating-with-great-powers-on-nuclear-arms.html

Koblentz, George, "Strategic Stability in the Second Nuclear Age," Council on Foreign Relations Report, November 2014, https://www.cfr.org/report/strategicstability-second-nuclear-age.

Koch, Susan J., "The Presidential Nuclear Initiatives of 1991-1992," *Center for the Study of Weapons of Mass Destruction Case Study 5* (Washington D.C.: National Defense University Press, September 2012).

Kofman, Michael, *Under the Missile's Shadow: What does the passing of the INF treaty mean?*, War on the Rocks, Oct 26, 2018. https://warontherocks.com/2018/10/under-the-missiles-shadow-what-does-the-passing-of-the-inf-treaty-mean/

Kremlin transcript, *Presidential Address to the Federal Assembly*, March 1, 2018, http://en.kremlin.ru/events/-president/news/56957, accessed November 9, 2020.
Kremlin transcript, *Meeting with representatives of Russian news agencies and print media*, February 20, 2019, http://en.kremlin.ru/events/president/news/59865, accessed November 6, 2020.

Kremlin transcript, *Statement by President of Russia Vladimir Putin on a comprehensive program of measures for restoring the Russia – US cooperation in the field of international information security*, September 25, 2020, http://en.kremlin.ru/events/president/news/64086.
Kremlin transcript, *Statement by Vladimir Putin on additional steps to de-escalate the situation in Europe after the termination of the Intermediate-Range Nuclear Forces Treaty (INF Treaty)*, October 26, 2020, http://en.kremlin.ru/events/president/news/64270.

Kristensen, Hans M., and Matt Korda, "French nuclear forces, 2019," *Bulletin of the Atomic Scientists*, Vol. 75, No. 1 (January 2019), 54-55.

Kristensen, Hans M., and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 1, 46-48.

Kristensen, Hans M., and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 2, 102-105

Kristensen, Hans M., and Matt Korda, "Chinese nuclear forces, 2020," Bulletin of the Atomic Scientists, Vol. 76, No. 6, 443-445

Kuhn, Ulrich, "Uncharted Waters: Europe and the End of Nuclear Arms Control," *Turkish Policy Quarterly*, Vol. 19, No. 2, Summer 2020, 103-112.

Kuhn, Ulrich, "Perceptions in the Euro-Atlantic," *Nuclear Risk Reduction Policy Brief Number 3* (Geneva, Switzerland: United Nations Institute for Disarmament Research, 2020), https://unidir.org/publication/perceptions-euro-atlantic.

Lee, Carrie A., "Electoral Politics, Party Polarization, and Arms Control: New START in Historical Perspective," *Orbis*, Vol. 63, No. 4, Fall 2019, 552-565.

Leonard, Mark and Jeremy Shapiro, *Empowering EU Member States with Strategic Sovereignty*, European Council on Foreign Relations, June 25, 2019.

Lewis, Jeffrey, "Minimum Deterrence," *Bulletin of the Atomic Scientists* (September 15, 2015).

Long, Austin, "Russian Nuclear Forces and Prospects for Arms Control," Testimony presented before the House of Representatives Committee on Foreign Affairs, Subcommittee on Terrorism, Nonproliferation, and Trade, June 21, 2018, RAND Testimony CT495.

Loukianova Fink, Anya and Olga Oliker, "Russia's Nuclear Weapons in a Multipolar World: Guarantors of Sovereignty, Great Power Status and More," *Daedalus*, Vol. 149, No. 2, Spring 2020, 37-55.

Mallory, King, *New Challenges in Cross-Domain Deterrence*, RAND Corporation publication PE259 (2018).

Manzo, Vince, *Nuclear Arms Control Without a Treaty? Risks and Options After New START* (Washington, D.C.: Center for Naval Analysis, 2019).

Maurer, John, "Purposes of Arms Control", *Texas National Security Review*, Vol. 2, No. 1 (November 2018), 22-37.

Maurer, John, "Restoring Nuclear Bipartisanship: Force Modernization and Arms Control," *War on the Rocks*, April 14, 2021, https://warontherocks.com/2021/04/restoring-nuclear-bipartisanship-force-modernization-and-arms-control/

Mazarr, Michael J. *et al.*, U*nderstanding the Emerging Era of International Competition: Theoretical and Historical Perspectives*, RAND Corporation Report (2018).

McLeary, Paul, "The Rest Of The Story: Trump, DoD & Hill Readied INF Pullout For Years," *Breaking Defense*, October 22, 2018, https://breakingdefense.com/2018/10/the-rest-of-the-story-trump-dod-hill-readied-inf-pullout-for-years/.

Miller, Steven E., "A Nuclear World Transformed: The Rise of Multilateral Disorder," *Daedalus*, Vol. 149, No. 2, Spring 2020, 17-36.

Mortlock, David, "Assessing the Use of Sanctions in Addressing National Security and Foreign Policy Challenges," Testimony to the Subcommittee on National Security, International Development, and Monetary Policy of the Committee on Financial Services, U.S. House of Representatives, May 15, 2019, https://www.-govinfo.gov/content/pkg/CHRG-116hhrg37927/pdf/CHRG-116hhrg37927.pdf

Office of the Secretary of Defense, *Nuclear Posture* Review (Washington D.C.: Department of Defense, February 2018.

Omelicheva, Mariya Y., "Russian Foreign Policy," in *Foreign Policy in Comparative Perspective*, Ryan Beasley, Juliet Kaarbo, Jeffrey Lantis, and Michael Snarr, eds. (Washington D.C.: CQ Press, 2012), 94-117.

Panda, Ankit, "The United States, China, and the Future of Arms Control", *The Diplomat*, July 8, 2020. https://thediplomat.com/2020/07/the-united-states-china-and-the-future-of-arms-control/

Peczeli, Anna, *et. al.*, *Nuclear Risk Reduction In An Era of Major Power Rivalry*, Center for Global Security Research Workshop Summary, Lawrence Livermore National Laboratory, February 19-20, 2020.

Perkovich, George, "A Brittle Nuclear Order," in Revitalizing Nuclear Arms Control and Nonproliferation, International Luxembourg Forum on Preventing Nuclear Catastrophe, 2017, 96-131. https://carnegieendowment.org/2017/12/18/brittle-nuclear-order-pub-75057.

Perkovich, George and Pranay Vaddi, *Proportionate Deterrence: A Model Nuclear Posture Review* (Washington D.C.: Carnegie Endowment for International Peace, 2021).

Perkovich, George, "Reinventing Arms Control," *The Day After – Navigating a Post-Pandemic World*, Carnegie Endowment for International Peace Digital Magazine (2020). https://carnegieendowment.org/2020/09/09/reinventing-nuclear-arms-control-pub-82500

Pezard, Stephanie, Andrew Radin, Thomas S. Szayna, F. Stephen Larrabee, "European Relations with Russia: Threat Perceptions, Responses, and Strategies in the Wake of the Ukrainian Crisis," Rand Corporation Publication RR1579, 2017.

Pifer, Steven, et al., *U.S. and Extended Deterrence: Considerations and Challenges*, Brookings Arms Control Series Paper 3, May 2010 (Washington: The Brookings Institution, 2010).

Pifer, Steven, *Missile Defense in Europe: Cooperation or Contention?*, Brookings Arms Control Series Paper 8 (May 2012),

Pifer, Steven, *Nuclear Arms Control Choices for the Next Administration*, Brookings Institute, October 2016.

Pifer, Steven, "Multilateralize the INF Problem," *Order from Chaos Brookings Institution Blog*, March 21, 2017, https://www.brookings.edu/blog/order-from-chaos/2017/03/21/multilateralize-the-inf-problem/.

Plous, S., "The Nuclear Arms Race: Prisoner's Dilemma or Perceptual Dilemma?" *Journal of Peace Research*, Vol. 30, No. 2, May 1993, 163-179.

Podvig, Pavel, Ryan Snyder and Wilfred Wan, "Evidence of absence: Verifying the removal of nuclear weapons," United Nations Institute for Disarmament Research Publication, 2018

Putin, Vladimir, "Meeting with experts in Sarov to discuss global threats to national security, strengthening Russia's defences and enhancing the combat readiness of its armed forces," Archive of the Official Site of the Prime Minister of the Russian Federation, February 24, 2012, http://archive.premier.gov.ru/eng/events/news/18248/.

Radin, Andrew and Clint Reach, "Russian Views of the International Order," RAND Publication RR1826, 2017.

Rapnouil, Manuel Lafont, Tara Varma, and Nick Witney, "Eyes Tight Shut: European Attitudes Towards Nuclear Deterrence," European Council of Foreign Affairs (December 2018).

Admiral Richard, Charles A., "Forging 21st-Century Strategic Deterrence," *U.S. Naval Institute Proceedings*, February, 2021.

Reif, Kingston and Shannon Bugos, "Russia Expands Proposal for Moratorium on INF-Range Missiles," *Arms Control Today*, November 2020, https://www.armscontrol.org/act/2020-11/news-briefs/russia-expands-proposal-moratorium-inf-range-missiles.

Reif, Kingston and Alicia Standers-Zakre, "U.S. Nuclear Excess: Understanding the Costs, Risks and Alternatives," *Arms Control Association Report*, April 2019.

Roberts, Brad, "On Adapting Nuclear Deterrence to Reduce Nuclear Risk," *Daedalus*, Vol. 149, No. 2, Spring 2020, 69-82.

Roberts, Brad, "On Theories of Victory, Red and Blue," *Livermore Papers on Global Security No. 7*, June 2020.

Roberts, Brad (ed.), *Major Power Rivalry and Nuclear Risk Reduction: Perspectives from Russia, China, and the United States*, Center for Global Security Occasional Paper, Lawrence Livermore National Laboratory, May 2020.

Roche, James G., and Thomas G. Mahnken, "What is Net Assessment?" from *Net Assessment and Military Strategy: Retrospective and Prospective Essays*, Thomas. G. Mahnken, ed. (Amherst, NY: Cambria Press, 2020), 20-32.

Scouras James, *U.S. Strategic Forces Under the Prospective START Treaty*, RAND Corporation Note N-3913-AF, 1991.

Scheinman, Adam, "Making Sense of the Nonproliferation-Disarmament Divide," *War on the Rocks*, August 6, 2020. https://warontherocks.com/2020/08/making-sense-of-the-nonproliferation-disarmament-divide/

Schelling, Thomas, "The Future of Arms Control", *Operations Research*, Vol. 9, Issue 5 (September/October 1961).

Schelling, Thomas, "What Went Wrong with Arms Control?", *Foreign Affairs*, Vol. 64, Issue 2 (Winter 1985/1986).

Schneider, Jacquelyn, "A Strategic Cyber No-First-Use Policy? Addressing the US Cyber Strategy Problem," *The Washington Quarterly*, Vol. 43, No. 2, 2020, 159-175.

Smith, Dan, "Nuclear Deterrence and Strategic Stability," *Contemporary Security Policy*, Vol. 5, No. 2, 1984, 180-188.

Stefanovich, Dmitry, "Strategic Stabilization: A Window of Opportunities for the Russia and U.S.," *Russia International Affair Council*, April 4, 2018, https://russiancouncil.ru/en/analytics-and-comments/analytics/strategic-stabilization-a-window-of-opportunities-for-russia-and-the-u-s/.

Stefanovich, Dmitry, "Russia to Help China Develop an Early Warning System," *The Diplomat*, October 25, 2019, https://thediplomat.com/2019/10/russia-to-help-china-develop-an-early-warning-system/, accessed November 16, 2020.

Stefanovich, Dmitry, "U.S. Inspection of New Russian Missile May Revive Stalled Arms Control Talks," *Moscow Times*, December 2, 2019, https://www.themoscowtimes.com/2019/12/02/us-inspection-of-new-russian-missile-may-revive-stalled-arms-control-talks-a68437, accessed November 16, 2020.

Stefanovich, Dmitry, "How to address the Russian post-INF initiatives," *European Leadership Network Commentary*, January 20, 2020, https://www.europeanleadershipnetwork.org/-commentary/how-to-address-the-russian-post-inf-initiatives/, accessed November 6, 2020.

Stent, Angela, "Russia and China: Axis of Revisionists?" *Brookings Institution Report on Global China: Assessing China's Growing Role in the World*, February 2020.

Talmadge, Caitlin, "The US-China Nuclear Relationship: Why Competition is Likely to Intensify," Brookings Institute Publication, September 2019.

Tannenwald, Nina, "Life After Arms Control: Moving Toward a Global Regime and Restraint and Responsibility," *Daedalus*, Vol. 149, No. 2 (Spring 2020).

Timbie, James, "A Way Forward," *Daedalus*, Vol. 149, No. 2, Spring 2020, 190-205.

Trachtenberg, David, "U.S. Extended Deterrence: How Much Strategic Force Is Too Little?" in *Tailored Deterrence: Influencing States and Groups of Concern*, eds. Barry Schneider and Patrick Ellis (Maxwell Air Force Base, AL: USAF Counter Proliferation Center, 2012).

Trenin, Dmitri, "Stability amid Strategic Deregulation: Managing the End of Nuclear Arms Control," *The Washington Quarterly*, Vol. 43, No. 3 (September 2020).

U.S. Defense Department, *Military and Security Developments Involving the People's Republic of China 2020 – Annual Report to Congress*, Office of the Secretary of Defense, September 2020.

U.S. Strategic Command, Admiral Charles Richard Interview with Mitchell Institute for Aerospace Studies Web Series, July 30, 2020, https://www.stratcom.mil/Media/Speeches/-Article/-2300365/interview-with-mitchell-institute-for-aerospace-studies-web-series/.

Vaddi Pranay and James M. Acton, *A ReSTART for U.S.-Russian Nuclear Arms Control: Enhancing Security Through Cooperation*, Carnegie Endowment for International Peace Working Paper (October 2020).

Van Bruusgaard, Kristin, "Russian Strategic Deterrence," *Survival*, Vol. 58, No. 4 (August-September 2016).

Vergun, David, "General Says NATO Prepared to Respond to Aggression Should Deterrence Fail," *U.S. Department of Defense News*, April 13, 2021, https://www.defense.gov/Explore-News/Article/Article/2570896/-general-says-nato-prepared-to-respond-to-aggression-should-deterrence-fail/.

Waltz, Kenneth, "The Spread of Nuclear Weapons: More May Be Better," Adlephi Papers, No. 171 (London: International Institute for Strategic Studies, 1981).

Weiss, Andrew S. and Nicole Ng, "Collision Avoidance: The Lessons of U.S. and Russian Operations in Syria," Carnegie Endowment for International Peace Report, March 20, 2019, https://carnegieendowment.org/2019/03/20/collision-avoidance-lessons-of-u.s.-and-russian-operations-in-syria-pub-78571.

White House, *National Strategy for Critical and Emerging Technologies*, October, 2020, https://www.whitehouse.gov/wp-content/uploads/2020/10/National-Strategy-for-CET.pdf.

Williams, Heather, "Asymmetric arms control and strategic stability: Scenarios for limiting hypersonic glide vehicles," *Journal of Strategic Stability*, Vol. 42, No. 6, August 2019, 789-813.

Wolfstahl, Jon (ed.), *Blundering Toward Nucleare Chaos: The Trump Administration After 3 Years* (Washington D.C.: Global Zero, 2020).

Wolfstahl, Jon, "Why Arms Control?" *Daedalus*, Vol. 149, No. 2, Spring 2020, 101-115.

Woolf, Amy, "The New START Treaty: Central Limits and Key Provisions," Congressional Research Service Report R41219, February 3, 2021.

Woolf, Amy, *Nonstrategic Nuclear Weapons*, Congressional Research Service Report RL32572, May 4, 2020.

Zenko, Michah, *Toward Deeper Reductions in U.S. and Russian Nuclear Weapons*, Council on Foreign Relations Special Report No. 57, November, 2010

Zhao, Minghao, "Is a new Cold War Inevitable? Chinese Perspectives on U.S.-China Strategic Competition," *The Chinese Journal of International Politics*, Vol. 12, No. 3, 2019, 371-394.

Zhao, Tong, "China in a world with no US-Russia treaty-based arms control," in Nuclear Arms Control Without A Treaty, Center for Naval Analyses, March 2019, https://www.cna.org/ - CNA_files/PDF/IRM-2019-U-019494.pdf.

Zhao, Tong, "Opportunities for Nuclear Arms Control with China," *Arms Control Today*, Vol. 50, No. 1 (2020), https://www.armscontrol.org/act/2020-01/features/opportunities-nuclear-arms-control-engagement-china.