STRATEGIC ARMS CONTROL
BEYOND NEW START

Lessons from Prior Treaties and Recent Developments

National Security Report

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Summary

The United States has been a party to numerous treaties on nuclear weapons, dating back to the 1960s. These treaties fall into two general categories, with some overlap between them: treaties that constrain activities (e.g., nuclear testing, placing nuclear weapons in outer space, and nuclear proliferation) and treaties that constrain the number and nature of weapons that the parties can possess. All treaties limiting the size and nature of nuclear arsenals have been bilateral agreements between the United States and Russia (or the Soviet Union before 1992). This report describes all eight of these treaties, with particular focus on the New Strategic Arms Control Treaty (New START),[1] and analyzes how well they kept up with emerging technology and the security environment of their times. This report then draws lessons from earlier treaties and developments of the last decade.

In negotiating strategic arms control agreements, the key US objectives have been to sustain stable strategic nuclear deterrence and to reduce unnecessary and costly arms races.[2] For example, in attempts to meet these goals, the original START of 1991 placed limits on "heavy" intercontinental ballistic missiles (ICBMs) with multiple warheads, and the Anti-Ballistic Missile (ABM) Treaty of 1972 placed limits on missile defenses. Data exchange and verification provisions, including on-site inspections, can support these objectives by reducing each side's concerns regarding the size and capabilities of the other side's arsenal. This report considers how arms-control agreements have (partially) met these goals over five decades, and what lessons the United States should learn for negotiating future arms-control agreements.

Of the treaties that limit nuclear forces (not activities), only the Intermediate-Range Nuclear Forces (INF) Treaty of 1987 and the New START of 2010 played any role in the last decade. The United States withdrew from the INF Treaty in August 2019 because Russia fielded a weapon of a type clearly prohibited by the treaty. Russia, of course, followed suit. The original expiration date for New START was February 5, 2021, but the United States and Russia extended it for an additional five years (the maximum allowable amount of time) in late January 2021. When President Obama took office in January 2009, the 1991 START was ten and a half months away from its expiration date. START took more than seven years to negotiate. Consequently, the negotiating teams operated under severe time pressure and therefore somewhat limited goals in comparison with those associated with the very lengthy negotiations for the INF Treaty and the original START. Hence, the United States must devote serious thought—and very soon—to how to get the best practical results from whatever treaty might follow New START.

This report lays out several issues that the United States should consider while preparing for the next treaty.

- The United States should try to make sure the next treaty accounts for credible near-term advances in relevant technology and new types of weapons through the middle 2030s at least.

[1] It is common to see START and New START referred to as the START Treaty and the New START Treaty, although the word *Treaty* at the end is redundant. The same applies to the Strategic Arms Limitation Treaty (SALT) of 1972. For conciseness, this report uses the terms START and SALT, with no *Treaty* added.

[2] In their 1964 book *Strategy and Arms Control*, Schelling and Halperin proposed that arms control should serve the same three objectives as defense policy and investment: reducing the likelihood of war, reducing the consequences if war occurs, and reducing the costs of preparing for war. Because of the enormous destructive power of nuclear weapons, there is no real prospect of reducing the consequences of an all-out nuclear war. Thus, reducing the likelihood of war (by sustaining deterrence and reinforcing stability) and reducing costs (by avoiding unnecessary arms races) stand out as the key US objectives.

  - Examples of new (and, in one case, resurrected) nuclear weapons that the next treaty should cover include hypersonic boost-glide weapons, intercontinental cruise missiles, air-launched ballistic missiles on fighters and medium bombers, and intercontinental torpedoes.

- In deciding how to approach the next treaty, the United States must anticipate and account for credible near-term changes in the international security environment, and the types of weapons that the United States might need to adjust to such changes. The next treaty should reflect a realistic view of the world at the time of the next treaty and hedge against plausible adverse developments for the duration of the treaty.
  - Many in the United States expected gradually improving relations with Russia for many years, starting around the time the Berlin Wall fell. The 2014 Russian intervention in Ukraine including the annexation of Crimea, along with subsequent actions including attempted intervention in US elections in 2016 and 2020, have shown that the United States should think of Russia as an adversary, absent dramatically favorable developments in the future. This does not mean that further arms-control negotiations are a bad idea; to the contrary, arms control is relevant for adversaries, not allies. However, the United States should approach such negotiations carefully, with a realistic view of the possible benefits and of plausible Russian behavior while the treaty is in force.
  - Further, treaty limits may need to reflect possible threats from countries other than Russia and—at least ideally—should not restrict development of specialized capabilities critical to deterrence of or defending against other adversaries. (The United States might trade away nonessential capabilities to advance US security vis-à-vis Russia if such capabilities threaten Russia appreciably—for example, by being able to reach Moscow or Saint Petersburg or by endangering Russian strategic forces.)
- The next treaty should define terms in a manner that does not allow easy exploitation of definitions for weapons.
  - Russia has been exploiting weapon definitions to field strategically important weapons that do not *automatically* count against New START. It may be possible to address these weapons through the *new kind rule* in New START (which is explained later), and the United States should certainly try to do so while New START is still in effect.
  - The next treaty should make it harder to field strategically important weapons that are not captured by treaty definitions unless the United States decides that deterrence and stability would be better served by the ability to emulate Russia in this manner.
- The next treaty should mandate robust data exchange and on-site verification measures. Furthermore, before formulating the treaty, the United States should devote thought to how much cheating, and of what types, would be sufficient to justify withdrawal from the treaty.
  - Previous Russian/Soviet violations of the ABM Treaty of 1972, the Strategic Arms Limitation Treaties (SALT) of 1972 and 1979, and the INF Treaty highlight the importance of robust verification measures and of the need to think about how to respond to violations.
  - New START is reasonably good in terms of data exchange and verification measures, and it is unclear that the United States could have achieved better provisions in the limited amount of time available to negotiate New START.

- The United States needs to consider the possible strategic impact (particularly threats to the US homeland) from types of weapons not covered by New START and earlier treaties. For example:
  - Because of its smaller size and more coastal nature, the United States is more vulnerable to medium-range sea-launched nonstrategic nuclear weapons than is Russia. Unfortunately, Russia has modern sea-launched long-range cruise missiles, possibly including nuclear weapons.[3]
  - Russia has a huge advantage over the United States in nonstrategic nuclear weapons overall, both numerically and in terms of operational characteristics. These weapons pose a major threat to NATO and appreciable threats to Japan and Alaska, over and above the threat posed to the continental United States by Russian sea-launched cruise missiles.
  - If practical, the next treaty should place some constraints on Russian nonstrategic nuclear weapons. If this is not practical, the United States needs to think about other ways to redress this disparity (e.g., improvements to US capabilities in nonstrategic nuclear weapons, better defenses against such weapons, or both).
- The United States is more likely to obtain a desirable outcome if it can negotiate from a position of strength and it has negotiating leverage.
  - The United States is more likely to obtain a desirable treaty if it maintains the strategic nuclear program of record, has a robust development program for hypersonic weapons, and conducts at least early steps toward reducing Russia's advantages in nonstrategic nuclear weapons.
  - As a historical example, newly deployed US weapons—the Pershing II ballistic missile and a ground-launched nuclear cruise missile—gave the United States leverage to extract major Soviet concessions in the INF Treaty.

Further, the United States should consider carefully whether it would accept any limits on its national ballistic missile defense (BMD) program, or BMD in Europe, in exchange for Russian concessions on something else, such as nonstrategic nuclear weapons not currently covered by any treaty. The goal of US national BMD is to defend against North Korea, but continued US expansion of this system could provoke Russian and/or Chinese increases in strategic offense that might not otherwise occur.[4] Hence, the United States needs to consider the value of US national BMD as a bargaining chip,[5] although no previous treaty has explicitly linked BMD to offensive systems in such a manner. However, any limitations on US BMD could easily result in a failure to achieve Senate consent to ratification of the treaty. Hence, the United States may find it difficult to exploit something that could provide significant leverage in negotiations with Russia.

[3] Ways to consider the impact of such weapons include war games and physics-based capability analyses of what adversary weapons could do to the United States.

[4] For example, China has recently initiated a major expansion to its silo-based ICBM force. It is uncertain whether US BMD contributed to this Chinese decision.

[5] Any such limits on US BMD might be based on a mutually agreed upon number of US and Russian systems, or the US limits could be based on the number of North Korean long-range ballistic missiles. Keying the limits to the number of North Korean strategic weapons might give Russia and/or China incentive to apply pressure on North Korea. The United States and the Soviet Union negotiated SALT and the ABM Treaty at the same time, so there may have been some behind-the-scenes linkages between missile defense and strategic offense.

In addition to considerations about treaties, the United States needs to think about the strategic/nuclear force structures that it would like to have in the future (with New START limits, with no limits, and possibly with notional but plausible limits other than those from New START). And, particularly if US missile defenses are "off the table," additional credible US nuclear delivery system programs could increase US bargaining leverage to achieve a follow-on agreement to New START that best meets US interests. As part of this process, the United States needs to think more broadly about the types of nuclear weapons and long-range conventional weapons (subsonic through hypersonic) that it should pursue for fielding in the 2030s and beyond, instead of simply adhering to the types of weapons in the current program of record. Russia, for example, is developing types of weapons that the United States neither possesses nor plans to possess. So is China. This is not to say that the United States should mimic Russian and/or Chinese efforts without regard for strategic stability or the operational desirability of such weapons in the US context. However, the United States needs to study multiple types of weapons that are not in the program of record. Examples include:

- Long-range nuclear weapons of various types on fighters and bombers
  - The United States should consider cruise missiles and other weapons—nuclear-capable hypersonic and ballistic missiles.
- Nuclear and conventional ground-launched and/or sea-launched cruise missiles, with ranges from 2,000 to more than 5,500 kilometers
  - Withdrawal from the INF Treaty in 2019 has provided flexibility for fielding ground-launched weapons of types previously prohibited.
- Nuclear boost-glide weapons on land and at sea
  - The United States plans to field conventional boost-glide weapons on land, on submarines, and possibly on B-52 bombers, and it should also evaluate nuclear-tipped boost-glide weapons.
- Nuclear and conventional intermediate-range ballistic missiles on land and at sea
  - Withdrawal from the INF Treaty has provided flexibility for the United States and Russia to field intermediate-range ballistic missiles on land. China already has a large inventory of such weapons, many of which employ state-of-the-art technology.

Such studies might identify types of weapons that warrant transitioning to acquisition programs. Further, early-stage acquisition programs on one or more such weapons might provide negotiating leverage.[6] In considering whether (and how far) to pursue such programs, the United States must balance the potential value for deterrence and bargaining chips against the financial cost of one or more new nuclear delivery systems.

This report focuses on bilateral arms control between the United States and Russia, but other factors are relevant for future analyses. For example, China has the economic resources and the technology to be a great nuclear power in the future if it desires to do so, and there are some indications that China does

[6] The history of prior negotiations cannot definitively prove the utility of yet-to-be-fielded weapons as bargaining chips. However, during the ABM negotiations in 1971 and early 1972, the United States was nominally planning to field five or more missile-defense sites. The Soviet Union agreed to major limitations on such defenses even though the US sites were in the developmental stage.

intend to become a great nuclear power by 2040 or even sooner. Major Chinese nuclear expansion could render bilateral US–Russian treaties undesirable by 2030 or lead to setting limits much higher than would otherwise be the case (for Russia and/or the United States to maintain a sizable margin of superiority over China). Hence, the United States should also study trilateral arms control.

Studies of the sort mentioned above could help inform decisions about

- which types of new weapons, if any, to field;
- desirable long-term US strategic force structure options;
- the best negotiating strategy to use with Russia;[7]
- possible considerations and caveats for continued bilateral treaties if China becomes a great nuclear power but refuses to participate in arms control; and
- possible considerations for trilateral arms control with Russia and China in the 2030s.
  - Relevant considerations would include how to entice China to participate in negotiations and join as a treaty party and how to set limits and counting rules in a trilateral treaty.

Finally, many earlier arms-control treaties between the United States and Russia (or the Soviet Union) took anywhere from two and a half to seven years to negotiate, exclusive of preparatory work to initiate negotiations. The expiration date for New START is less than four and a half years away, so the time to begin thinking about arms control beyond New START is now.

[7] The United States and Russia have completed an initial round of strategic stability talks, with Wendy Sherman as the head of the US team. They preliminarily agreed to move forward with a successor to New START.

The United States has been a party to many treaties on nuclear weapons, dating back to the 1960s, some of which limited activities rather than nuclear forces. Table 1 lists treaties that limited the size or nature of nuclear arsenals for the signatories (always the United States and the Soviet Union [now Russia]). Of these treaties, only the New Strategic Arms Reduction Treaty (New START) is still in force. New START was set to expire on February 5, 2021, but the United States and Russia extended it for another five years in January 2021.

The eight treaties listed in the table differ substantially in terms of the items on which they placed limits. Six of the treaties are conceptually similar, in that they placed limits on the number of strategic offensive weapons (a term that was not well or consistently defined) allowed to each party. The Anti-Ballistic Missile (ABM) Treaty placed limits on the number of ballistic missile defense (BMD) interceptors and BMD interceptor sites, plus restrictions on BMD radars and the nature of BMD interceptors (e.g., no laser weapons). The Intermediate-Range Nuclear Forces (INF) Treaty banned a whole family of intermediate-range ground-launched weapons. To identify lessons for the future, the appendix discusses and analyzes all eight of the treaties listed in Table 1 in detail. Table 2 briefly summarizes the types of items limited by each of the six treaties on strategic offensive arms.

This report focuses on treaties that limit US and Russian arsenals, with implications for negotiations on whatever treaty may replace New START. It discusses the following topics:

- A description of New START
- Various lessons the United States should learn from New START and earlier treaties regarding factors relevant to future arms-control negotiations (one section per major lesson). Major lessons pertain to:
  - The importance of anticipating and accounting for credible near-term advances in relevant technology and types of weapons
  - The importance of anticipating and accounting for credible near-term changes in the international security environment, and the types of weapons that the United States might need to respond to such changes

Table 1. US–Russian Treaties on the Size or Nature of Nuclear Arsenals

Name	Date Signed	Entry into Force	Planned End Date	Notes
Strategic Arms Limitation Treaty (SALT)	1972	1972	1977	Largely adhered to until START entered into force
ABM Treaty[a]	1972	1972	Never	United States withdrew in 2002; limited US–Soviet-Russian national missile defense
SALT II	1979	US Senate did not ratify because of the Soviet invasion of Afghanistan. Effectively superseded by START.		
INF Treaty	1987	1988	Never	United States withdrew in 2019. Banned a whole family of weapons.
START	1991	Dec. 1994	Dec. 2009	Expired on planned end date
START II	1993	Never	Senate ratified but Russian Duma modified the treaty. Senate never ratified the modified version.	
Strategic Offense Reduction Treaty (SORT)	2002	2003	2013	Superseded by New START on February 5, 2011
New START	2010	2011	2026	Extended until February 5, 2026; original end date was 2021

[a] The ABM Treaty limited BMD against strategic missile, not offensive forces.

Table 2. Overview of Items Limited by Various Treaties

Treaty	ICBMs	SLBMs	SSBNs	Bombers	Delivery Vehicles	Deployed Warheads
SALT	Yes	Yes	Yes	No	Not directly[a]	No
SALT II	No[b]	No[b]	No	No	Yes	No
START	No[c]	No	No	No	Yes	Yes
START II	No	No	No	No	No	Yes
SORT	No	No	No	No	No	Yes
New START	No	No	No	No	Yes	Yes

[a] SALT had separate sub-limits on land-based intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and ballistic missile submarines (SSBNs), with no limit on bombers. There was little flexibility to trade ICBMs, SLBMs, and SSBNs within some overall combined limit.

[b] SALT II had a separate sub-limit on the combined number of ICBMs and SLBMs that were equipped with multiple independently targeted reentry vehicles (MIRVs).

[c] START had a separate sub-limit on "heavy ICBMs" that exceeded a defined size or had a payload exceeding a defined weight.

  - The need to define terms in a manner that does not allow easy exploitation of definitions
  - The importance of robust verification measures to detect cheating, and the need to think about how to respond to cheating before formulating the treaty
  - The possible strategic impact (particularly threats to the US homeland) from types of weapons not covered by treaties to date (particularly nonstrategic nuclear weapons [NSNWs] but also new and novel weapons). For example, because of its smaller size and more coastal nature, the United States is more vulnerable to medium-range sea-launched NSNWs than is Russia.
  - The importance of having negotiating leverage
- A roll-up of these lessons into a path forward for a successor to New START, which this report calls START 2026
- A chronological description of the treaties that have limited US and Russian/Soviet nuclear forces since 1972, including an analysis of the extent to which these treaties did or did not keep up with weapons technology that was evolving at the time of the treaties, with Soviet/Russian behavior, and with general foreign developments. This is in the appendix, which also contains a cursory description of treaties that limit activities rather than arsenals.

In addition, China has apparently decided to implement a major buildup of its nuclear forces over the next decade or two, and it may be a great nuclear power by 2040.[1] This raises questions about the continued viability of bilateral agreements between the United States and Russia after New START expires, about ways to entice China into a trilateral arms-control framework, and on how the limits and counting rules might work in a trilateral treaty. However, these considerations—although important—are beyond the scope of this report.

Description of New START

When President Obama took office in January 2009, the 1991 START was ten and a half months away from its expiration date. START took seven years to negotiate, not counting preparations for starting

[1] OSD, *Military and Security Developments 2020*.

actual negotiations. It took about three months to get negotiations going for New START. The negotiations then lasted from late April 2009 until the beginning of April 2010. Consequently, the negotiating teams operated under severe time pressure, somewhat limiting the goals in comparison with those associated with the very lengthy negotiations for the INF Treaty and the original START. Further, the bipartisan Perry–Schlesinger commission recommended in early 2009 that the negotiators "make the first step on U.S.-Russian arms control modest and straightforward in order to rejuvenate the process and ensure that there is a successor to the START I agreement before it expires at the end of 2009. The United States and Russia should not over-reach for innovative approaches."[2]

On April 8, 2010, US President Barack Obama and Russian President Dimitri Medvedev signed New START. The treaty entered into force on February 5, 2011. New START defines ballistic missiles, cruise missiles, and the range of a cruise missile in the same way as earlier treaties dating back to the INF Treaty and START, but it has some differences regarding SLBMs and heavy bombers. New START definitions are as follows:

- *Ballistic missile* means a weapon-delivery vehicle that has a ballistic trajectory over most of its flight path.
  - The treaty did not define the term *ballistic trajectory*.
- *Cruise missile* means a self-propelled weapon-delivery vehicle that sustains flight by aerodynamic lift over most of its flight path.
  - The treaty did not define the term *self-propelled*. The US interpretation is that *self-propelled* means continuously powered, like an aircraft.
- The treaty defined the *range* of a *cruise missile* as the distance flown when the missile runs out of fuel, plus "projection to the Earth's surface." The final clause about projection to the Earth's surface presumably refers to the distance a missile might glide after running out of fuel, but this is not explicit.
- *Submarine-launched ballistic missile (SLBM)* means a ballistic missile (nuclear or conventional), with a range exceeding 600 kilometers, of a type that has ever been carried by or launched from a submarine.
  - A long-range ballistic missile on a surface ship would not automatically count against New START limits unless a submarine had also carried the same type of missile.
- *Intercontinental ballistic missile (ICBM)* means a land-based ballistic missile (nuclear or conventional) with a maximum range exceeding 5,500 kilometers.
- *Heavy bomber* means a nuclear-capable aircraft with a one-way unrefueled range exceeding 8,000 kilometers or any aircraft that carries a nuclear air-launched cruise missile (ALCM) with a range exceeding 600 kilometers.
  - A bomber can carry purely conventional weapons of any range without counting against New START limits if that bomber is not equipped to carry any nuclear weapons, or if that bomber has a one-way range of less than 8,000 kilometers and it does not carry nuclear ALCMs with a range exceeding 600 kilometers.
  - An aircraft could potentially carry nuclear weapons of very long range without counting against treaty limits if the weapons in question are not cruise missiles. Examples include air-launched ballistic missiles (ALBMs) and hypersonic boost-glide weapons (HBGWs). START banned ALBMs. The section after next discusses ALBMs and HBGWs.

[2] Perry et al., *America's Strategic Posture*, 71.

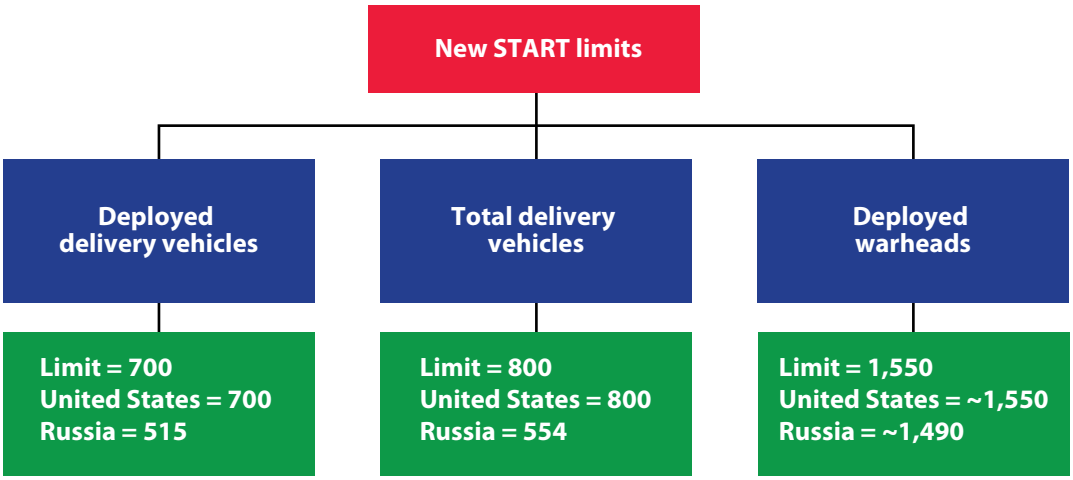


Figure 1. New START Limits Plus US and Russian Force Levels

The way that New START defines the terms above (such as *heavy bomber*, *ICBM*, and *SLBM*) leaves ambiguities and loopholes that Russia could exploit. (Most of these issues date back to earlier treaties. The only exceptions are for ALBMs and ballistic missiles on surface ships.) As will be explained later, Russia actually has exploited some of these ambiguities. It may be the case that the United States tried to avoid such issues during the New START negotiations but was unable to obtain Russian consent in the limited amount of time available. However, readily available sources do not discuss this point.

Figure 1 illustrates New START limits.[3] The United States and Russia had to meet the limits by February 2018, with intermediate steps along the way. Each operational heavy bomber, ICBM, or SLBM counts as one deployed strategic delivery vehicle. Each usable, but empty, ICBM silo (or an empty launcher vehicle for a mobile ICBM, which Russia has but the United States does not) counts as one total delivery vehicle (but not as a deployed delivery vehicle).[4] Each empty SLBM tube on a ballistic missile submarine (SSBN) in long-term overhaul counts as one total delivery vehicle (but not as a deployed delivery vehicle). ICBMs and SLBMs in storage do not count against treaty limits. Each heavy bomber in long-term maintenance counts as one total delivery vehicle (but not as a deployed delivery vehicle). Each operational heavy bomber counts as one deployed warhead, without regard for the bomber's maximum weapon load or the number of nuclear weapons available for use by bombers. An operational ICBM or SLBM with *N* warheads counts as *N* deployed warheads. The accountability can vary from one missile to another of the same type, which potentially complicates verification but also potentially provides better insight into real capabilities. New START places no limits on the number or nature of weapons carried by heavy bombers or on nuclear cruise missiles of any type (ground-launched cruise missiles, or GLCMs; or sea-launched cruise missiles, or SLCMs).[5]

In 2010, US forces exceeded all three limits,[6] whereas Russia was already in compliance with the limits on delivery vehicles. It is uncertain whether Russia exceeded the limit on deployed warheads in 2010.

[3] See the full text of New START at https://2009-2017.state.gov/t/avc/newstart/c44126.htm.

[4] The actual term in the treaty is "deployed plus non-deployed delivery vehicles," but "total delivery vehicles" is a simpler term and will be used throughout the rest of this report.

[5] However, the INF Treaty banned GLCMs with a maximum range between 500 and 5,500 kilometers from 1987 until 2019.

[6] The United States had 820 deployed delivery vehicles and 886 total delivery vehicles at that time. The number of deployed warheads was greater than 1,550.

New START has three additional provisions of relevance here. If a new weapon employs the booster stack from a missile that is already declared as an ICBM or SLBM, then the new weapon would count as an ICBM or SLBM against treaty limits, even if the new weapon does not meet the definition of a ballistic missile. This is called the *existing type rule*. In addition, New START has a provision allowing the United States or Russia to identify a new weapon as a *new kind of strategic offensive arm* and initiate discussions in the Bilateral Consultative Commission to determine how, or whether, it should count against treaty limits. The treaty does not define the term *new kind of strategic offensive arm*, but testimony to the US Senate during the New START ratification process apparently indicated that this term would not apply to a purely conventional weapon. Neither the United States nor Russia has ever invoked the *new kind of strategic offensive arm rule*, so it is impossible to say how such discussions might play out. Thus, it impossible to know whether this rule—even if pursued aggressively—is adequate to capture emerging technologies. Finally, some surface-to-air missiles (SAMs) and BMD interceptors technically meet the definition of a ballistic missile, but New START, and several earlier treaties, exempt missiles designed and tested *solely* to intercept objects above the surface of Earth. However, if an offensive weapon were to use the booster stack from an interceptor, then that missile would no longer be *solely* for intercepting objects above the surface of Earth. Under these conditions, the defensive interceptor might be treated as an ICBM or SLBM—*even if the offensive version did not meet the definition of a ballistic missile*.[7]

Assessment: First, New START originated at a time when the United States thought that the relationship between Russia and Western democracies was on a desirable long-term trajectory. Unfortunately, events since 2010 have proven otherwise. Second, New START did not do a good job of keeping up with emerging technology, such as ALBMs, HBGWs, intercontinental GLCMs, and intercontinental nuclear torpedoes. Several earlier treaties prohibited ALBMs. Earlier treaties did not address HBGWs, but these weapons were on the horizon in 2010, which was not the case at the time of earlier treaties. Intercontinental nuclear GLCMs have long been practical, and the United States briefly fielded such GLCMs in the early 1960s. It would have been desirable to address such weapons in New START, and it may be that the US delegation tried to do so but was unable to obtain Russian acquiescence in the limited amount of time available. (The United States has not released the negotiating record, so it is hard to know what the United States tried to do but without success.) On the positive side, New START has extensive verification procedures and good procedures for data exchange, avoided any accountability for British and French forces, avoided any limits on US missile defenses, and had a reasonable expiration date. Finally, the United States needs to avoid a situation like that in 2009, with little time left to negotiate a complex treaty that is set to expire soon. **The time is already ripe to begin thinking about START 2026.**

[7] The observation about the *new kind rule* apparently not applying to a purely conventional weapon was likewise relayed to the author by the head of the relevant division at the Pentagon. This provision about offensive use of previously defensive interceptor missiles is not directly relevant to any of the issues discussed in this report but could be relevant in the future and could limit US or Russian efforts to develop offensive versions of SAMs or BMD interceptors, or to modify such weapons to fulfill both offensive and defensive roles. There is also a *new type rule* that applies to new weapons of a general type already covered by the treaty, such as a new land-based ballistic missile with a range greater than 5,500 kilometers. For example, the new Russian SS-29 Satan ballistic missile would be classified as an ICBM because of the *new type rule*.

Translating Prior Experience into Lessons for the Future

Examination of previous treaties, recent developments in the international security environment, and recent developments in military technology reveal several lessons that the United States should incorporate into future negotiations on strategic arms. First, START 2026 needs to account for plausible developments in relevant weapon technology through 2035 at least. Similarly, the numerical limits in START 2026 need to avoid disproportionate US reductions (unless the United States gets something else in return that is important).

Second, treaties reflect assumptions about the world security environment and the relationship between the signatories of the treaty. All treaties from START through New START were based on optimistic assumptions about the evolving relationship with Russia. Such assumptions are no longer consistent with the current world situation. Moreover, the United States needs to think about the threats from potential adversaries other than Russia and avoid the assumption that everything other than Russia is a "lesser included case." Specialized capabilities—that are potentially unimportant against Russia—might be important against other adversaries. The United States needs to protect flexibility for such capabilities to the extent practical.

Third, START 2026 needs to do a good job of defining weapons and other terms. Russia has been exploiting existing shortcomings in definitions (some of which are long-standing, others of which are not) to develop and even field strategically relevant weapons that do not *automatically* count against treaty limits. The United States should strive to avoid such issues in the future, without needing to rely on a complex and uncertain feature such as the *new kind rule* in New START.

Fourth, the Soviet Union cheated on the ABM Treaty (by building a forbidden type of radar at Krasnoyarsk) and SALT II (by encrypting telemetry from ICBM flight tests). Russia cheated on the INF Treaty for several years (by fielding a prohibited type of GLCM) before the United States withdrew from the treaty in 2019. While conducting future negotiations, the United States needs to give serious thought to verification procedures, strategies on what to do if Russia cheats on the next treaty (or New START), and how much cheating would have to occur before withdrawal from the treaty would be the best recourse. Research on new technologies to assist with verification would also be desirable.

Fifth, Russia has major asymmetric advantages over the United States in NSNWs and this situation has become markedly more pronounced in the last 20 years. This is related to the issue on new technology, but some important types of NSNWs have been around since the 1970s and 1980s and have never counted against strategic treaty limits. In addition, the United States is smaller and more coastal than Russia (especially in terms of ice-free coasts) and is therefore more vulnerable to medium-range weapons at sea than is Russia. Consequently, there is a potentially significant threat to the US homeland from Russian NSNWs that do not count against New START limits (nor would they have counted against the limits from any earlier treaty). The United States needs to consider the impact of such weapons in the future. Earlier treaties, except for the INF Treaty, largely ignored the military importance of Russian NSNWs (and the INF Treaty only applied to ground-launched NSNWs, even though sea-launched NSNWs might be equally threatening).

Sixth, it is reasonable to think that the United States would be in better position to achieve a treaty that is beneficial to US interests if the United States can negotiate from a position of strength. It will be hard to obtain Russian concessions unless the United States has something to give up (or at least limit) that Russia fears, in an area where the United States is numerically or technologically superior to Russia. For example, Russia seems to be concerned

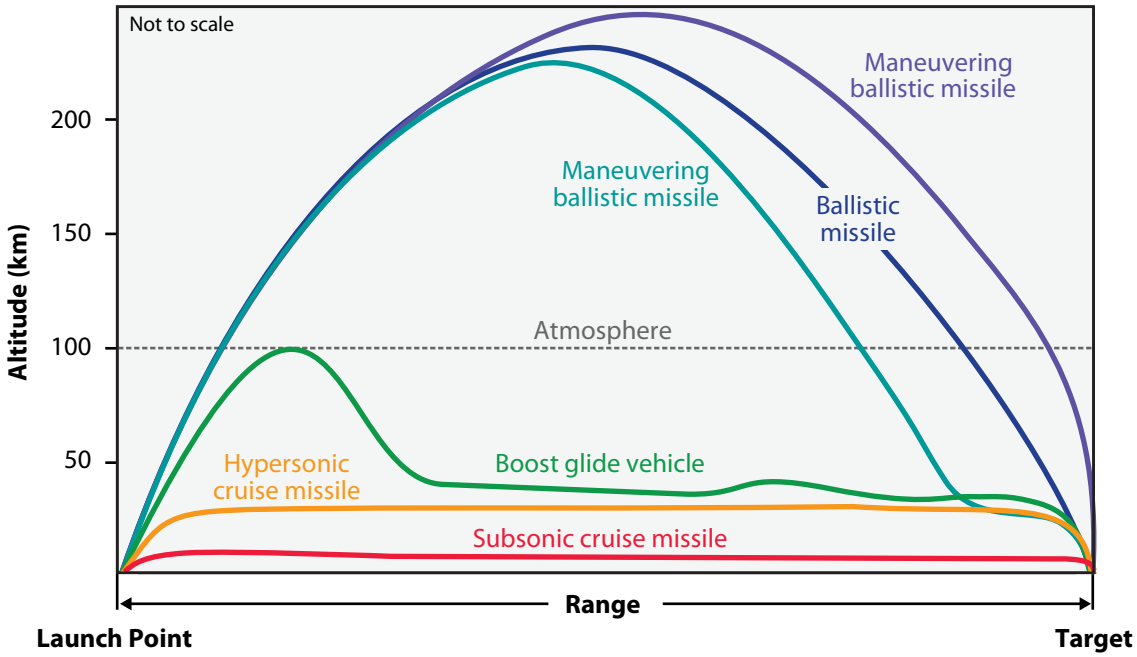


Figure 2. Boost-Glide Weapons vs. Ballistic Missiles vs. Cruise Missiles

about US national BMD and about US BMD in Europe (perhaps more concerned than is warranted, based on the number and performance of US BMD interceptors). Connecting BMD to offensive weapons in the next treaty might provide US leverage for Russian concessions on something else (such as NSNWs), but would be politically contentious (perhaps fatally so, in terms of Senate ratification) within the United States.

Lesson One: Account for New Types of Weapons

Emerging types of weapons had little or no impact on treaties before New START. That is now changing, and the next treaty needs to keep up with emerging and foreseeable technology. The most publicized example may pertain to hypersonic weapons. In the 1980s, the only hypersonic weapons were ballistic missiles. In recent years, the United States, Russia, and China have been pursuing HBGWs. Several countries are also pursuing hypersonic air-breathing cruise missiles (HACMs), but current and previous arms-control treaties treat all cruise missiles the same, regardless of speed. (However, HACMs could have operational implications that warrant special treatment in treaties.[8]) An HBGW—even if launched from an aircraft—uses a rocket to launch a hypersonic glide vehicle (HGV) to a high altitude. The HGV then dives to an altitude where the atmosphere is thick enough to let the HGV glide the rest of the way to the target. An HGV would typically glide slightly more than half the distance from the launch point to the target.

Figure 2 compares several types of hypersonic weapons, plus subsonic cruise missiles. (Supersonic cruise missiles are an intermediate case between HACMs and subsonic cruise missiles.) The figure is not to scale. Some long-range HBGWs might have a maximum altitude of up to 200 kilometers, and

[8] The term *hypersonic* refers to speeds of Mach 5 (about 6,100 kilometers/hour) or higher. The United States has never fielded an HACM, although the AGM-28 Hound Dog (Mach 2+) and the AGM-69 Short-Range Attack Missile (SRAM, Mach 3) were supersonic nuclear ALCMs. The SRAM II (terminated in 1991) would have been similar to SRAM in terms of speed, but would have had more range, a smaller radar cross section, and a new warhead.

the fraction of distance spent in glide for an HBGW would usually be less than shown in the figure (but still over 50 percent). The maximum altitude for a ballistic missile would depend on the range of the missile and could be up to 600 kilometers or more.

An HBGW has several potential advantages over a ballistic missile that does not have a large amount of terminal maneuverability, especially for longer-range weapons:

- A ballistic reentry vehicle (RV) on a long-range missile would be at an extremely high altitude for most of its trajectory, which might allow enemy radars to track the RV for a long time. By contrast, surface-based radars would have a much shorter line of sight to an HGV. This could benefit the HGV in terms of survivability.
- An HGV could control its angle of impact at the target, whereas a purely ballistic RV could not. The ability to control the angle of impact could increase the lethality of a conventional warhead.[9]
- Many current BMD interceptors have a minimum intercept altitude exceeding the altitude at which the HGV would glide; therefore, BMD interceptors would be ineffective against a boost-glide weapon unless they could hit the HBGW before the HGV descended to its glide altitude.
- An HBGW might have slightly more range than a ballistic missile of the same size and payload weight.

Conversely, the time of flight for an HBGW would typically be about 10 to 15 percent longer than that of a ballistic missile of similar range.

Relative to a subsonic cruise missile, the primary advantages of an HBGW or an HACM would be a shorter time of flight (useful for time-critical targets) and better survivability. However, HBGWs may have advantages over HACMs in survivability because of their greater cruising speed and higher cruising altitude.

In addition to its possible utility, an HBGW apparently does not meet the New START definition of a ballistic missile because it does not fly a "predominantly ballistic trajectory." One could argue that an HBGW should qualify as a ballistic missile because it is probably capable of flying a "predominantly ballistic trajectory," but it might be hard to make this argument stick unless the HBGW has actually flown such a trajectory. Hence, unless an HBGW uses a booster stack previously associated with an ICBM or an SLBM (and is captured by the New START *existing type rule*), it would probably not qualify as an ICBM or SLBM under New START. In particular, the United States plans to field a conventional HBGW, with a range considerably in excess of 600 kilometers, on attack submarines (SSNs), and the US position is that this weapon is not an SLBM. Much like a cruise missile, an HBGW employs aerodynamic lift to sustain flight for most of the distance flown to the target. However, it is unclear whether an HBGW is *self-propelled*, because it is powered for only a small fraction of the distance flown. In any event, New START imposes no limits on GLCMs or SLCMs,[10] so classification of an HBGW as a cruise missile would matter only if an aircraft carries the HBGW. Neither the United States nor Russia has ever invoked the *new kind of strategic offensive arm rule* from New START, so it is hard to say how this rule might apply to an HBGW.[11]

[9] For several decades, ballistic missiles adhered strictly to a ballistic trajectory even if the RV had some terminal guidance. Some of the newer foreign ballistic missiles have guided RVs with significant terminal maneuverability. This makes it harder for a BMD system to hit the RV and allows the RV some control over angle of impact.

[10] The United States should consider whether future treaties should limit SLCMs or GLCMs.

[11] Senate testimony during New START hearings apparently indicated that the *new kind* provision would apply only to nuclear weapons, but this language does not appear in the treaty itself.

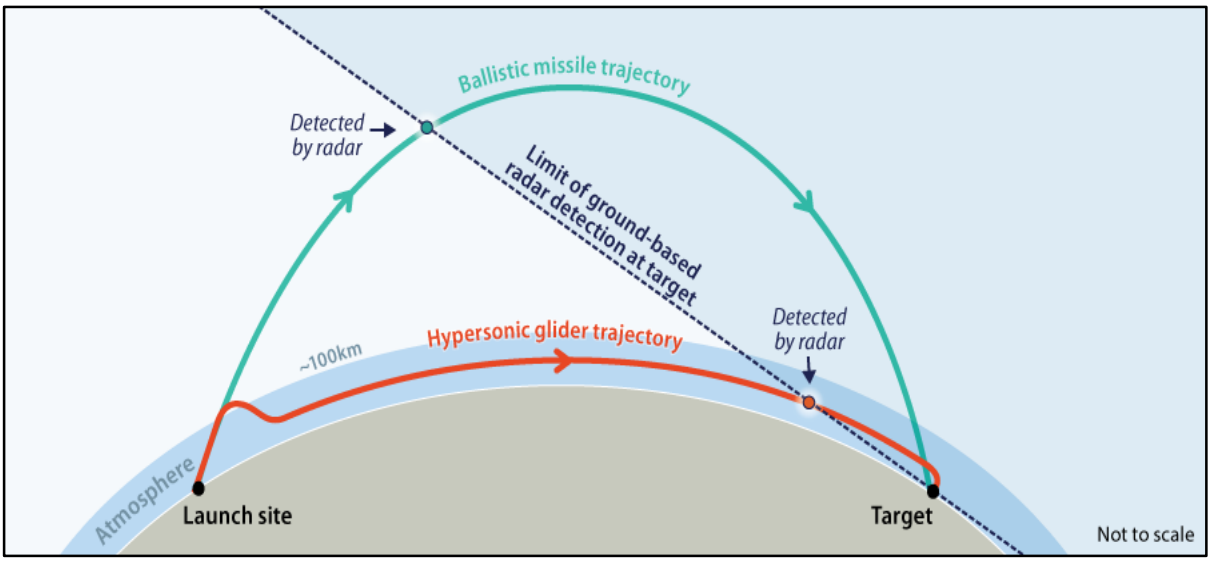


Figure 3. Terrestrial Radar Detection of HGVs and Ballistic RVs

Boost-glide weapons also introduce potential issues regarding strategic stability. For example, the first point in the list above is relevant to stability, because a country being attacked would probably have less opportunity to track an HGV than a ballistic RV on a missile with a range similar to the boost-glide weapon. However, if the country being attacked has missile-warning satellites, it could detect the launch of a long-range boost-glide weapon, although it might not initially be certain whether it was the intended target.[12] Figure 3 illustrates this factor, although not to scale. Moreover, an HGV could divert to the left or right of its ballistic trajectory, thereby introducing ambiguity about the intended aimpoint. In theory, satellites might be able to track the heat signature of an HGV, but Michael Griffin, former under secretary of defense for research and engineering, stated that "hypersonic targets are 10 to 20 times dimmer than what the United States normally tracks by satellites in geostationary orbit."[13]

Conceptually, a new type of weapon could impair stability in other ways, but these are of varying or questionable relevance to hypersonic weapons. First, a new weapon might be more lethal than existing weapons against hard targets such as ICBM silos, thereby facilitating a disarming first strike. This parameter is a function of yield, accuracy, and fusing options. However, there is no reason to think that HGVs or HACMs would be superior to guided ballistic RVs or subsonic cruise missiles by this metric. Second, a new weapon could conceivably introduce nuclear-conventional ambiguity issues that were previously absent. However, subsonic cruise missiles have come in nuclear and conventional versions for decades, and China has nuclear and conventional variants of medium-range ballistic missiles (MRBMs) and intermediate-range ballistic missiles (IRBMs). Hence, HGVs and HACMs

[12] The United States has a robust constellation of advanced missile-warning satellites. Russia reportedly has four modern missile-warning satellites, according to the Russian news agency TASS ("Russia Sets Up Basic Missile Attack Early Warning Satellite Grouping"). It is uncertain whether China has such satellites, but it has the resources and technology to field a robust constellation of missile-warning satellites by 2030. No other countries are likely to have such satellites by 2030.

[13] Quoted in Sayler, *Hypersonic Weapons*, 3. However, this is not the same as an explicit statement that US Space-Based Infrared System (SBIRS) satellites have no capabilities against even the largest and fastest HGVs. Most US satellites for detecting ballistic missile launches are in geostationary orbit, but some are in highly elliptical polar orbits. Figure 3 appears on p. 3 of this same report.

Table 3. US, Russian, and Chinese Efforts on Novel Weapons

Type of Weapon	United States	Russia	China
Intercontinental nuclear HBGW	No	Fielded	R&D
Regional nuclear HBGW	No	R&D	R&D
Regional conventional HBGW	R&D	?	R&D, maybe fielded
Conventional ALBM	No	Fielded	Possible R&D
Nuclear ALBM	No	Possibly fielded	Possible R&D
Nuclear intercontinental GLCM	No	R&D	No
Nuclear intercontinental torpedo	No	R&D	No

R&D, research and development.

do not make nuclear ambiguity worse.[14] Finally, boost-glide weapons could impair the effectiveness of current BMD systems. However, opinions vary on whether BMD systems are stabilizing or destabilizing, and advanced countries such as Russia, China, and the United States could develop specialized defenses that are effective against HGVs during their glide phase. Such defenses might involve satellites in low Earth orbit that could track HGVs (by their heat signature) plus SAMs that are effective at higher altitudes than currently fielded strategic SAMs and/or BMD interceptors that are effective at lower altitudes than those of currently fielded BMD interceptors.

At least three other types of new or resurrected weapons are also relevant (ALBMs, intercontinental GLCMs, and intercontinental torpedoes), although the United States is not working on any of them. Table 3 lists these types of weapons and whether the United States, Russia, and China are working on them. The text discusses some of these efforts.

ALBMs are not conceptually new; there was research on such weapons as far back as the 1970s and the United States tested such a weapon. However, no country has fielded an ALBM until recently. China is apparently developing ALBMs, and Russia has fielded an ALBM with a range of perhaps 2,000 kilometers (according to Russian open literature)—called the Kh-47M2 Kinzhal—on MiG-31 fighters and possibly on Tu-22M3 Backfire medium bombers (neither of which counts against New START limits). The Kinzhal has a conventional version and may have a nuclear version, according to open literature.[15] If it has a nuclear version, the Kinzhal exploits a loophole in New START. Any aircraft that carries a nuclear ALCM with a range exceeding 600 kilometers counts against New START limits as a heavy bomber, without regard for the range of the aircraft or the number of such weapons that it can carry. Hence, if either the MiG-31 or the Tu-22M3 were equipped with a nuclear ALCM having even one-half the postulated range of the Kinzhal, then these aircraft would be heavy bombers under New START counting rules. The United States could identify the Kinzhal as a *new kind of strategic offensive arm* and initiate discussions in the Bilateral Consultative Commission on counting it against New START limits. Russia has about 120 MiG-31 fighters and 65 Tu-22M3 bombers.[16] In October 2020, Russia declared that it

[14] However, China apparently mixes nuclear and conventional variants of MRBMs and IRBMs in the same launch units. This introduces another, and potentially dangerous, form of nuclear ambiguity. Foreign attacks on Chinese conventional missiles might destroy nuclear missiles in the same launch units and thereby trigger a Chinese nuclear response.

[15] Missile Defense Project, "Kinzhal."

[16] "Aircraft - Fixed-Wing - Military - MiG (Mikoyan) MiG-31."

possessed 515 deployed strategic delivery vehicles (versus a limit of 700), 554 total delivery vehicles (versus a limit of 800), and 1,491 deployed warheads (versus a limit of 1,550).[17] If these two aircraft were to count against New START limits as heavy bombers, this would place Russia in violation of the limit on deployed warheads.[18] In operational terms, on the other hand, the MiG-31 with the Kinzhal could not function in the manner of a true heavy bomber because of its short combat radius (similar to that of a US F-15E) and the possibly shorter range of the Kinzhal in comparison with nuclear ALCMs such as the US AGM-86 (2,500 kilometers or more) on the B-52 and the Russian Kh-102 (reportedly 4,500 kilometers) that is carried by Bear and Blackjack heavy bombers.[19] The Backfire has a much greater unrefueled one-way range than the MiG-31 (probably at least 6,000 kilometers), and it might pose some threat to North America if equipped with a 2,000-kilometer nuclear standoff weapon. In other words, the Kh-47 violates the apparent intent of New START, and it poses a major threat in Europe (from bases in western Russia), Japan (from Russian bases near Manchuria or Korea), and Alaska (from bases in far eastern Russia). When carried by the Backfire bomber, it may also threaten substantial parts of North America.[20]

Second, GLCMs of intercontinental range are not completely new, in that the United States briefly fielded a small number of SM-62 Snark intercontinental GLCMs from 1958 through the early 1960s. However, there were no such weapons for more than 60 years after retirement of the Snark in late 1961 (due to the perceived superiority of ICBMs). This has now changed. Russia is developing an intercontinental nuclear-tipped cruise missile—possibly called the Burevestnik or Skyfall—that may be nuclear powered. Such a cruise missile would probably be too large for delivery by aircraft or SSNs, so this new missile is probably a GLCM. This GLCM would function much like a single-warhead ICBM but would not count against New START limits. If this weapon enters production, the United States could invoke the *new kind rule* (with no guarantee of success). However, the fact that the United States once fielded a GLCM with intercontinental range (even if only briefly, and before SALT) might work against a successful objection. Conversely, if Skyfall really is nuclear powered, this might make it easier to invoke the *new kind rule*, since no country has ever fielded a nuclear-powered aircraft or missile.[21]

Finally, Russia is developing a nuclear-powered uncrewed underwater vehicle (UUV) or super torpedo. This UUV/torpedo has intercontinental range, with autonomous navigation, and reportedly has a multi-megaton warhead. It may also be fast enough that the United States would have difficulty intercepting it. Articles in the open literature refer to this weapon by several names, including Poseidon, Kanyon, and Status-6.[22] A (deliberately?) leaked photograph shows a torpedo-like object with a diameter of 1.6 to 2 meters and a length of 24 meters. There is much uncertainty about the specifications for this system; some reported values of speed, range, and maximum depth are approximately 100 kilometers/hour, 10,000 kilometers, and 1,000 meters, respectively. However, if Kanyon is nuclear powered, as has been reported, the operational range could be far in excess of 10,000 kilometers and the weapon could stay at sea for weeks

[17] Woolf, *New START Treaty*.

[18] Sayler, in *Hypersonic Weapons* (p. 12), indicates that Russia is also fielding the Kinzhal on the Su-34 fighter, plus the MiG-31 and the Tu-22M3. If the Su-34 were to count against New START limits, Russia would be in violation of all three limits.

[19] "Kh-101, Kh-102."

[20] Woolf, *New START Treaty*.

[21] Sanger and Kramer, "U.S. Officials Suspect New Nuclear Missile"; and Wikipedia, s.v. "9M730 Burevestnik." (*Note on Wikipedia:* This tertiary source is cited in cases where no other open sources could be located or it was the only source that I knew to be accurate.)

[22] Gady, "Nuclear Torpedo-Carrying Sub to Enter Service"; and Wikipedia, s.v. "Status-6 Oceanic Multipurpose System."

Table 4. US Efforts on Conventional Hypersonic Weapons

System	Budget Requests/Enacted (Millions)			Range (km)	IOC[a] Date
	FY 2020	FY 2021	FY 2022		
IRCPS in VPM tubes on Block V *Virginia*-class SSNs	$512	$767	$1,374	2,500 to 3,780	2028
LRHW on ground vehicles	$404	$832	$301	2,500 to 3,780	2024
ARRW on aircraft	$286	$386	$238	1,800	2024
TBG on ships	?	$82	$50	?	?
OpFires on ground vehicles	$202	$48	$45	1,800	?
HAWC on aircraft	$20	$31	$200	?	?

Sources: The funding information, the 2,500-kilometer range for IRCPS/LRHW, and the 1,800-kilometer range for ARRW are from Sayler, *Hypersonic Weapons*, 5–8. The range estimate for OpFires is from Freedberg, "DARPA's Hypersonic OpFires." A Union of Concerned Scientists blog post indicates that IRCPS has a range of 3,780 kilometers (Tracy, "Common Hypersonic Glide Body").

[a] Initial Operational Capability.

before striking a target. Warhead yields of 2 to 100 megatons have been mentioned in connection with Kanyon, but the leaked photograph indicates a warhead volume about one-fourth that of the Soviet 50-megaton Tsar Bomb from 1961. This suggests a yield well below 50 megatons.[23] Finally, some articles describe Kanyon as being "autonomous," although the meaning of this term is uncertain in this case. It may simply mean that the weapon can navigate autonomously to its preplanned target after Russia launches it. If Kanyon can select a target on its own or decide whether to attack while loitering at sea, this would be an extremely worrisome application of autonomy. Overall, Kanyon is a new-in-principle weapon with no Cold War analogue (even at the R&D stage), although its combination of long range and high yield places it squarely in the category of strategic weapons. As with the other weapons mentioned, Kanyon would not count against New START limits except possibly because of the *new kind rule*.

The United States is developing several types of conventional hypersonic weapons, as listed in the Table 4. The Navy is developing an HGV and a booster stack for use on Block V *Virginia*-class SSNs in Virginia Payload Module (VPM) tubes, starting in 2028. This weapon is called the Intermediate-Range Conventional Prompt Strike (IRCPS) missile. The Army is planning to field the same weapon on ground vehicles under the name Long-Range Hypersonic Weapon (LRHW). The Air Force is working on an HBGW called the Advanced Rapid Response Weapon (ARRW) for delivery by the B-52 and possibly other aircraft. (The Air Force also performed some R&D on an ALBM for the B-52 but canceled the program in 2020.) DARPA (the Defense Advanced Research Projects Agency) is developing an HGV called Tactical Boost Glide (TBG) and a booster stack for use on ground vehicles and ships. The combination of the TBG HGV and the DARPA booster stack is referred to as OpFires. DARPA and the Navy are also investigating the use of the TBG HGV on a (presumably smaller) booster stack that would fit in the tubes of a Mark 41 Vertical Launch System (VLS) on cruisers and destroyers. DARPA is also working on the Hypersonic Air-Breathing Weapon Concept (HAWC), an HACM that unspecified

[23] The original variant of the SS-18 ICBM reportedly carried a single warhead with a yield of 18 to 25 megatons. The SS-18 currently carries 10 warheads with a reported yield of 750 to 1,000 kilotons. The original SS-18 warhead might be the Poseidon warhead (Pike et al., "R-36M / SS-18 SATAN").

aircraft will carry. HAWC is supposed to transition to the Air Force in fiscal year (FY) 2022.

Finally, other emerging technologies—especially artificial intelligence but also quantum technology and cyberattacks on nuclear command, control, and communications (NC3) systems—are relevant to nuclear stability and possibly the balance of military power. However, such information-related technologies do not automatically lead to weapons that treaties would count, and restrictions on the use of these technologies in nuclear systems would be extremely hard to verify.

Possible approach to using this lesson: Recently fielded and developmental Russian weapons have major arms-control implications. Hence, the United States needs to consider ways to capture these new weapons in the next round of arms-control negotiations. Further, before beginning negotiations, the United States needs to seriously think about types of weapons that could plausibly emerge during the period in which START 2026 will be in effect. The United States should try to capture such weapons in the next treaty unless it wants to pursue new and emerging types of weapons outside of treaty constraints. One possible approach to this would be to define the types of weapons—or nuclear weapons at a minimum—that are allowed (e.g., ballistic missiles on land or on submarines, bombers with nuclear weapons, and so on), with everything that is not mentioned being banned. This would be radically different from the approach taken in all treaties to date. In addition, the need to account for new technologies and new types of weapons could argue against treaties that are of indefinite duration (such as the INF Treaty and the ABM Treaty), or perhaps any duration exceeding ten years.

Lesson Two: Account for the Current and Evolving International Security Environment

Arms-control treaties are intended to help shape the world or bilateral security environment in a desirable manner, and such treaties have often had this effect. On the other hand, all arms-control treaties are themselves based on assumptions about the international security environment during the period when the treaty will be in effect. If the treaty has an indefinite duration, or even a duration exceeding a decade, these assumptions may not line up with reality. In fact, such assumptions may diverge from reality within a few years of signing a treaty.

In terms of a big-picture view of the world situation, all the treaties from START through New START were signed at a time when the United States expected a gradual, although perhaps not monotonic, improvement in relations with Russia and a gradual reduction in the importance of nuclear weapons to international security. These treaties were also designed to help reinforce such a desirable trend. There were probably also assumptions about China's future role in the world, possibly including its lack of ambitions to become a great nuclear power.

Events of the last decade cast serious doubts on all these assumptions, and Russia is generally regarded as an adversary today. Of course, the situation could improve again by the time negotiations begin on a future treaty. Moreover, this report does not claim that adverse changes in the relationship between the United States and Russia are entirely the fault of Russia. The expansion of NATO and the war against Serbia during the Clinton administration, the invasion of Iraq and further expansion of NATO during the Bush administration, and the NATO intervention in Libya during the Obama administration plausibly contributed to the deterioration in relations between the West and Russia.

Additionally, Russia views US intentions to spread democracy worldwide as a threat. This includes a (presumably incorrect) view that the United States orchestrated so-called color revolutions in neighboring states that were once a part of the Soviet Union in an attempt to turn those countries against Russia. Russian bad behavior includes open aggression in Georgia and Ukraine and attempts to influence elections and undermine democracy in the United States and various other democracies.

Regardless of the underlying causes, however, the relationship between Russia and the West is not what the United States expected, let alone hoped for, at the time the Soviet Union broke up, or even in 2010. Consequently, the United States needs to devote thought, in advance, to what it might do if Russia breaks out of New START (or its possible successor treaty) or engages in aggression beyond anything that has occurred to date. Would the United States want to field new types of strategic weapons or NSNWs? Would the United States be satisfied with strategic parity, or would US superiority be a goal? The answer would depend on the United States' grand strategy and on its ability to integrate arms control into an effective deterrence strategy.

Further, since New START was signed in 2010, China has evolved to become a peer competitor to the United States in terms of its economy, conventional military power (at least in the Western Pacific), and science and technology. To make matters worse, there is a realistic chance that China will become a great nuclear power in the 2030s.[24] A bilateral US–Russian treaty, especially one with long (or indefinite) duration and low limits, might have an unwanted effect in terms of incentivizing China to strive for the number-one position in the world (or at least a peer of the United States). The rest of this section deals with specific examples of how changes in the world security environment did, or could, change the way the United States thinks about specific types of weapons that could be subject to arms-control limitations.

A prime example of changes in the security environment relates to the ABM Treaty of 1972, which had no built-in expiration date. In 1972, the United States and the Soviet Union were the only two great nuclear powers, although the United Kingdom and France did pose some threat to the Soviet Union. Neither signatory to the treaty anticipated much of a threat from China or from countries that have become nuclear powers since 1972 (North Korea, India, Pakistan, and maybe Iran before long) or the possible need to deploy defenses against such countries. During the Reagan administration, the United States began research efforts on national missile defense against the Soviet Union and various lesser threats. Efforts to defend against a massive Soviet attack were doomed from the start. US efforts in the 1990s switched to national defenses against small attacks (such as North Korea today, although the possible magnitude of a North Korean attack may grow substantially by 2030). Some of these US efforts were of dubious consistency with the ABM Treaty. President Bush announced withdrawal from the ABM Treaty in 2001, nominally because of the perceived future threat from North Korea, Iran, and possibly even Iraq—unfortunate developments that nobody expected in 1972.

Other hypothetical examples are also possible. For example, it would be technologically practical to field new weapons that might be of considerable value against North Korea or Iran, and that would pose little threat to Russia, but would nevertheless count against New START limits. An SLBM with a range of possibly 700 kilometers, carried in the VPM tubes on Block V *Virginia*-class SSNs, might be an example of such a weapon. Fielding such weapons within New START constraints would be very unlikely because the United States would have to give up "real" strategic assets to field such a

[24] OSD, *Military and Security Developments 2020.*

weapon while complying with New START limits.[25] This example does not pertain to future changes in the world security environment, but rather to considering the world security environment—and our associated operational needs—in its entirety, and to trying to maintain flexibility to deal with threats other than those from Russia and China.

Possible approach to using this lesson: Before beginning negotiations, the United States needs to seriously consider various undesirable ways in which the international security environment could evolve during the period in which START 2026 will be in effect. Such considerations would apply both to how the Russian situation might change and to possible developments in other countries. This issue may argue against a treaty of indefinite duration, or even a duration exceeding possibly a decade.

Lesson Three: Think about the Impact of Definitions

As noted earlier, treaties to date—including, but not limited to, New START—have done a questionable job of defining terms such as *ballistic missile*, *ballistic trajectory*, *cruise missile*, and *self-propelled*. Consequently, HBGWs—even if nuclear—apparently do not automatically count against treaty limits as either ballistic missiles or cruise missiles.[26] START 2026 should do a better job of defining these terms if it is written in such a way that such terms are relevant. This highlights the importance of thinking about how Russia might exploit definitions.[27]

A potentially significant current issue pertains to the definition of a heavy bomber. A heavy bomber is a nuclear-capable aircraft with an unrefueled one-way range exceeding 8,000 kilometers or any aircraft that carries a nuclear ALCM with a range exceeding 600 kilometers. An aircraft could carry a nuclear weapon of arbitrarily long range and still not count against New START limits if the weapon in question is not a cruise missile and the aircraft has a one-way unrefueled range of less than 8,000 kilometers.[28] A simple—but partial—solution to this particular issue might be to substitute a term such as *nuclear weapon of any type* for *nuclear ALCM*. Although this would eliminate the loophole for ALBMs and HBGWs on aircraft, it still does not resolve the heart of the problem. A short-range Russian fighter that has a nuclear weapon with a range of 650 kilometers would pose no broad threat to North America, but it would pose a threat to most of Alaska. Similarly, a US nonstealthy fighter, such as the F-15E, probably would not pose a severe threat to Russia from bases in Europe if it carried a nuclear weapon with a range of 650 kilometers.[29] A

[25] Major utility against Iran might require a longer range, especially if launched from the Arabian Sea.

[26] There is some overlap here with the section on new types of weapons, in order to permit a full discussion within each section.

[27] Such problems are not limited to treaties on offensive weapons. The Outer Space Treaty of 1967 prohibits the deployment of "nuclear weapons and other weapons of mass destruction" in space, but there is no definition for the term other weapons of mass destruction. Similarly, the ABM Treaty of 1972 applied to defenses against "strategic ballistic missiles" but not to defenses against "theater ballistic missiles," without ever defining a cutoff point between strategic missiles and theater missiles.

[28] New START does not limit purely conventional weapons on aircraft, as long as those weapons are easily distinguishable from any nuclear weapon. This is probably not cause for concern. In addition, there is a possibility that a nuclear ALBM or HBGW could be captured by the new kind rule, but this is not certain.

[29] The threat would be greater from a stealthy aircraft that can carry standoff weapons internally, but Russia has no such fighter today (and neither does the United States). Aside from issues related to possible target coverage, the relevant bases are highly vulnerable to large-scale Russian conventional attacks or small-scale attacks with low-yield nuclear weapons. The Rus-

better solution might be to define a heavy bomber as "a nuclear-capable aircraft that has a total one-way unrefueled range exceeding <some operationally meaningful cutoff value>, including both the unrefueled one-way range of the aircraft and the maximum range of any nuclear weapon that the aircraft is equipped to carry."[30]

There are also issues with ICBMs. Treaties to date have defined an ICBM as a land-based ballistic missile with a range exceeding 5,500 kilometers (or capable of reaching any part of the Soviet Union from any launch point in the United States). An intercontinental GLCM or HBGW could function much like an ICBM without counting against treaty limits. A simple technical fix would be to define an "intercontinental land-based missile" as a land-based missile, of any type, with a range exceeding 5,500 kilometers (or some new cutoff value).

There are also issues with SLBMs and other weapons at sea. New START defines an SLBM as "a ballistic missile, with a range exceeding 600 kilometers, of a type that has ever been carried by or launched from a submarine." As with the issue in the definition of heavy bombers, this definition leaves a loophole for HBGWs, which could function much like SLBMs, with a short time of flight and excellent in-flight survivability. Further, a ballistic missile on a surface ship would not count against treaty limits unless a submarine has also carried the same type of missile (apart from the possibility of being captured by the *new kind rule*). START defined an SLBM in the same way as New START but prohibited surface ships from carrying ballistic missiles with a range exceeding 600 kilometers. Further, treaties to date have explicitly excluded SLCMs—even if nuclear—regardless of range. It is hard to understand why a conventional SLBM with a range of 650 kilometers should count against treaty limits while a nuclear SLCM with a range of 6,500 kilometers should not. Unlike the situation with heavy bombers, there is no obvious way to address this issue through better technical definitions.

Possible approach to using this lesson: The United States needs to give serious thought to defining weapons and technical terms in the next treaty, both to avoid loopholes (unless the United States wants to exploit such loopholes itself) and to ensure that the most relevant types of weapons are included in a consistent manner. There may be a simple technical fix for some issues (such as the definition of heavy bomber), but there is no obvious path forward for other factors. This could be a good topic for some sort of conference among experts in the field.

Lesson Four: Be Ready to Detect Cheating and Think about Its Implications in Advance

Russia violated both the INF Treaty and the ABM Treaty. Further, it is uncertain whether US actions from the mid-1980s through the end of the Clinton administration complied with the ABM Treaty, although there were no formal Russian/Soviet claims of US cheating. Details appear below.

The ABM Treaty stipulated that US and Soviet missile-warning radars could be located only along national peripheries and had to face outward. This latter provision would prevent such radars from tracking RVs within the United States or the Soviet Union and then providing high-quality cues to the allowed BMD sites. In 1983, the United States discovered a large radar under construction near

sian emphasis on nuclear cruise missiles, combined with the weakness of existing US/NATO defenses against land-attack cruise missiles, exacerbates this vulnerability.

[30] Aerial refueling can extend the operational range of an aircraft, but no treaty to date has ever accounted for this factor, and it is not obvious how a future treaty could do so.

the city of Krasnoyarsk, which is located about 700 kilometers north of the border with Mongolia. The radar consisted of two structures, each with a single phased-array radar panel—one for transmitting and one for receiving. The radar panels faced northeast, into Siberia, not toward the border with Mongolia. The United States raised concerns about this radar with the Soviet Union. The Soviets initially claimed that the radar was for satellite tracking. Construction continued slowly until 1987, despite repeated American objections. Construction apparently stopped in 1987. In September 1989, Soviet President Mikhail Gorbachev admitted that the radar was a treaty violation, and he committed to having it destroyed. Demolition was finished around 1992.

Even now, more than 31 years after the Soviet Union committed to eliminating this radar, the United States has limited understanding of how the Soviets intended to use this radar complex or how much military utility an operational radar of this type and in this location would have had. Nevertheless, this incident highlights the importance of being able to detect treaty violations—even when they occur in locations not previously associated with strategic forces—and taking persistent action to pressure the other country into eliminating the violation.

In another example, Russia has fielded a GLCM, known as the SSC-8, which violated the INF Treaty.[31] According to a briefing by the director of national intelligence at the time, Dan Coats, the SSC-8 has both conventional and nuclear versions and a range significantly in excess of 500 kilometers (but the precise range is not stated).[32] The Center for Strategic and International Studies (CSIS) assesses that the SSC-8 is operational and has a range of 2,500 kilometers.[33] With a range of 2,500 kilometers, a missile based in Kaliningrad could reach all of France, Italy, and the United Kingdom, plus part of Spain and Iceland. Coverage of most NATO countries would be less extensive for missiles based in the far western parts of contiguous Russia. Figure 4 shows target coverage for a Russian SSC-8 based in Kaliningrad, with the range varied parametrically from 500 kilometers (the INF limit) to 3,500 kilometers. The US government has not issued an unclassified estimated range for the new Russian GLCM, so the figure treats its range parametrically, despite the existing CSIS estimate of 2,500 kilometers.[34]

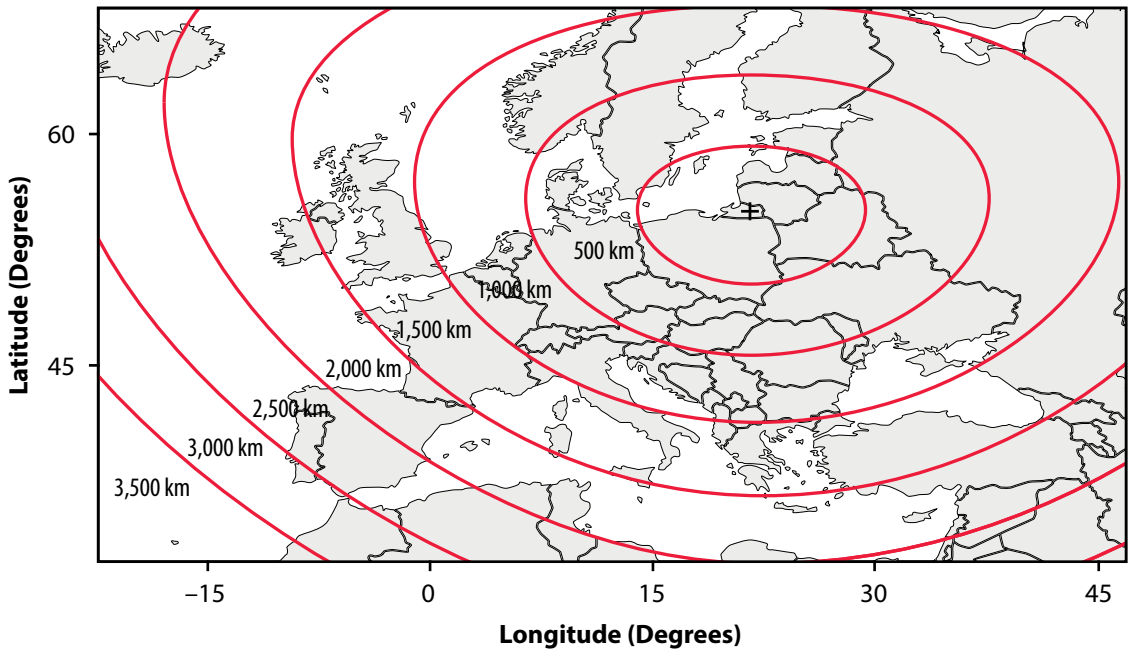
The United States also flirted with ABM Treaty violations for 18 years before withdrawing from the treaty. President Reagan initiated the Strategic Defense Initiative (SDI) in 1983, with an initial goal of providing national missile defense against a large-scale Soviet attack. The ABM Treaty expressly prohibited national missile defense, regardless of the technology employed. Further, wording in the treaty explicitly or implicitly prohibited BMD weapons in space; mobile strategic BMD weapons on land, at sea, or on aircraft; and directed-energy weapons for strategic BMD. In other words, virtually everything investigated as part of the SDI would have been a violation of the ABM Treaty had it been deployed. Russia was initially very upset by, and opposed to, the SDI. By the late 1980s, however, the Soviets had apparently reached the (probably correct) conclusion that an effective national defense against an all-out Soviet attack (even after a US first strike) was of dubious feasibility. In the 1990s, the US emphasis

[31] Woolf, *Russian Compliance with the INF Treaty*. Russia admits developing a new GLCM but denies that its range exceeds 500 kilometers. Russia also accuses the United States of violating the INF Treaty. Russia claims that the vertical launch system at the Aegis Ashore missile defense site in Romania can launch Tomahawk cruise missiles and not just missile defense interceptors.

[32] DNI, "Coats on Russia's Intermediate-Range Nuclear Forces (INF) Treaty Violation."

[33] Missile Defense Project, "9M729 (SSC-8)."

[34] The SS-X-28 developmental ballistic missile may also have been an INF violation, but there have been no known tests of this missile for years and Russia may have canceled the program. Evans, Hannah, and Schwalbe, *Nonstrategic Nuclear Forces*.



Ranges from the launch point are shown as rings and measured in kilometers. A second launch point, near Estonia, would slightly improve coverage against Baltic targets for missile ranges under 1,000 kilometers. A notional third launch point in western Belarus would improve coverage for missile ranges up to about 2,500 kilometers. The CSIS estimate is 2,500 kilometers.

Figure 4. Geographic Coverage for SSC-8 GLCMs in Kaliningrad

shifted to national BMD against a small and less sophisticated attack from a country such as North Korea, or against a small accidental or unauthorized launch from Russia or China. These efforts featured a much greater emphasis on land-based interceptor missiles at fixed sites than was the case with SDI. This approach was known as Global Protection Against Limited Strikes (GPALS). Nevertheless, the vast majority of the items under development as part of GPALS would have been treaty violations if the United States had deployed them. In other words, the US actions were not a clear-cut violation of the ABM Treaty, but spending tens of billions of dollars for research on items prohibited by the treaty was not consistent with the spirit of the treaty.

The United States gave the required six months' notice of its intention to withdraw from the ABM Treaty in December 2001. This withdrawal was nominally due to the need for national BMD against countries such as North Korea and Iran but may have also reflected US political leaders' excessive faith in the effectiveness of such BMD systems at the time. The events of September 11 may also have influenced this decision, although the relevance of such a terrorist attack to national BMD is unclear. The United States now has such a system, called Ground-based Midcourse Defense (GMD). GMD has 44 interceptors in Alaska and California, and there is a plan to add 20 more interceptors in Alaska, plus a complex array of sensors and a corresponding command and control system. GMD has yet to be tested in intercept tests with multiple interceptors and multiple incoming targets. No current or funded interceptor locations are optimized for defense against threats from Iran or elsewhere in the Middle East.[35]

[35] See Rusten, *U.S. Withdrawal*, for more details on the US decision to withdraw from the ABM Treaty and the factors that may have influenced this decision.

Possible approach to using this lesson: The United States needs to give serious thought to incorporating rigorous verification procedures in the next treaty. Ideally, these procedures should be at least as rigorous as those in New START. Further, the United States should consider—in advance of treaty negotiations—what to do if it detects cheating. How much cheating would be required before the United States should withdraw from a treaty? Short of treaty withdrawal, what else might the United States do in response to treaty violations?

Lesson Five: Consider the Strategic Impact of NSNWs

Another question pertains to the types of weapons that should be included in START 2026. This issue overlaps, but extends beyond, capturing new or resurrected types of weapons (e.g., the Russian Avangard boost-glide ICBM, Kinzhal ALBM, Skyfall intercontinental GLCM, and the Poseidon UUV). Weapons of types that have been fielded for 40 years, and that have not counted against (or have not been banned by) arms-control treaties, could possibly pose a threat to the entire US homeland. The only US weapon in this category that ever posed a major threat to the Russian/Soviet homeland was the nuclear version of the Tomahawk SLCM, but the United States withdrew this weapon from service in 1992 and eliminated it during the Obama administration.

Hence, the rest of this section focuses on current Russian weapons that may pose a major threat to the US homeland without counting against treaty limits. There is not much in the way of a corresponding threat to Russia from US nuclear weapons. The United States has B61 nuclear bombs at several bases in NATO; nonstealthy short-range fighters carry these bombs. Absent standoff weapons, these fighters have questionable survivability against modern, intact air defenses, and their short range would limit them to attacking targets in western Russia. Finally, the bases are known, fixed, soft targets that are vulnerable to preemptive negation in a war—either by large-scale conventional attack or a small attack with low-yield nuclear weapons.

The previous section describes the threat that the Russian SSC-8 GLCM poses to Europe from launch sites in Kaliningrad and/or the westernmost regions of contiguous Russia. If based in far eastern Siberia, the SSC-8 would also pose a threat to Alaska and possibly parts of Canada. With a range of 2,500 kilometers, as assessed by the CSIS, the SSC-8 could reach all of Alaska and some of northwestern Canada. "Strategic" targets that the SSC-8 could attack include the BMD early warning radar at Clear, Alaska; the BMD interceptor site at Fort Greely, Alaska; the Cobra Dane radar on Shemya Island; and the planned Long-Range Discrimination Radar at Clear, Alaska. (SSC-8 GLCMs in Kaliningrad could also reach the BMD early warning radar at Fylingdales in the United Kingdom, if the range is 1,800 kilometers or greater. The SSC-8 probably poses no threat to the BMD early warning radar at Thule, Greenland.)

The threat to the United States from Russian SLCMs is more speculative than the threat from the SSC-8 but could be significant. Russia has reportedly completed three *Yasen*-class cruise missile submarines (SSGNs), with several more under construction and a plan to have ten in total. The *Yasen*-class SSGNs[36] are quieter than earlier Russian submarines, which would make it easier for them to get close to the United States without being detected. Different sources say that a *Yasen*-class SSGN can carry 24 or 40 SS-N-30 Kalibr SLCMs. The CSIS assesses that the Kalibr has a conventional version,

[36] The nomenclature for this class of submarine is confusing. It is usually the case that a class of submarines or ships is named after the first submarine or ship of that class. However, the first SSGN of this class is the *Severodvinsk*.

with a nuclear version being possible, and that the range of the missile is anywhere from 1,500 to 2,500 kilometers. Hans Kristensen, writing for a Federation of American Scientists (FAS) blog, assesses that the Kalibr has both conventional and nuclear versions, and that the conventional version has a range of 2,000 kilometers. Kristensen assesses that the nuclear version may have a range exceeding 2,500 kilometers (compared to an FAS estimate of "at least" 2,800 kilometers for the earlier Russian SS-N-21 nuclear SLCM).[37] It would require an implausibly large number of conventional SLCMs to achieve major strategic effects against the United States. Nuclear SLCMs are in a different category altogether. For simplicity, assume the following:

- Kalibr has a nuclear version.
- A *Yasen*-class SSGN can carry 32 SLCMs (the average of 24 and 40).
- Two such SSGNs are 200 kilometers off the west coast of the United States.
  - These two SSGNs are shown as being close enough together to count as one dot in the figure. However, spreading the two western SSGNs out from each other would improve target coverage if the range of Kalibr were less than about 2,000 kilometers.
- One such SSGN is about 200 kilometers east of Norfolk, Virginia.
- This would add up to 96 SLCMs (bounding range = 72 to 120), and most or all of these SLCMs might be nuclear.

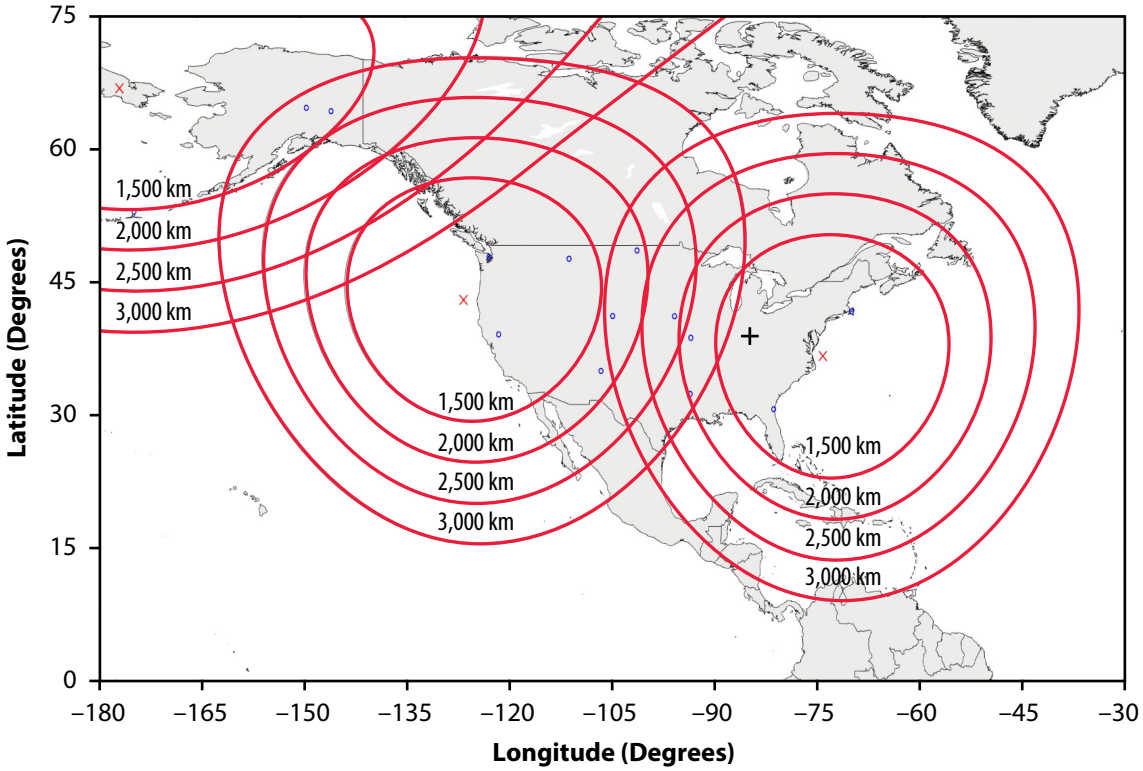
Taken together, the assumptions above could be viewed as alarmist, but they are not outside the bounds of plausibility. With the assumptions listed above, Kalibr SLCMs could potentially attack:

- The SSBN bases at Bangor, Washington, and Kings Bay, Georgia (two or three SLCMs per SSBN base)
- All 45 ICBM launch control centers (LCCs) at the three US ICBM bases (one SLCM per LCC) in Montana, Wyoming, Nebraska, and North Dakota (one base straddles two states)
  - The Kalibr would not have the ability to reach the ICBM base at Minot, North Dakota, if its range were significantly less than 2,000 kilometers.
  - Operationally, it would be desirable to aim more than one nuclear SLCM at each LCC, because they are hard targets, but this would be infeasible with only three Russian SSGNs.
- All three of the bases for US bombers with nuclear weapons (two or three SLCMs per base)
  - There would be some sensitivity to the exact range of the Kalibr in this conclusion, especially for the bases in North Dakota and Louisiana.
- The BMD early warning radars at Beale, California, and Cape Cod, Massachusetts (one SLCM per target)
- Offutt Air Force Base (near Omaha, Nebraska), the home of US Strategic Command and the E-4B National Airborne Operations Center NC3 aircraft (one or two SLCMs)
- Kirtland Air Force Base (in Albuquerque, New Mexico), which is home to the Air Force's storage site for nondeployed nuclear weapons (one or two SLCMs)
- Tinker Air Force Base (in Oklahoma), which has been mentioned as a base for the E-6B Mercury/TACAMO NC3 aircraft (one or two SLCMs)

The attack against the targets listed above would add up to anywhere from 60 to 68 SLCMs, and nuclear warheads would be required for all targets except the BMD radars.[38] Figure 5 illustrates

[37] Kristensen, "Kalibr: Savior of INF Treaty?"

[38] Only the ICBM LCCs and the BMD site at Fort Greely would definitely require nuclear warheads. However, negating the var-



Ranges from the launch points in Siberia and off the east and west coasts of the United States are shown as rings and measured in kilometers. Each launch point is shown as a red x. The figure also shows the locations of notional targets for the Russian GLCMs and SLCMs. The CSIS estimate for the range of the SSC-8 GLCM is 2,500 kilometers. The range of the Kalibr SLCM is more speculative. The two Pacific SSGNs are close together, with only one launch point shown for both of them. With a SLCM range of 2,000 kilometers or more, the second SSGN off the Pacific Coast would be needed only for volume of fire. If the range of Kalibr were significantly less than 2,000 kilometers, Russia would need to separate the two Pacific SSGNs to improve target coverage.

Figure 5. Geographic and Target Coverage for SSC-8 GLCMs in Siberia and Kalibr SLCMs on Submarines off the Coasts of the United States

Russian launch points and US target locations. It is based on assumed ranges of 1,500 to 3,000 kilometers, in steps of 500 kilometers, for both the SSC-8 GLCM and the Kalibr SLCM. Although the postulated attack might require three Russian submarines, only two launch points are shown for the Russian submarines. The map also shows the locations of the postulated US targets. If the range of the Kalibr SLCM is 3,000 kilometers or more, it would be possible to find SSGN launch points that allowed partial coverage of Alaska plus all the area in the contiguous 48 states without relying on GLCMs in Siberia (although GLCMs could increase the volume of fire and cause missiles to approach the United States on multiple attack vectors).[39]

Key conclusions from this coverage analysis include the following:

ious Air Force bases and the two SSBN bases with conventional cruise missiles would, in the aggregate, require many hundreds of cruise missiles, and the maximum number of SLCMs available would not exceed 120 (3 SSGNs with 40 SLCMs each).

[39] The Russian Tsirkon hypersonic cruise missile might also pose some threat to the US homeland. However, its range is probably less than that of the Kalibr SLCM, and it is possible that it can be launched only from surface ships, which could not approach the United States as closely as Russian SSGNs could. If it can also be launched from submarines and has a nuclear version (which is uncertain), then it would be a threat to the US homeland. The magnitude of the threat would depend on the range of the Tsirkon.

- With a range of 1,600 kilometers or more (versus 2,500 kilometers in the CSIS assessment), Russian GLCMs can reach all of Alaska. However, the SSC-8 poses no threat to the 48 contiguous states unless its range greatly exceeds any known estimate.
- If the SS-N-30 SLCM has a range of 2,200 kilometers or more, then two Russian SSGNs at the launch points shown in Figure 5 could reach all the notional targets in the 48 contiguous states.
  - However, if the SS-N-30 has a range of exactly 2,200 kilometers, much of Texas would be out of range from the two arbitrary launch points selected for use in Figure 5.
- If the SS-N-30 has a range of 3,000 kilometers, then the SSGNs at the two launch points shown could cover all of the 48 contiguous states geographically, and an SSGN at the Pacific launch point could reach three of the four notional targets in Alaska.
- Even with a range of 3,500 kilometers, a Russian SSGN could not simultaneously threaten Hawaii and a large fraction of the area in the 48 contiguous states.

Possible approach to using this lesson: The United States needs to broaden its aperture in thinking about the types of weapons to include in START 2026. One of the key goals in arms control is to promote strategic stability, and Russian NSNWs may undermine stability by increasing the chances of a successful first strike (decapitation of national leadership, destruction of bombers on ground alert). Unfortunately, the United States is at a major asymmetric disadvantage in NSNWs. Hence, the United States has little leverage for getting Russia to agree to count these weapons under future treaties. This leads into the next lesson.

Lesson Six: The United States Needs Leverage

Conceptually, it seems reasonable that negotiating from a position of US strength would be advantageous in terms of obtaining an arms-control treaty that is beneficial to the United States. This might be a good topic for a subsequent study that includes detailed historical analyses on force levels, force capabilities, and trends in both force structure and capabilities at the times of earlier treaties. These results could then be compared with what resulted in the actual treaties. The discussion here is merely illustrative, not comprehensive.

SALT mostly prohibited the United States and the Soviet Union from increasing their ICBM and SLBM forces, and it is hard to ascertain whether the treaty was more beneficial to one signatory than to the other. Actual forces at the time were in rough parity. It is likewise difficult to determine whether the ABM Treaty, which was signed the same day as SALT, was more beneficial to one side than the other. The Soviet Union fielded a first-generation BMD system near Moscow in 1971 or 1972, whereas the United States fielded a conceptually similar system near an ICBM base in 1975. At the time of the negotiations, however, the United States was nominally planning to field anywhere from 5 to 12 such sites (mostly at ICBM bases). It is hard to say how each side perceived its relative standing in BMD at the time, but the Soviet Union may have been aware of US plans to field a sizable number of BMD sites. This could have provided leverage for the United States.

SALT II never entered into force because of political tensions over the Soviet invasion of Afghanistan. US and Soviet forces were in approximate parity at the time of SALT II, aside from possible US advantages in technology (e.g., ICBM accuracy). The treaty limits corresponded approximately to the actual US and Soviet force levels in 1979.

At the time of the INF Treaty in 1987, the Soviet Union had many more NSNWs in Europe than did the United States. However, the United States was rapidly deploying the Pershing II IRBM and the Gryphon GLCM, both of which were perceived as being at the cutting edge of technology and probably superior to their Soviet counterparts. For example, the Pershing II reportedly had an accuracy of 100 feet (impressive for an IRBM even by today's standards), a variable-yield warhead, terminal maneuverability to thwart defenses, and the ability to reach Moscow from West Germany (and with a very short time of flight).[40] The Soviet Union was also under economic strain, which was probably exacerbated by the Chernobyl nuclear accident in 1986 and the situation in Afghanistan. The net result was a bilateral agreement to eliminate all such weapons, and the Soviet Union had to destroy more weapons than did the United States. This a probable example of US leverage leading to beneficial effects.

The treaties from START through New START date from an era when the United States expected steady improvement in the relations between Russia and the West, and a steady decline in the importance of nuclear weapons in world affairs. Hence, these treaties may have aimed more at solidifying a cooperative relationship with Russia than at seeking US advantage. The breakup of the Soviet Union and Russian economic difficulties in the aftermath of that breakup put the United States in a strong position relative to Russia in the 1990s and early 2000s. The United States did not use these likely advantages to drive major concessions from Russia.

The situation will be different heading into negotiations for START 2026. The United States still has a modest advantage in strategic systems that count against New START. On the other hand, Russia has nuclear long-range HBGWs, ALBMs on fighters and medium bombers (possibly including a nuclear variant), nuclear GLCMs that can threaten Alaska and most of Europe, and SLCMs that may have nuclear variants and enough range to threaten most or all of the United States from plausible launch points. Russia is also developing an intercontinental nuclear GLCM and an intercontinental nuclear torpedo. The United States has reason to be concerned about all these weapons but has nothing comparable to use as a bargaining chip. The 2018 Nuclear Posture Review endorsed a nuclear SLCM, but this weapon has not yet become a program of record. The United States plans to deploy conventional Tomahawk cruise missiles on land as GLCMs, but a modest number of medium-range conventional weapons would probably not provide much (if any) leverage in the next round of arms-control negotiations, especially considering that much of Russia would be out of range from the most credible launch sites.

Possible approach to using this lesson: The United States needs to preserve the nuclear program of record and establish procurement objectives for future systems that are sufficient to keep the United States at the New START limits. This might provide leverage to trade strategic weapons for NSNWs, at least if the United States is superior to Russia in strategic force structure and technology. Alternatively, or additionally, the United States could transition a nuclear SLCM to a program of record and include deploying the same weapon on land as a GLCM as part of the program. This program could be significant as a bargaining chip.

Considerations for Future Forces and a Future Arms-Control Treaty

As noted earlier, the United States and Russia recently extended New START until February 5, 2026. This treaty extension should be accompanied by extensive US analyses on what should be included in a

[40] Missile Defense Project, "Pershing 2."

successor treaty, followed by negotiations on such a treaty (starting perhaps in the second half of 2022). The successor treaty—if a good treaty emerges—could supersede New START when ratified by the United States and Russia or run in parallel with New START.[41] Thus, extension of New START for five years does not automatically lead to New START definitions, limits, and counting rules remaining in force until February 2026.

It is time for a thorough US rethinking of what it wants to accomplish in future negotiations on strategic weaponry. In particular, the United States needs to approach the next round of negotiations with a clear view of the world security environment and the roles of Russia and China in the world (even if China is not a participant in the negotiations). Absent improvements in the next year or so, the time for optimism has passed. The United States should revive the mindset that went into the ABM Treaty, SALT, SALT II, and the INF Treaty. Russia and China are adversaries and, as such, we may find ourselves in a nuclear crisis or war with either or both of them in the future. Arms-control agreements define the nuclear weapons available for use in those dire circumstances.

Further, the United States should promptly begin giving attention to three issues, all of which relate to future forces and the future of arms control:

(1) Should treaties beyond START 2026 continue to be bilateral agreements between the United States and Russia?

   – The assumption here is that the next treaty will be a bilateral agreement, although perhaps the last one, between the United States and Russia.

(2) What strategic/nuclear force structure should the United States seek to have in the 2030s and 2040s?

   – Deliberations and analyses on this question should begin in 2022 and help inform negotiations on START 2026.

(3) Within the constraints of a bilateral treaty, what treaty characteristics should the United States pursue in 2026? Characteristics should be based mainly on US interests and verifiability. Considerations related to improving the US relationship with Russia should be secondary (although relevant).

This report devotes detailed attention only to the third question above, but it lays out ways in which possible future analyses could help inform decisions on the first two questions.

First, bilateral US–Russian treaties such as New START may not be beneficial much longer. China has become a great economic, military, and technological power. China currently ranks second in the world in official gross domestic product (GDP), and GDP estimates based on purchasing power parity already rank China first in the world.[42] In addition, China has a larger share of the most powerful 500 computers in the world than any other country, and China is a world leader in artificial intelligence. Chinese nuclear forces are currently small compared with those of the United States and Russia, but the latest edition of an annual Defense Department report indicates that China is now in the early stages of a major nuclear buildup.[43] Hence, further steep reductions in START 2026 could have the perverse effect of incentivizing China to pursue a goal of becoming the world's greatest nuclear power. Moving beyond START 2026, we encounter two difficult questions, the second of which has several parts. First, could the United States incentivize China to participate in the treaty after next,

[41] Alternatively, START 2026 and New START could apply simultaneously until early 2026, with the United States and Russia required to meet the provisions of both treaties until New START finally expires. For example, the United States and Russia had to meet the requirements of both SORT and START from the time that SORT entered into force until START expired in December 2009.

[42] *CIA World Factbook*, s.v. "United States."

[43] OSD, *Military and Security Developments 2020*.

and how? Second, what should be the relative limits for China, Russia, and the United States? The answer to this question would depend in part on the nuclear arsenals of the three countries when the trilateral negotiations begin, but it would also be necessary to consider the comparative relationships among the three countries. For example, if Russia and China are both friendlier to each other than to the United States, this dynamic could argue for higher limits for the United States than for Russia or China, although it would be extremely hard to obtain Russian and Chinese agreement on that.[44] Additionally, Russia, China, or both might point to US allies (e.g., Israel, France, and the United Kingdom) possessing nuclear weapons and want them to be counted on the US side of the ledger. (Russia tried to do this in the New START negotiations, without success.)

Further, nuclear weapons have proliferated to India, Pakistan, and North Korea since the original START was ratified, and additional proliferation by 2040 is plausible. This is not to say that countries such as Pakistan should be participants in future treaty negotiations, but treaty limits for the United States, Russia, and (if applicable) China need to account for possible threats from multiple countries, not just from each other.

Second, the United States needs to think about the desired strategic forces and other nuclear forces (if there is any future distinction between strategic forces and other nuclear forces) for the 2040s, with New START limits, with no arms-control limits, and possibly with notional limits of various types (perhaps keyed to ongoing arms-control negotiations). Further, the United States needs to "widen its aperture" in thinking about the types of nuclear weapons, and long-range conventional weapons (subsonic through hypersonic), that it should pursue for fielding in the 2030s and beyond (accounting for the demise of the INF Treaty and the possible impact of eventual New START expiration), instead of merely adhering to the types of weapons in the current program of record. Russia and China have been examining, and often developing, types of weapons that the United States neither possesses nor plans to possess. This is not to say that the United States should mimic Russian and Chinese efforts, without regard for strategic stability or the operational desirability of such weapons in the US context. However, the United States needs to study multiple types of weapons that are not in the current program of record, such as

- long-range nuclear weapons of various types (not just cruise missiles) on fighters, plus long-range nuclear weapons other than cruise missiles on bombers;
- nuclear or conventional ground-launched and/or sea-launched cruise missiles, with ranges from 2,000 kilometers to more than 5,500 kilometers;
- nuclear boost-glide weapons on land and at sea; and
- nuclear or conventional IRBMs on land or at sea.

Follow-on analyses could help inform decisions about which types of such weapons, if any, to field, and on the comparative desirability of various possible future force structures. Further, development programs on such weapons could possibly provide leverage in arms-control negotiations (as the developmental BMD program possibly did in 1971 and 1972), even if the US programs are at an early stage.

The remainder of this section deals with the question of how to approach bilateral negotiations with Russia on START 2026. This report takes no position on what the limits or counting rules should be. However, the United States should account for current US and Russian forces when considering limits and counting rules. Table 5 shows current Russian and US force levels, not all of which count under New START. The United States is slightly ahead of

[44] Alternatively, the United States could pursue superiority in types of weapons not limited by the treaty, possibly including long-range conventional strike.

Table 5. Declared and Estimated US and Russian Force Levels in Late 2020

Type of Weapon	United States	Russia
Total ICBMs	454	318
Deployed ICBMs	400	295
Total SLBMs	288	160
Deployed SLBMs	240	144
Total SSBNs (not explicitly limited by New START)	14	10
Total heavy bombers	66	76
Deployed heavy bombers	60[a]	76[a]
Deployed delivery vehicles	700	515
Total delivery vehicles	800	554
Deployed warheads	1,550	1,491
Fighters equipped to carry long-range ALBMs	0	120 to 244[b]
Medium bombers equipped to carry long-range ALBMs	0	0 to 65[b]
Intercontinental GLCMs	None	Development
Intermediate-range nuclear GLCMs	None	Some
Intermediate-range nuclear SLCMs	None	Probably some
Intercontinental nuclear torpedoes/UUVs	None	Development
BMD interceptors for homeland defense (not counting theater BMD and SAMs with a secondary BMD capability)	44	68 to 100[c]

[a] Typically, about 80 to 85 percent of bombers are operational, so this overstates the number of US and Russian bombers that are operational routinely.

[b] Russia has 120 MiG-31 fighters that are equipped to carry the Kinzhal ALBM and 124 Su-34 fighters and 65 Tu-22M3 medium bombers that may be similarly equipped (see "Aircraft - Fixed-Wing - Military - Sukhoi Su-34"). It is not certain that there is a nuclear variant of the Kinzhal or that Russia has enough of these weapons for all these aircraft to carry the weapon at one time.

[c] The count of 68 is from Wikipedia (s.v. "A-135 Anti-Ballistic Missile System"). The count of 100 comes from *Jane's Land Warfare Platforms,* "[ARCHIVED] A-30 (SH-08 'Gazelle')."

Russia in terms of weapons that count against New START. However, the table indicates that current Russian forces would count as anywhere from 700 to 824 deployed delivery vehicles (versus a limit of 700), 739 to 863 total delivery vehicles (versus a limit of 800), and 1,676 to 1,800 deployed warheads (versus a limit of 1,550) if the Kinzhal ALBM has a nuclear variant and this weapon were treated like a nuclear ALCM. The variation depends on whether the Russian Su-34 fighter is equipped to carry the Kinzhal. This is not a claim that a Russian fighter equipped with one Kinzhal ALBM poses as great a threat as a Bear or Blackjack bomber with 12 or 16 Kh-102 nuclear ALCMs (which have an assessed range of 4,500 kilometers[45]), but a US fighter that carried a nuclear ALCM with a range of even 650 kilometers would count against treaty limits.

This report also takes no firm position on whether a future treaty should limit only delivery vehicles (like SALT and SALT II) or both delivery vehicles and warheads (like START and New START). It is much easier to verify the number of

[45] "Kh-101, Kh-102."

delivery vehicles than the number of warheads, so START 2026 should incorporate limits on delivery vehicles (unlike START II and SORT).

On the other hand, the United States should address several general issues before entering into negotiations on a new treaty (and thinking about limits and counting rules, for example). As an overarching concern, the United States needs to consider what kinds of weapons should be covered by the treaty, and why. This issue has been flying on autopilot since SALT II and even more so since START. It is time for a thorough rethinking of this problem. For example, it might be desirable for the next treaty to have a much broader scope than New START, with limits on strategic nuclear weapons, some types of NSNWs, and some types of BMD. The following subsections contain details on the following:

- The possible scope of the next treaty (in terms of offensive weapons)
- Definitions of weapons and treaty provisions (as noted earlier, New START leaves various loopholes because of the way it defines types of weapons, technical terms of various types, and other treaty provisions)
- Whether the next treaty should include special provisions on hypersonic weapons (this is related to, but not the same as, the issue on technical loopholes in New START)
- Possible linkage between BMD and offensive forces in the next treaty
- How to define and count nuclear-capable bombers in START 2026
- Verification procedures in START 2026
- Possible inclusion of warhead production in START 2026

Types of weapons to limit in the treaty: A first consideration might be whether to exempt all purely conventional weapons of types that are easy to distinguish from any known nuclear weapons. Treaties to date have been inconsistent in this regard, applying to all ballistic missiles (conventional or nuclear) that exceed some cutoff range, while treaties since START have exempted purely conventional weapons on bombers (if those weapons are easy to distinguish from nuclear weapons). At the time of SALT, and for many years afterward, all ballistic missiles with enough range to be captured by any of the treaties considered in this report really were nuclear. Long-range ballistic missiles are expensive and, until the US Pershing II IRBM in the 1980s (which was eliminated because of the INF Treaty), they were not accurate enough to be highly effective with low-yield nuclear warheads, let alone with conventional warheads. Missile accuracy has improved greatly since the 1980s, and China has extremely accurate conventional IRBMs (some of which may also have nuclear versions). Moreover, the planned US IRCPS missile, which will be fielded on Block V *Virginia*-class SSNs and possibly also on mobile ground vehicles, will have a range considerably in excess of 600 kilometers and high accuracy. The IRCPS missile will incorporate boost-glide technology, so it might not meet the definition of a ballistic missile under previous treaties and New START, but this weapon—at least on SSNs—could be lumped in with SLBMs in a future treaty if measures are not taken to exempt purely conventional weapons that are easily distinguished from any nuclear weapon.

Another consideration could pertain to the definition of what constitutes a strategic weapon. This involves issues on weapon range, the launch mode for a weapon, and weapon technology. The situation is probably simplest for land-based weapons such as ICBMs, at least for a bilateral treaty between the United States and Russia. Treaties from START through New START define an ICBM as a land-based ballistic missile with a range of at least 5,500 kilometers. The minimum distance between any point in the 48 contiguous states and any point in Russia is about 5,500 kilometers, so a land-based missile with a range slightly exceeding

5,500 kilometers could threaten a small area in the 48 contiguous from a small set of launch areas in Russia.[46] Hence, the value 5,500 kilometers has some plausibility. More troubling is the fact that a boost-glide weapon with a range exceeding 5,500 kilometers would not automatically count against any current or prior treaty limits unless that weapon employed the booster stack from a missile that was already associated with a declared ICBM or SLBM. GLCMs may be even worse. If the Russian Skyfall GLCM enters service, it might be able to reach most or all of the 48 contiguous states from a wide range of launch points in Russia. Given that previous treaties (except the defunct INF Treaty) have expressly excluded GLCMs, and the United States once fielded an intercontinental GLCM (even if only briefly and before SALT, and with normal jet propulsion), it might well be impossible to include this weapon under New START. In the case of ICBMs and GLCMs, there is a possible simple fix for the issue. Replace the term *ICBM* with *intercontinental land-based missile*, which would apply to any land-based missile, regardless of its technology, with a range exceeding 5,500 kilometers. (Per the discussion above, a purely conventional land-based weapon with a range exceeding 5,500 kilometers might not count if the missile is easy to distinguish from all nuclear missiles.) This approach would not eliminate the vulnerability of Alaska to shorter-range Russian missiles in eastern Siberia, but the close proximity of Alaska to Siberia makes this issue virtually impossible to address.[47]

The situation gets murkier when it comes to weapons on aircraft or weapons at sea. New START and START define a heavy bomber as a nuclear-capable aircraft with a one-way range (without aerial refueling) exceeding 8,000 kilometers (measured with a full load of weapons) *or* any aircraft that carries a nuclear ALCM with a range exceeding 600 kilometers. New START gives a free pass to ALBMs and air-launched boost-glide weapons, aside from the possibility of capturing such weapons under the *new kind rule*. In practice, all bombers with a range exceeding 8,000 kilometers have been large aircraft with a substantial weapon load. However, the second clause in the definition would apply to a short-range fighter that can carry one or two ALCMs with a range of 610 kilometers, even though such a fighter would pose no threat to the 48 contiguous states from any Russian air base (or vice versa).[48] Hence, it might make more sense to define a heavy bomber as a nuclear-capable aircraft with a total one-way range exceeding 8,000 kilometers (or some other cutoff value) including the one-way unrefueled range of the aircraft plus the maximum range of any nuclear weapon (not just ALCM) that the aircraft is equipped to carry. Further, defining a heavy bomber in this manner would have more operational relevance than the current approach or the approach from the 1991 START.

The situation is probably worst for weapons based at sea. At present, a conventional SLBM with a range of 610 kilometers would count against New START limits, whereas a nuclear SLCM with a range of 6,100 kilometers would not count and probably would not be captured by the *new kind rule* because of previous exemptions for nuclear SLCMs (albeit ones of considerably shorter range than 6,100 kilometers). Moreover, a nuclear boost-glide weapon

[46] This would be much more complex for a trilateral treaty that included China. A Chinese land-based missile with a range of 5,400 kilometers could threaten much of Russia (although not necessarily from current Chinese ICBM bases), whereas a Chinese land-based missile with a range of 5,600 kilometers could not reach any point in the 48 contiguous states.

[47] This issue will also work in the reverse direction to a limited extent, starting in 2021 or 2022. The United States is planning to field a land-based derivative of the Tomahawk cruise missile, which has a reported range of 1,600 kilometers (according to US Navy, "Tomahawk Cruise Missile"). However, there is no longer a nuclear version of Tomahawk, whereas the Russian SSC-8 GLCM has a nuclear version whose range CSIS estimates to be 2,500 kilometers.

[48] If based in Europe, such an aircraft could threaten Russia to a greater extent than can current NATO fighters armed only with B61 nuclear bombs, but most of Russia would still be out of reach.

with a range exceeding 600 kilometers might not count either, although there might be more hope for applying the *new kind rule* in this case. Aside from the conventional-versus-nuclear issue, a US SLBM with a range of 610 kilometers would pose only a limited threat to Russia. A US SSBN almost certainly could not operate in the Baltic Sea or the Black Sea, and an SSBN in the North Sea or the Norwegian Sea could reach little of Russia with a 610-kilometer missile (and could not reach Moscow or Saint Petersburg). An SSBN in the Arctic Ocean might be more of a threat to Russia, but many of the desired launch areas would be covered by ice for much of the year (although that is slowly changing as a result of global warming). An SSBN in the northwest Pacific could reach some of eastern Siberia with such a weapon, but this is mostly not a target-rich environment, except for a couple Russian naval bases (including an SSBN base). The United States is more vulnerable to short-range sea-based weapons than is Russia, because of differences in geography, and a Russian submarine with a 610-kilometer missile could reach many large US cities, the two SSBN bases, and the B-52 base in Louisiana (although many launch points would be required and some of these launch points might be rather sporting). However, the three ICBM bases, the other two nuclear bomber bases, Offutt Air Force Base in Nebraska, and Kirtland Air Force Base in New Mexico would all be out of range. By contrast, a Russian SLCM with a range of 2,500 kilometers could reach all plausible targets in the 48 contiguous states from two credible launch points off the east and west coasts of the United States, whereas a US SLCM of similar range would be unable to reach significant portions of Russia, unless a US submarine could get close to Russia's north coast.

The next treaty should possibly capture all sea-based (not just submarine-launched) nuclear weapons with a range exceeding 600 kilometers (or some new cutoff value greater than 600 kilometers), regardless of the technology embodied in the weapon. However, Russia probably has nuclear SLCMs, and the United States does not, so the United States has limited leverage for including such a provision in START 2026. Moreover, counting nuclear SLCMs could introduce potential complications. For example, the US Mark 41 and Mark 57 VLSs on many cruisers and destroyers currently carry conventional Tomahawk missiles and defensive weapons. If there were a nuclear version of Tomahawk, the United States would have to come up with a way to avoid counting thousands of Mark 41 and Mark 57 VLS tubes against treaty limits. The best approach might be to establish a well-funded program for a US nuclear SLCM (perhaps with a GLCM version) and then try to negotiate a ban on such weapons (as with the INF Treaty).

The prospects for counting sea-based nuclear boost-glide missiles in the same manner as SLBMs are probably better because Russia apparently does not have any such weapons today. Conversely, counting purely conventional boost-glide missiles would be disadvantageous to the United States because of the IRCPS program. It is difficult to know what to do about intercontinental nuclear torpedoes, but a future treaty should capture such weapons in some manner if Russia fields the Poseidon.

The danger in the details of the definitions: As noted earlier, New START and earlier treaties include problematic definitions of types of weapons and other terms. Russia is aggressively exploiting loopholes related to definitions of various types. The next treaty needs to be better in terms of such definitions. In particular, the next treaty should do most or all of the following:

- Define the term *ballistic trajectory* in a sensible and unambiguous manner if this term appears in the treaty.
- Define the term *self-propelled* in a sensible and unambiguous manner if this term appears in the treaty (e.g., regarding cruise missiles).

- Define the term *new kind of strategic offensive arm* in a sensible and unambiguous manner if this term, or anything like it, appears in the treaty.
- Define the range of a cruise missile in a manner that makes sense operationally, regardless of the speed or cruising altitude of the missile, if the treaty mentions cruise missiles specifically.
- Possibly treat long-range nuclear weapons of the same delivery mode in a consistent manner, regardless of the technology of the weapon. Any distinction based on technology (e.g., ballistic versus boost-glide) should be deliberate and beneficial to the United States.
- Explicitly clarify the status of SAMs and BMD interceptors, in cases where there is an offensive version of the interceptor, and the offensive version is easy to distinguish from the defensive version.
- Explicitly clarify the status of long-range nuclear weapons on surface ships vis-à-vis similar weapons on submarines. The next treaty should either treat weapons on surface ships the same as similar weapons on submarines or ban certain types of weapons on surface ships (e.g., long-range ballistic missiles on surface ships, as was the case in START).

Hypersonic weapons: New START treats HACMs just like subsonic cruise missiles, so Russia could not avoid treaty accountability by relying on HACMs. However, HACMs may have operational differences from slower cruise missiles that warrant specific mention in the next treaty. As noted earlier, HBGWs apparently do not meet the definition for either a cruise missile or a ballistic missile, so even a long-range nuclear HBGW might avoid treaty accountability under New START, unless captured by the *existing type rule* (as a result of using a booster stack already associated with a declared ICBM or SLBM) or the *new kind of strategic offensive arm rule*. Further, HBGWs may have operational differences from earlier weapons that warrant specific mention in the next treaty.

Ballistic missiles, even ones of intercontinental range, have a short time of flight (no more than about 36 minutes), but they follow a predictable trajectory that makes it easy for the country being attacked (at least in the case of Russia or China or the United States) to determine the impact point to within tens of miles long before impact. The predictable trajectory is also beneficial to BMD systems, although some of the most modern foreign ballistic missiles have guided, maneuvering RVs that enhance survivability against endo-atmospheric BMD systems. These guided RVs do not, however, introduce major ambiguity about the impact point. Traditional cruise missiles have a long time of flight, unless launched close to the target. Moreover, for ALCMs, the (usually long) time of flight of the aircraft before launching the ALCM should be included in the overall time of flight. On the other hand, cruise missiles can follow a circuitous path on the way from the launch point to the target, so the country being attacked may not know the real target until almost the moment of impact. HACMs and HBGWs, by contrast, combine a short time of flight (exclusive of flight time for the delivery aircraft, if the hypersonic weapon is on an aircraft) with significant ambiguity about the intended aimpoint. In other words, the actual target could be more escalatory than the country being attacked initially thinks (or vice versa). This trait is potentially bad for stability, in that a country being attacked could make an erroneous worst-case assumption about the intended target and immediately conduct an escalatory response. This suggests that the next treaty might include explicit restrictions on HACMs and HBGWs instead of treating HACMs like subsonic cruise missiles and ignoring HBGWs altogether.

In addition, HBGWs may offer survivability advantages against many current BMD systems and air-defense systems. Some BMD systems have a

minimum intercept altitude that is above the glide altitude for a long-range HGV. Most or all current air-defense systems have a maximum altitude below the altitudes at which HBGWs glide. Moreover, an HGV could maneuver violently during its final approach to the target, which could enhance survivability against SAMs and endo-atmospheric BMD systems. There is an extensive body of literature on the question of whether defenses against strategic weapons are stabilizing or destabilizing, and the conclusions lack consistency. Nevertheless, the potential survivability advantages of HBGWs may well be operationally relevant and could be a factor to consider in the next round of arms-control negotiations.

In operational practice, the issues above are probably more significant for HBGWs than for HACMs. The Russian Avangard HBGW has a nuclear warhead and intercontinental range. The US IRCPS/LRHW conventional missile may have a range as great as 3,780 kilometers. By contrast, no published range estimate for any HACM exceeds 1,000 kilometers. For example, the previously mentioned Congressional Research Service report on hypersonic weapons credits the Russian Tsirkon ship-launched conventional HACM with a range of 400 to 950 kilometers, and there are no unclassified range estimates for HAWC available. (Moreover, it is not certain that Tsirkon is really an HACM instead of an HBGW.) Hence, HACMs probably have less ability to strike targets deep inside a large country than do HBGWs, unless delivered by a stealthy aircraft that can penetrate air defenses before launching its weapons.

To sum up, the United States needs to think about whether the next treaty should continue to give HBGWs a free pass, treat them like ballistic missiles (the most nearly similar weapon), treat them like cruise missiles, or impose special restrictions on them. However, the existence of the Russian Avangard system and the lack of any similar US nuclear weapon probably makes it much more difficult to get Russia to agree to restrictions on HBGWs beyond possibly counting them as ballistic missiles.

US and Russian BMD systems: The United States has a national BMD system called the GMD system. There are 40 conventional exo-atmospheric interceptors in Alaska and 4 more in California, all integrated with numerous radars and space-based sensors, plus a complex command and control system. The 2019 Missile Defense Review recommended adding 20 more interceptors in Alaska, because the North Korean ICBM threat is growing faster than was expected in earlier years. (However, the lack of operationally realistic GMD intercept tests with multiple incoming "threats" and two or more US interceptors per "threat" makes it difficult to assess the true utility of expanding GMD.) The United States is also considering deployment of some undecided number of Aegis Ashore sites as a backup defense against incoming RVs that elude the GMD system. It will be difficult to convince Russia and China that continued expansion of the GMD system, especially if combined with the addition of several Aegis Ashore sites, is aimed exclusively at defense against North Korea. Hence, US BMD expansions might spur Russia or China to field more strategic offensive systems than would otherwise be the case—with deleterious effects for the United States.[49] Consequently, the United States needs to consider whether it would be willing to place numerical limits on its BMD systems (either absolute limits or limits keyed to the assessed number of ICBMs in North Korea)[50] in exchange for Russian agreement on various other topics. Of course, any such limits should not be one-sided. Russia has an operational endo-atmospheric BMD system with nuclear-tipped interceptors at Moscow.

[49] As noted earlier, China is in the early stages of a significant nuclear buildup. The extent to which US BMD may have stimulated this Chinese buildup is uncertain.

[50] Iran is years away from having any ICBMs. However, if Iran is close to fielding nuclear weapons and ICBMs while the negotiations are in progress, then Iranian systems might also factor into the equation.

Any limits on US BMD should probably be accompanied by limits on the existing Russian BMD system at Moscow and/or on further expansions of Russian BMD (either additional sites similar to the one at Moscow or some sort of future system analogous to the US GMD system). On the other hand, provisions limiting US BMD could interfere with Senate ratification of such a treaty.[51]

Bombers and their weapons: As noted earlier, the definition of a heavy bomber in START and New START is a good candidate for improvement in START 2026. Another issue pertains to bomber-counting rules (assuming START 2026 limits warheads and not just delivery vehicles, and assuming that START 2026 limits bombers at all). Although this report makes no recommendation on what bomber-counting rules should be, there are relevant factors to consider. For example, there have been wide variations in how recent treaties counted US bombers:[52]

- START: B-52 = 10 warheads, B-2 = one warhead
- START II: B-52 = 20 warheads, B-2 = 16 warheads
- SORT: Counted nuclear weapons available for prompt use by bombers (that is, stored on the bomber bases), but not bombers themselves
- New START: B-52 = B-2 = one warhead

Another relevant factor is that the number of nuclear weapons available for use by heavy bombers (however that term ends up being defined) might bear little resemblance to the single-sortie weapon capacity of the heavy bomber fleet. Consequently, it might make sense to count the number of bomber weapons (especially long-range nuclear weapons) either in lieu of or in addition to the number of bombers. On the negative side, air-launched nuclear weapons are small in comparison with bombers, ICBMs, and SLBMs. This could complicate efforts to verify the number of such weapons.

Finally, treaties need to account for the (currently) low alert status of bombers, the long flight time for bombers, and the probably lower in-flight survivability of bombers and ALCMs relative to ICBMs, SLBMs, and long-range HBGWs. In other words, it might even be desirable to return to the scheme used in SALT back in 1972, which did not count bombers at all.

In other words, it is not clear how, or whether, START 2026 should account for bombers. Fresh and comprehensive thinking is needed on this subject.

Verification without trust: As will be described in the appendix, New START is far superior to SORT, and superior to treaties before the INF Treaty of 1987, in terms of verification procedures. START 2026 should include provisions prohibiting the United States and Russia from interfering with treaty verification by national technical means. (This issue was not mentioned in SORT.) START 2026 should also include provisions for on-site inspections, as did the INF Treaty, START, START II, and New START. Details would need to be worked out on the allowable number of inspections per year, the types of sites that could be inspected (only military bases, or military bases plus production facilities, or facilities that make nuclear warheads), the amount of warning required before an inspection, the size of inspection teams, and what inspection teams would be allowed to see. Overall, START 2026 should be at least as good as New START in these regards, and preferably better (if possible).

As a final consideration on verification, treaties that are hard to verify (such as the Comprehensive Test Ban Treaty from the 1990s) are likely to be at increased risk of rejection by the US Senate. Hence, good verification provisions are important for multiple reasons.

[51] There were such limits until the United States withdrew from the ABM Treaty.

[52] Counting rules for ICBMs and SLBMs have been more stable. SALT and SALT II only limited delivery vehicles, so they had no counting rules.

Nuclear warhead production: No treaty to date has limited US or Russian abilities to produce nuclear warheads. Any such limits would be difficult to agree on (and possibly hard to verify), but it may be worth considering whether to try to include such limits in a future treaty. Unfortunately, Russia has a huge advantage over the United States in pit production, and this could make it harder to obtain agreements on limiting warhead production, at least absent US revitalization at the National Nuclear Security Administration. Further, US deficiencies in warhead production would work against the United States in any near-term arms race with Russia.

Conclusions and Recommendations

This report raises many questions and provides few answers. Nevertheless, several observations and suggestions come to mind in closing, although the list below is not in strict order of priority:

- Although future arms control is probably desirable and could have a favorable influence on the international security environment and on US–Russian relations, it is time to go back to the mindset that prevailed in the Nixon through Reagan administrations. Absent favorable developments, the United States needs to think of Russia and China as adversaries, not as countries that are evolving toward democracy and/or friendship with the West.
- Before starting negotiations on a successor to New START, the United States needs to think about desirable strategic/nuclear force structures for 2040 and beyond. Analyses should take account of US–Russian, US–Chinese, and Russian–Chinese relations; Russian capabilities; growing Chinese nuclear capabilities; and evolving threats from additional countries.
  - For example, the United States may need specialized capabilities that are optimized for use against lesser powers, and it would be desirable that START 2026 not impose excessive constraints on such capabilities.
  - Analyses on future force structures should include the full range of systems that might be technologically practical in the 2030s and should not be constrained to types of systems currently or recently in the US inventory.
- START 2026 needs to account for credible technological advances through 2035 at least. The goal should be to prevent Russia from fielding strategically important capabilities that use new technologies not captured by the treaty.
- The limits and counting rules in START 2026 should not require disproportionate cuts to US weapons, relative to Russia, unless the United States gets something important in return.
- The United States needs to consider the massive Russian numerical and qualitative advantage in NSNWs. This is related to the issue on new types of weapons, but some of these NSNWs are of types that have existed for decades and have never counted against treaty limits.
  - These Russian NSNWs pose a major threat to NATO, plus a threat to Japan and Alaska. Further, some Russian sea-launched weapons may pose a significant threat to the US homeland.
  - The United States needs to try to obtain limits on these NSNWs. Even if the United States does not obtain numerical limits on Russian NSNWs, a desirable goal might be to keep NSNWs out of Kaliningrad, because weapons in Kaliningrad provide more extensive target coverage of Europe than would weapons in contiguous Russia. In exchange for removal of Russian weapons

from Kaliningrad, the United States might promise to never deploy nuclear weapons in Poland or the Baltic states, or possibly to dismantle the Aegis Ashore BMD site in Poland.

  - Alternatively, the United States could seek major improvements to its own NSNWs, if limits on NSNWs are off the table. Better defenses against Russian SLCMs (or at least better abilities to detect an attack before missiles get close to their targets) would also be helpful.

- START 2026 needs to define terms in a comprehensive, unambiguous manner that makes it difficult to violate the spirit of the treaty by exploiting loopholes in definitions (unless the United States wants to maintain the flexibility to emulate recent Russian actions along these lines).
- New START does not limit air-launched conventional weapons that are easily distinguished from nuclear weapons, but it treats conventional and nuclear ballistic missiles identically. It may be time to exclude conventional weapons that are easily distinguished from all nuclear weapons from the next treaty.
- START 2026 needs to have rigorous provisions for detecting cheating—at least as rigorous as New START and preferably more rigorous. Further, the United States needs to think in advance about what to do if it detects cheating. What should the US responses be? How much cheating is "too much," leaving withdrawal from the treaty as the best US response?
- The United States needs to consider whether it will accept limits on national BMD in exchange for Russian concessions on something else. Further, continued US expansion of national BMD could provoke Russian and Chinese buildups beyond what they would otherwise do.
- The United States needs to have leverage if it wants to get significant Russian concessions in areas where Russia is currently superior to the United States.
  - In particular, the United States should probably avoid any unilateral cuts to the strategic nuclear program of record or to programs on hypersonic weapons. Further, the United States should possibly move forward with a nuclear SLCM as a program of record, improve homeland defenses against Russian SLCMs, or both. Finally, there should also possibly be considerations about deploying this weapon on land if any host nation in a reasonable location will agree to this.

The list above is aspirational; it is not meant to imply that the United States will be able to implement all the suggestions laid out. However, it may be possible to negotiate a treaty that is somewhat similar to New START but with most of the following improvements: better definitions that eliminate most of the previously described loopholes from New START, a more sensible definition for a heavy bomber, and a more coherent and consistent treatment of conventional versus nuclear weapons. Unfortunately, the Russian advantage in NSNWs is so large that is hard to see any near-term prospects for obtaining limits on such weapons, except possibly by linkage to limits on US BMD systems that are effective against long-range ballistic missiles (namely GMD and Aegis Ashore with the SM-3 Block 2A interceptor). On the other hand, US acceptance of limits on such BMD systems could make it harder to secure Senate ratification of the treaty.

In addition to the treaty-oriented points above, the United States should begin thinking about desirable force structure options for the 2040s, with New START limits, with notional but plausible limits, and with no limits. A reasonable timeline for moving forward might be to conduct additional

analyses—on future force structure options and on treaty considerations—in 2021 and 2022 and then begin negotiations on a successor treaty in late 2022 or early 2023. The successor treaty—if one emerges—could then replace New START as soon as it is ratified or run in parallel with New START until New START expires.

A final thought: Finally, it is unlikely—but not impossible—that China will build up its nuclear forces fast enough to undermine the rationale for near-term US–Russian negotiations for one last bilateral treaty on strategic forces. However, if projected trends emerge, the future buildup in Chinese strategic forces will eventually change things fundamentally. The United States needs to begin thinking about a trilateral nuclear future and what this might mean for arms control and national security. Toward that end, the United States must be mindful of the precedents the next strategic arms-control treaty might set for a trilateral treaty in the future.

Appendix Details on Treaties to Date

Treaties before the New Strategic Arms Control Treaty (New START): Summary and Comparison

As mentioned in the introduction, some treaties constrain activities rather than the size or nature of US/Russian nuclear forces. Treaties that constrain or mandate activities include

- the Limited Test Ban Treaty (1963 entry into force);
- the Outer Space Treaty (1967 entry into force);
- the Non-Proliferation Treaty (1970 entry into force);
- the Threshold Test Ban Treaty (1973 entry into force);
- the Open Skies Treaty (initial signatures in 1992, entered into force in 2002, US withdrawal in 2020); and
- the Comprehensive Test Ban Treaty (initial signatures in 1996 but never entered into force).

The Outer Space Treaty has many signatories and prohibits placing nuclear weapons and other weapons of mass destruction (an undefined term) in space. The Treaty on the Non-Proliferation of Nuclear Weapons, better known as the Non-Proliferation Treaty (NPT), also has many signatories, and one of its goals is to prevent the spread of nuclear weapons to additional countries beyond the acknowledged nuclear powers as of 1970. The goals of the countries without nuclear weapons are that they have access to nuclear power and that the nuclear weapon states accomplish general and complete nuclear disarmament (but with no date specified for disarmament). The Limited Test Ban Treaty prohibits testing of nuclear weapons at the Earth's surface, in the atmosphere, in outer space, or underwater. The signatories were the United States, the Soviet Union, and the United Kingdom. The Threshold Test Ban Treaty prohibits nuclear tests with yields exceeding 150 kilotons. The signatories were the United States and the Soviet Union. The Comprehensive Test Ban Treaty (CTBT) would have prohibited all nuclear tests that produced measurable nuclear yield. Numerous nations approved this treaty. President Clinton signed it, but the Senate did not ratify the treaty. It has never entered into force (although the United States has observed it anyway). The Open Skies Treaty allowed announced, unarmed overflights of the signatory countries to help verify other treaties and provide transparency into force size and force deployment. In each case, personnel from the observing country and the observed country were on the aircraft. The United States withdrew from this treaty on November 22, 2020, because of claimed Russian noncompliance with obligations under the treaty. The United States provided little information on the details of the noncompliance.

Rationales for arms-control treaties on nuclear weapons include the following:

- Reducing the risk of nuclear war
  - This often results from measures to improve strategic stability by making it harder to conduct a disarming first strike.
- Reducing the consequences of war, should it occur
  - However, there could be tension between reducing the consequences of a war and reducing the likelihood of a war.

- Avoiding expensive competitions in numbers and characteristics of weapons
- Setting the ground for improved relations between the negotiating partners, partly by providing each side insight into the other side's concerns

The remainder of this appendix contains detailed descriptions of and commentary on the seven treaties from Table 1 that preceded New START—the only treaty of its type that is still in effect.[53] Five of these treaties were conceptually similar, in that they placed numerical limits on various types of strategic offensive weapons (a term that was mostly not limited to nuclear weapons). Table 2, which appears early in this report, briefly summarizes the items limited by New START and the earlier treaties that were conceptually similar to New START. Of the six relatively similar treaties from Table 1, SALT and SALT II limited only the number of strategic delivery vehicles, whereas START limited both strategic delivery vehicles and deployed strategic warheads. New START is similar to START in this respect. START II and SORT limited only deployed warheads. Any treaty that limits warheads needs to have "counting rules" that relate the number of delivery vehicles to the number of warheads. In these treaties, the term "strategic delivery vehicle" usually refers to intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and heavy bombers, although one treaty limited the number of ballistic missile submarines (SSBNs).[54] In general, the cutoff between strategic nuclear weapons and nonstrategic nuclear weapons (NSNWs) has not followed any sort of well-grounded logical basis. For example, long-range nuclear sea-launched cruise missiles (SLCMs), especially on submarines, could pose a strategic threat but have never been included in any treaty.

The other two treaties from Table 1 were considerably different. The Anti-Ballistic Missile (ABM) Treaty placed bilateral limits on the number of "strategic BMD interceptors," the number of sites for such interceptors, and the location and orientation of radars that could track incoming ballistic missile reentry vehicles (RVs) at long range. Ballistic missile defense (BMD) interceptors were further restricted to being land based and fixed, like silo-based ICBMs. The INF Treaty prohibited the United States and the Soviet Union from possessing ground-launched cruise missiles (GLCMs) or ground-launched ballistic missiles with a maximum range between 500 and 5,500 kilometers.

The various treaties from SALT and the ABM Treaty to New START differed significantly in their complexity, attention to detail in defining items, verification provisions, congruence with near-term changes in the international security environment, and how well they kept up with existing technology and emerging technology that was easily foreseeable when the treaties were signed. In terms of verification provisions:

- START and START II (not ratified) had the most extensive provisions for ensuring compliance.
- New START and the INF Treaty are one step down.

[53] This appendix is mostly based on the treaties as they emerged from negotiations. I attempted to find information on what the United States hoped to achieve going into the negotiations for each treaty and how the US position evolved as negotiations proceeded. Unfortunately, easily accessible unclassified documents do not provide much information. The best information is on the ABM Treaty, the Strategic Arms Limitation Treaty (SALT), SALT II, the Intermediate-Range Nuclear Forces (INF) Treaty, and New START. There is also a short section on the background of, and negotiations on, New START. Details on the treaty that emerged from these negotiations appear early in this report.

[54] Descriptions and analyses of the various treaties are based on examining the full text of the treaties; Woolf, *Arms Control and Proliferation*; and descriptions of those treaties from Wikipedia, the State Department website, the White House website, and the Federation of American Scientists website.

- SALT, SALT II, and the ABM Treaty were another step down.
- SORT had the fewest procedures for avoiding cheating.

In terms of comprehensive and unambiguous definitions for weapons, facilities, procedures, and other terms, START and START II were the "best" treaties and SORT was the worst. However, some of these treaties may have incorporated deliberate briefness and/or ambiguity for some definitions or limits to make the treaties more politically palatable to the legislatures that needed to ratify them.

In terms of keeping up with the technology that existed or was reasonably predictable at the time of the treaty negotiations, all the treaties before SORT were generally successful. It is hard to evaluate SORT, because it was so limited in how it described anything. New START fails to address types of weapons that were easily predictable at the time of the negotiations in 2009 and 2010, and these omissions are becoming of increasing relevance today. Of course, it may be that the United States tried, but failed, to address new types of weapons. The State Department has not released the negotiating record for New START.

The Anti-Ballistic Missile (ABM) Treaty of May 1972

On May 26, 1972, President Richard Nixon of the United States and General Secretary of the Communist Party of the Soviet Union Leonid Brezhnev signed the ABM Treaty. The Senate ratified the treaty on August 3. The United States and the Soviet Union began negotiations on the ABM Treaty and SALT at about the same time, in late 1969. The extent of overlap between the negotiating teams for the two treaties is uncertain, but each country presumably pursued negotiations on the two treaties in congruence with some sort of unifying strategy. Details on the negotiations, as opposed to the actual treaties, mostly appear in the subsection on SALT.

Except for the ABM Treaty, all the treaties considered in this report limited or banned (mostly limited) certain types of US and Soviet/Russian offensive weapons. This treaty placed limits on US and Soviet BMD systems for defending their respective homelands (details to follow). A treaty of this sort could have two general benefits:

(1) It could prevent an unconstrained race in offensive arms, in order to overcome unconstrained defensive systems.

  – Another 1972 treaty placed limits on US and Soviet strategic offensive arms, but the existence of the ABM Treaty may have reduced incentives to cheat on the other treaty or to break out of it altogether.

(2) It could improve strategic stability by reducing the incentive to strike first in a crisis.

  – It would almost certainly be the case that a US ABM/BMD system would be insufficiently effective to prevent catastrophic US losses against a Soviet first strike. However, a Soviet retaliatory strike, after a US first strike, would be much smaller than a Soviet first strike, and the US ABM/BMD system might reduce US losses against the Soviet retaliatory strike to a tolerable level. Such a situation would give the Soviet Union incentive to strike first in a crisis if the Soviet leaders regarded a US first strike as a realistic (even if unlikely) possibility.

  – This situation would also apply in reverse and could incentivize a US first strike in a severe crisis.

Before this appendix delves into details on the final treaty, it summarizes the status of US and Soviet efforts on strategic BMD going into the start of the negotiations. In the spring of 1969, the United States nominally planned to deploy up to 12 fixed ABM sites, primarily for defense of ICBM bases. Each site would defend a relatively small area (a few thousand square miles) against Soviet ICBMs and SLBMs. The exact locations of the planned ABM sites may not have been decided, and it is uncertain whether these sites would have defended any city other than Washington, DC.[55]

The Soviet Union, by contrast, deployed its A-35 BMD system near Moscow in 1971. This site had 64 A-350 Galosh high-yield nuclear interceptors and several radars. The Galosh was primarily or entirely for conducting interceptions slightly outside the atmosphere, and it had a nuclear warhead with a yield of 2 to 3 megatons. The Soviet Union began working on a more advanced system, now known as the A-135 BMD system, somewhat later. Russia deployed the A-135 as a replacement for the A-35 around 1995.

Various US memoranda from May 1969 through late 1971 suggest the lack of a broadly accepted, or well-defined, US position on the desired outcome of the ABM negotiations, or its exact linkage to the parallel SALT negotiations. By early 1970, the US plan was for five ABM sites—four for defending ICBM bases and one for defending Washington, DC. Internal US discussions emphasized the importance of obtaining congressional funding for these sites, partly for leverage in the negotiations. At one point, the United States proposed having four US sites—all for defense of ICBM bases—in exchange for one Soviet site at Moscow. Not surprisingly, the Soviet Union was not enthusiastic about this idea.[56] In the middle of 1971, US internal discussions began devoting attention to whether the treaty should limit development, testing, or production of ABM systems employing mobile launchers or based on new technology (such as directed-energy weapons). In late 1971, the Soviet Union brought up issues on whether the treaty should ban any sort of national ABM system.

Available internal US memoranda mostly provide little insight into US views on the linkage between the future ABM Treaty and SALT. However, some memoranda expressed opposition to the idea of combining an ABM ban with a ban on ICBMs that have multiple warheads. The authors apparently felt that such a dual ban would work to the benefit of the Soviet Union, in terms of the number of weapons that would survive a first strike. The reason for this belief is uncertain. The remainder of this subsection deals with the ABM Treaty as it finally emerged form negotiations.

In its original form, the ABM Treaty limited each signatory to two fixed BMD sites, with up to 100 interceptors per site. One site could defend the nation's capital, and the other site could defend an ICBM base. Each signatory was forbidden to develop or deploy space-based, air-launched, sea-based, or mobile land-based BMD systems. Although the treaty did not explicitly mention directed-energy weapons such as lasers, the way it defined an ABM/BMD site may have implicitly prohibited directed-energy defenses at fixed land sites. Each nation also agreed not to deploy any sort of national BMD system. Each site was limited to defending an area 150 kilometers in radius. If a defensive site complied with this 150-kilometer limit, it would take an extremely large number of sites to defend the 48 contiguous US states, let alone the much

[55] The primary reference for details on the ABM negotiations is Burr, "Secret History of the ABM Treaty." The site includes 41 declassified documents, all of which were originally either Secret or Top Secret.

[56] In a possibly sarcastic or comic tone, the lead Soviet negotiator expressed surprise that the United States had not proposed a 12:1 ratio of US to Soviet ABM sites. The US response was that the United States was holding a 12:1 proposal in reserve, but that it would apply to martinis, not ABM sites.

larger Soviet Union. The treaty also limited the number of ABM/BMD radars per site, although neither country ever came close to this limit. Finally, the treaty prohibited the signatories from deploying any ABM/BMD/early warning radars—other than the ones at the two permitted sites—except at the peripheries of their countries and pointing outward.

The sites were limited to defense against "strategic ballistic missiles," a term that was not defined in the treaty. The treaty did not restrict defenses against aircraft, cruise missiles, or theater ballistic missiles. This opens up a point of potential ambiguity, in that a Soviet SLBM with a range of 2,500 kilometers could be "strategic," because it could threaten all of the 48 contiguous states from two launch points (one in the Pacific and one in the Atlantic) that might plausibly be accessible to Soviet SSBNs.[57] If the Soviet Union deployed the same missile on land in Europe, it would be a "tactical" or "theater" missile, and defenses against it would have been permissible.[58] Hence, defenses against tactical ballistic missiles might have been effective against some of the comparatively short-range SLBMs in service in 1972 (although such missiles were not around for much longer).[59]

A 1974 addendum to the treaty restricted each country to one site, as neither country had started on a second site. The Soviet Union chose to defend Moscow with the A-35 system. The original A-35 system transitioned into the A-135 system in the 1990s. The A-135 system is still operational. The A-135 Moscow BMD system consists of the Pill Box radar and Gazelle low-yield nuclear-tipped endo-atmospheric interceptors. The system originally also included high-yield Gorgon exo-atmospheric interceptors, but these were retired in 2007. Since the current system is limited to endo-atmospheric interceptions, its defended area would be small, and it would take a large number of sites to defend most of Russia. The defended area of the Gorgon interceptor could, in theory, have been much larger than the treaty allowed, but the detection range of the Pill Box radar near Moscow probably limited the Gorgon's effective range.

The United States chose to defend a now-closed ICBM base in North Dakota. The US Safeguard system was conceptually similar to the later Moscow BMD system, with a high-yield exo-atmospheric interceptor (Spartan), a low-yield endo-atmospheric interceptor (Sprint), and powerful radars. (The original Soviet system relied purely on high-yield interceptors.) Safeguard was operational for only 10 months before the United States retired it.

Treaty verification was limited to "national technical means," and both countries agreed not to take any steps to interfere with such verification. Of necessity, this verification approach is mostly limited to detecting sizable objects, especially fixed ones (such as ICBM silos or, better yet, large radars) and to intercepting communications and other signals. Both the US and Soviet sites relied on large, fixed radars that could easily be observed and counted.

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[57] The term *SSBN* nominally refers only to nuclear-powered ballistic missile submarines, but this report uses the term for all ballistic missile submarines. The United States never deployed diesel-powered ballistic missile submarines, but the Soviet Union had some diesel-powered ballistic missile submarines until about 1980.

[58] This point of ambiguity might be less serious in the reverse direction because of the large size of the Soviet Union, arctic ice (that impeded US SSBN operations), and the lack of oceans immediately south of the Soviet Union. There was no ambiguity regarding ICBMs, because such a missile would need a range of 5,000 kilometers or more to strike the Soviet Union from bases in the 48 contiguous states. Conversely, a US ballistic missile with a range of 2,500 kilometers could threaten all of the western Soviet Union if deployed in West Germany.

[59] The United States had switched to the Polaris A-3 SLBM (range of ~4,600 kilometers) by 1972. The Soviet R-21 and R-27 SLBMs were still in service in 1972, with ranges of about 1,700 to 3,000 kilometers.

There is one known Soviet violation of the ABM Treaty, which pertained to a radar at Krasnoyarsk. This was described in the section on cheating. It is also plausible that the Gorgon interceptor may have been able to defend an area exceeding 150 kilometers in radius, depending on the range at which the Pill Box radar could track incoming RVs. (This range would depend on the radar cross section of the incoming US RV and the performance characteristics of the Pill Box radar.) Similar concerns may have applied to the US Spartan interceptor, but it was operational for less than a year.

The United States began backing away from the ABM Treaty when President Ronald Reagan introduced the Strategic Defense Initiative (SDI) in 1983. President George W. Bush announced the United States' intention to withdraw from the ABM Treaty on December 13, 2001, so that it could pursue a limited national BMD system that would protect against small attacks from countries such as Iran or North Korea (or possibly a small unauthorized or accidental launch from Russia or China).

A final point of interest is that both the US and Soviet/Russian systems included exo-atmospheric interceptors with high-yield nuclear warheads (reportedly 1 megaton for the Soviet/Russian Gorgon and 5 megatons for the US Spartan). The US Starfish Prime nuclear test of July 9, 1962, exploded a warhead with an alleged yield of about 1.5 megatons at an altitude of 400 kilometers, near Johnston Atoll in the Pacific. The explosion caused significant electromagnetic pulse (EMP) effects as far away as Honolulu (1,450 kilometers away) and Kwajalein Island (2,600 kilometers away). Hence, use of either Gorgon (detonations within a few hundred miles of Moscow) or Spartan (detonations most likely over south-central Canada or near the US–Canadian border) would have resulted in a self-inflicted EMP attack of considerable severity. The first detonation might have blinded the BMD radars and rendered the systems useless. Nevertheless, Russia reportedly kept Gorgon until 2007.

Assessment: In terms of technical loopholes and consistency with the technology of 1972, the ABM Treaty appears to have been simple, comprehensive, and exhaustive, aside from the single (but significant) point of ambiguity regarding overlap between "strategic ballistic missiles" and "theater ballistic missiles." No type of system that was on the verge of fielding in 1972 or 1974 would have provided a way to field defenses outside the scope of the treaty. In recent years, boost-glide weapons have blurred the distinction between ballistic missiles and cruise missiles. This would complicate the definition of BMD. However, such systems were not readily foreseeable in 1972.

The Strategic Arms Limitation Treaty (SALT) of May 1972

On May 26, 1972, President Richard Nixon of the United States and General Secretary of the Communist Party of the Soviet Union Leonid Brezhnev also signed SALT. The Senate ratified SALT on August 3. As noted earlier, negotiations on SALT ran concurrently with negotiations on the ABM Treaty, and the two countries presumably employed some kind of consolidated strategy on negotiations for both treaties. This is unlike the situation with subsequent treaties.

The Johnson administration desired to initiate arms-control negotiations with the Soviet Union as early as 1967 and reached a preliminary agreement to initiate such talks in July 1968. However, the Soviet invasion of Czechoslovakia in August 1968 caused the United States to postpone the negotiations. Preliminary negotiations began in November 1969. The US and Soviet delegations tried to gain insight into the views

of the other side, and they agreed that the talks would be private, with no press reporting on proposals, discussions, and so on. The main talks began in Vienna in April 1970 for both SALT and the ABM Treaty. Negotiations then alternated between Helsinki and Vienna.

In 1967, the primary concern within the US executive branch was to prevent an expensive arms race in BMD. By 1968, high-level US officials began to worry about the emergence of accurate ICBMs with multiple independently targeted reentry vehicles (MIRVs), because such missiles could threaten the survivability of silo-based ICBMs. The United States was particularly worried about the large Soviet SS-9 ICBM. However, by the time negotiations actually got underway in late 1969, the technology for MIRVed ICBMs was becoming mature, thereby making it harder to preempt the fielding of such weapons.[60] The Soviet Union had entirely different concerns and was worried that forward-based US nuclear systems in Western Europe could reach parts of the Soviet Union. The Soviets wanted to classify any US weapon of a type then deployed in Europe and capable of reaching any appreciable part of the Soviet Union as a strategic weapon subject to limitation in SALT. The United States strongly resisted this proposal and, for a time, the Soviets wanted to discuss only limitations to BMD, and to defer negotiations on strategic offensive weapons until after an agreement on BMD.[61]

The available unclassified sources do not provide much insight into internal US deliberations on the SALT and ABM negotiations, or on whether the United States had some sort of agreed-upon position on the desired outcome of the negotiations. There were internal US discussions on whether the treaty should ban ICBMs with multiple warheads per missile, but it is doubtful that the Soviet Union would have been amenable to such an idea. The internal US memoranda were hostile to such a ban. Internal US discussions apparently included offense–defense linkage on BMD and ICBMs or SLBMs with MIRVs. Options discussed fell into four general categories:

(1) High or no limits on BMD plus high or no limits on MIRVed ICBMs and SLBMs (except through limits on the total number of ICBMs and SLBMs)

(2) High or no limits on BMD plus severe restrictions on MIRVed ICBMs and SLBMs (possibly even a total ban on such missiles)

(3) Serious restrictions on BMD (zero to two BMD sites with limits on the capacity per site and the technological capabilities) plus high or no limits on MIRVed ICBMs and SLBMs (except through limits on the total number of ICBMs and SLBMs)

(4) Serious restrictions on both BMD and MIRVed ICBMs and SLBMs

The United States submitted numerous detailed proposals during the first 18+ months of the negotiations. The Soviet Union mostly stuck to criticizing the US proposals. Further, the Soviet negotiators were reluctant to release information on the size of Soviet nuclear forces.

The Soviets were interested in limits on BMD but were initially reluctant to accept any limits on strategic offense unless the United States included some of its NSNWs in Europe as part of its strategic offensive

[60] Burr, "The Secret History of the ABM Treaty." The site includes 41 declassified documents, all of which were originally either Secret or Top Secret. See also Newhouse, "Cold Dawn." BMD sites protecting ICBM bases might, therefore, be viewed as stabilizing by making it harder to carry out a successful first strike. BMD sites protecting cities might be destabilizing by letting a country with robust BMD strike first, destroy almost all of the other country's ICBMs, and then count on BMD to negate the retaliatory strike.

[61] US Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements*.

forces. (Some of these systems could reach the western Soviet Union.) The Soviets were also more interested in pursuing BMD at cities than in protecting ICBM bases. (The Soviet BMD site at Moscow, which became operational in 1971, may have been able to protect some ICBM silos near Moscow, so it potentially performed "double duty." US ICBM bases were far from major cities, so no US BMD site could protect both ICBMs and cities.) The Nixon administration did not think that Congress would agree to fund a city-centric BMD system, so an agreement to allow only BMD sites near cities would have likely permitted only the Soviet Union to field such BMD. In addition, the United States apparently proposed a moratorium on building SSBNs, but the treaty did not do this. The rest of this subsection deals with the treaty that emerged from the negotiations.

US news leaks on the internal US deliberations also annoyed the Soviets and impeded progress. After the Soviet Union learned of the possible US rapprochement with China in the second half of 1971, Soviet negotiators became more interested in achieving a treaty or two, and the negotiations began to be more fruitful. The actual result from the two treaties was serious restrictions on BMD (see details in the previous subsection) plus no explicit limits on MIRVed ICBMs and SLBMs (apart from an overall limit on the number of ICBMs and SLBMs).

Unlike treaties of the last 30 years, the SALT limits did not require the United States or the Soviet Union to reduce weapons below the prevailing levels. In another difference from modern treaties, SALT applied only to the number of ICBMs and SLBMs. It did not limit bombers or cruise missiles, nor did it account for ICBMs or SLBMs that carried MIRVs. The last omission may have been due to perceived verification difficulties. The treaty was initially agreed to last for five years. In 1977, however, both countries agreed to comply with SALT limits until a new treaty took effect.

The limits in SALT were complex and were keyed to force levels at that time, not to somewhat arbitrary numerical limits (as in New START, for example). In May 1972, the United States had 1,000 Minuteman ICBMs—a mixture of single-warhead Minuteman II missiles and three-warhead Minuteman III missiles—plus 54 Titan II ICBMs.[62] All these ICBMs were deployed in hardened silos. The United States had 41 SSBNs, each with 16 Polaris A3 or Poseidon SLBMs, all of which were MIRVed.[63] The Soviet Union had 1,618 ICBMs. The Soviet Union had 34 nuclear-powered SSBNs with 440 SLBMs. The Soviet Union also had 28 diesel-powered ballistic missile submarines with 77 shorter-range SLBMs (range of 300 to 1,650 kilometers, for different missile variants), although it began retiring some of these submarines around 1973.

SALT did not define the term *ballistic missile*. It defined an ICBM as a ballistic missile with enough range to reach the northwestern corner of the continental Soviet Union from the northeastern corner of the United States (presumably Maine), or vice versa. The treaty did not state how much range a submarine-launched missile had to have to qualify as an SLBM. It apparently applied to all SLBMs that were fielded at that time, although a few Soviet SLBMs had a range of less than 500 kilometers. It did not mention ballistic missiles on surface ships, so both signatories might have been able to evade the SALT limits by fielding ballistic missiles on surface ships. Moreover, neither signatory faced any limits on nuclear-capable bombers or nuclear cruise missiles (such as the US AGM-28 Hound Dog [two per B-52, range of about 1,250 kilometers] and the AGM-69 Short-Range Attack Missile [20 per B-52, range of about 200 kilometers]). However, bomber

[62] Although limited to one warhead, the Titan II had the largest range-payload product of the US ballistic missiles, and its warhead was very high in yield.

[63] These US SLBMs had a shorter range (~4,500 kilometers) and smaller, lower-yield warheads than the ICBMs.

bases were significantly vulnerable to preemptive attacks from ICBMs or SLBMs. In my opinion, this called into question the desirability of a huge buildup in bombers, although it is uncertain whether the negotiating teams shared this view in 1969 through early 1972. Similarly, neither signatory faced any restrictions on deploying long-range GLCMs. For example, the United States briefly deployed the SM-62 Snark intercontinental GLCM in the 1960s, but neither country had an intercontinental GLCM in 1972.[64]

SALT contained the following provisions and limitations:

- Each country agreed not to construct additional fixed ICBM launchers after July 1, 1972.
  - The term *fixed ICBM launcher* was not defined. It would presumably include silo-based ICBMs and highly vulnerable ICBMs in fixed above-ground launchers.
- Each country agreed not to replace "light ICBMs" with "heavy ICBMs" and not to replace existing ICBM with new ICBMs that were "significantly larger."
  - The treaty did not define the terms *light ICBM* and *heavy ICBM*. The term *significantly larger* referred to 15 percent of current dimensions. Hence, an increase of 16 percent in either length or diameter would presumably violate this provision. It is unclear whether an increase of 9 percent in both length and diameter would be a violation, although this would increase the volume of the missile by almost 30 percent.
  - The goal of this provision was probably to avoid a buildup in the number of warheads on ICBMs, because large missiles could carry more warheads than smaller missiles.
- Each country agreed not to increase its number of SLBMs or SSBNs, unless it reduced its number of ICBMs by a number at least equal to the number of additional SLBMs.
- The Soviet Union agreed not to deploy more than 62 SSBNs or more than 950 SLBMs, no matter how much it reduced its ICBM force.
  - The Soviet Union had 62 such submarines in 1972 (some of them diesel powered), but the origin of the number 950 is not clear.
- The United States agreed not to deploy more than 44 SSBNs or more than 710 SLBMs, no matter how much it reduced its ICBM force.
  - If the United States retired the Titan II ICBM and replaced those 54 missiles one-for-one with SLBMs, this would add up to 710 SLBMs.
  - All US SSBNs at that time had 16 tubes, so building three more SSBNs of the most recent type would have added 48 SLBMs, not 54.
- The treaty included a unilateral statement by the United States on mobile ICBMs. The United States agreed to defer explicit restrictions on mobile ICBMs to a follow-on treaty but stated that it would consider the deployment of mobile ICBMs to be incompatible with the objectives of the treaty.

[64] Neither the United States nor the Soviet Union/Russia has fielded an intercontinental ground-launched cruise missile (GLCM) since the Snark, but Russia is developing such a missile.

As with the ABM Treaty, verification was limited to "national technical means," and both countries agreed not to take any steps to interfere with such verification. Of necessity, this verification approach is partially limited to detecting sizable objects, especially fixed ones (such as ICBM silos). Interceptions of telemetry could potentially reveal how many warheads an ICBM or SLBM carried during a flight test, but SALT placed no specific limits on the number of warheads per missile or on the number of missiles that could carry multiple warheads. There was no requirement for on-site inspections. Such inspections would be useful for verifying the number of warheads per missile and for addressing mobile missile launchers, among other things.

Assessment: This was the first treaty that placed any limits on strategic offensive weapons. As such, it may be unreasonable to expect the level of detail (e.g., definitions, counting rules, and verification procedures) found in later treaties such as START. Further, SALT applied only to a subset of US and Soviet strategic weapons. Hence, SALT allowed unrestrained buildups in

- nuclear-capable bombers, with or without nuclear cruise missiles or other nuclear standoff weapons;
- nuclear GLCMs and SLCMs; and
- the number of warheads per ICBM or SLBM (within constraints imposed by the size and payloads of the missiles).

Because the treaty applied only to ballistic missiles and did not define the term *ballistic missile*, it is hard to determine how well the treaty accounted for the technology of the early 1970s. There is no compelling evidence that the Soviet Union violated the SALT numerical limits. The later Soviet/Russian SS-18 ICBM may have violated the spirit of the "heavy ICBM" restriction, but the failure to define a heavy ICBM makes this hard to determine.

The Second SALT (SALT II) of 1979

Negotiations on SALT II began in November 1972 and continued through three US presidencies for more than six years. In June 1979, US President Jimmy Carter and General Secretary of the Communist Party of the Soviet Union Leonid Brezhnev signed SALT II. The treaty never officially entered into force. The US Senate deferred a vote on ratifying the treaty because of the Soviet invasion of Afghanistan. In 1980, President Carter said that the United States would comply with the treaty limits if the Soviet Union did. In May 1982, President Ronald Reagan likewise said that the United States would comply with the treaty limits if the Soviet Union did, but he never submitted the treaty to the Senate for approval. In 1984, 1985, and 1986, President Reagan accused the Soviet Union of violating some of its commitments under SALT and SALT II, but he did not allow the United States to exceed the treaty limits.

Hence, SALT II functioned like a "real treaty" even though it never entered into force. In effect, the United States and the Soviet Union complied (more or less) with SALT and SALT II until START of 1991 superseded both of the earlier treaties.

SALT II had a complex and torturous history. Henry Kissinger led the US effort from November 1972 through the end of the Ford administration. After President Carter took office in January 1977, the comparative roles of Cyrus Vance (the secretary of state), Harold Brown (the secretary of defense), and Zbigniew Brzezinski (the national security advisor) were unclear. Further, Jimmy Carter took a more active role

in the proceedings than did Gerald Ford. Richard Nixon was extremely interested in foreign policy, but the Watergate scandal consumed his attention from early 1973 until his resignation in August 1974. Further, Jimmy Carter was interested in setting the SALT II limits low enough to require immediate reductions in both US and Soviet nuclear arsenals.

Apart from issues pertaining to US weapons, and as was the case with the SALT/ABM negotiations, the Soviets objected to US news leaks about the negotiations. News leaks about the Soviet rejection of the March 1977 US proposal (described later), and the Soviet failure to make a counteroffer, were particularly annoying and unhelpful. In addition, the Soviets objected to President Carter's criticism of Soviet human rights violations, a topic that Nixon and Ford had ignored. Conversely, the Soviet delegation refused to state how many strategic weapons the Soviet Union possessed and said that it was up to the United States to figure that out. This approach was unpopular with the US delegation.

Early in the Ford administration, US goals in the SALT II negotiations included the following:[65]

- Including bombers in the treaty limits
- Setting equal limits for both sides
  - The number of 2,400 total delivery vehicles (the number later incorporated into the treaty) was already under serious consideration by the US side by November 1974. Later on, President Carter was interested in having lower limits, possibly down to 1,800 total delivery vehicles.
- Setting the stage for gradual reductions in strategic forces
- Avoiding a technological arms race on new types of weapons

The United States submitted a proposal that was relatively close to the final agreement as early as November 1974. Nevertheless, the negotiations dragged on until 1979. The change in administrations in January 1977, with potentially different priorities by the Carter administration, may have contributed to these delays.[66]

The United States was worried that the large Soviet SS-9 ICBM could carry perhaps five to ten MIRVs and thereby pose a severe threat to US silo-based ICBMs. In reality, it is uncertain that the SS-9 ever carried more than three MIRVs, the same number as the much smaller (and probably more accurate) US Minuteman III ICBM.[67] The United States also wanted to include the Soviet Tu-22 Blinder medium bomber (range of ~4,900 kilometers) and the Soviet Tu-22M Backfire medium bomber (range of ~6,800 kilometers) in the treaty limits.[68]

The Soviet Union was also worried about US weapons that in development at that time. The US B-1 bomber was almost ready for production in early 1977. It had a long range, a top speed of slightly over 1,000 miles

[65] US State Department, "Strategic Arms Limitations Talks/Treaty (SALT) I and II"; and Talbott, *Endgame: The Inside Story of SALT II*.

[66] US Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements*.

[67] Wikipedia, s.v. "R-36 (Missile)." The later Soviet SS-18 ICBM could carry up to ten high-yield MIRVs, but the SS-18 was years away from deployment at the time of the SALT II negotiations.

[68] Russia retired the Blinder around the year 2000. The Backfire is still in service. Neither aircraft could pose much of a threat to the US homeland without a long-range nuclear weapon, which neither bomber carried in 1979. Unfortunately, the Backfire now may have the Kinzhal ALBM, which may have a range of up to 2,000 kilometers and may have a nuclear version. Wikipedia, s.v. "Tupolev Tu-22"; and Wikipedia, s.v. "Tupolev Tu-22M."

per hour, and the ability to fly low for an extended distance. The ability to fly low would negate surface-based radars, except at short ranges, and force the Soviets to rely on airborne radar aircraft similar to the US AWACS (Airborne Warning and Control System). The B-1 was supposed to carry the AGM-86A nuclear ALCM, a subsonic cruise missile with a range of 1,125 kilometers. The AGM-86A entered low-rate production in early 1977.[69] President Carter canceled the B-1 in June 1977, preferring to rely on a longer-range version of the ALCM on the B-52 and on future stealth aircraft.[70] This decision probably reduced US leverage in the SALT II negotiations. The Soviet Union was also alarmed by US developmental efforts on long-range nuclear ALCMs and nuclear GLCMs. Long-range nuclear ALCMs would greatly increase the effectiveness of US heavy bombers, and long-range nuclear GLCMs could hit the western Soviet Union from launch sites in Western Europe. To make matters worse, the Soviet Union would have had little or no ability to detect GLCM launches, and GLCMs could fly low enough to impair detection by Soviet ground-based radars.[71] In addition, the Soviets feared that the United States would produce long-range nuclear ALCMs in vast numbers and integrate them on modified Boeing 747 civilian transport aircraft. For a while, the Soviets wanted to count each US bomber with long-range ALCMs as being more than one delivery vehicle.

Finally, the Soviet Union was concerned about US NSNWs based in Western Europe. Some of these weapons could reach parts of the western Soviet Union, whereas no corresponding Soviet weapon in Eastern Europe could reach any of the United States. The Soviets wanted to include these US weapons in the treaty. The United States did not. The United States also did not want to include British and French weapons in the treaty, although it is uncertain that the Soviets ever proposed to do so.

The United States submitted a "Joint Comprehensive Proposal" to the Soviet delegation in March 1977. Sources available to me do not describe this proposal in detail, but it differed significantly from the last Kissinger/Ford proposal. It apparently proposed lower overall limits than earlier proposals and new limits on Soviet heavy ICBMs and/or MIRVed ICBMs. The Soviets rejected the Joint Comprehensive Proposal without making a counteroffer. This derailed the negotiations for several months.

At a meeting in September 1977, the US and Soviet delegations discussed a proposal that was close to the final agreement from 1979. Both sides seemed to agree that this proposal represented a viable path forward, and there was joy on the US side, tempered by the expiration of SALT in October 1977. Unfortunately, things did not go smoothly over the winter. Some details on the September 1977 proposal came out in the United States, and Democratic senator Henry Jackson and multiple Republicans, including former secretary of defense Melvin Laird, severely condemned it.

Further, the Defense Department continued to worry about the survivability of US silo-based ICBMs. During the winter of 1977–1978, the United States discussed revised/lower limits for Soviet heavy ICBMs and/or MIRVed ICBMs. (A "heavy ICBM" would include a missile of large size, high maximum payload at

[69] "AGM-86A Cruise Missile."

[70] President Reagan revived the B-1, in the form of the B-1B, in 1981. The B-1B has a top speed of about 830 miles per hour, compared to at least 1,000 miles per hour for the original B-1A, but has a smaller radar cross section than the B-1A. The United States had already terminated the AGM-86A by this time, so the B-1B carried the shorter-range AGM-69 SRAM. After cancellation of the B-1A, the United States developed a much longer-range version of the AGM-86, known as the AGM-86B, for use by the B-52. The AGM-86B is still in service and has a range of about 2,500 kilometers, or perhaps more. The B-2 stealth bomber did not become operational until 1999, and then only in small numbers. Wikipedia, s.v. "Rockwell B-1 Lancer"; and Wikipedia, s.v. "AGM-86 ALCM.".

[71] The US aircraft most nearly equivalent to the Soviet Blinder and Backfire medium bombers was the FB-111A. Although smaller than either Soviet aircraft, it was similar in range to the Blinder.

launch, or high maximum payload at some meaningful range.) After internal discussions, the United States decided that the operationally relevant factor was having MIRVs on the missile, not the missile's size per se. However, implementing limits on MIRVs was not to be easy. On the US side, the situation was arguably clearer than on the Soviet side. Each of the 450 Minuteman II ICBMs carried one warhead. Each of the 550 Minuteman III ICBMs carried three warheads. Each of the 54 Titan II ICBMs carried one extremely large warhead (but United States was phasing out the Titan II). Each of the 656 Poseidon SLBMs carried 10 to 14 small RVs. The complication was that the Minuteman II and Minuteman III ICBMs resided in identical silos, and the Soviets feared that all silos might actually contain Minuteman III ICBMs.[72] Conversely, the Soviets had single-warhead and multiple-warhead versions of the same types of ICBMs (with the single-warhead versions having much greater explosive yields). This interfered with US efforts to determine how many Soviet ICBMs carried MIRVs.

In addition, the United States considered various measures to make US ICBMs more survivable: ICBMs on mobile ground vehicles, ICBMs on railroad tracks in underground tunnels, and shell game basing (officially known as the Multiple Aim Point System, or MAPS). Under the MAPS approach, the United States would construct thousands of new ICBM silos and shuttle the 1,000 Minuteman ICBMs around between these silos. There were a couple major problems with this approach. First, while a silo is cheaper than an ICBM, the cost ratio is not huge (perhaps three to one or four to one), so it might be more cost-effective to expand the ICBM force than to build a huge number of mostly empty silos. Second, the United States would have to take steps to interfere with Soviet "national technical means" in order to keep the Soviets from knowing which silos actually contained ICBMs. Hence, the Soviets would have probably insisted on treating all silos as containing ICBMs. Unfortunately, the United States broached the issue of MAPS with the Soviet delegation in the spring of 1978, even though US analyses on the subject were not complete and the United States was not close to being committed to MAPS.

Another issue in the spring of 1978 also created political problems for the US side, although they were not pertinent to strategic weapons. The United States had developed enhanced radiation weapons, colloquially known as neutron bombs. These weapons derived a higher-than-normal fraction of their explosive yield from high-energy neutrons (from deuterium–tritium fusion). Such neutrons were good at penetrating steel, so an airburst from such a weapon could penetrate the steel on Soviet armored vehicles that were invading NATO, and kill their crews, all while minimizing damage to surrounding areas. Such weapons would have been for theater use and would presumably not have been subject to SALT II limits. However, President Carter initially pressured NATO countries to accept deployment of such weapons, and then canceled the project in the spring of 1978. This turnabout on the neutron bomb led to renewed domestic criticism of President Carter's entire defense program, and of his conduct on arms control.

Yet another technical issue pertained to guidance systems for ballistic missiles. The ability of an ICBM or SLBM to destroy an ICBM silo is critically dependent on the accuracy of the RVs from the attacking missile. In 1978, the United States discussed various ways to limit improvements in missile guidance systems. Such limits would be hard to verify at best. Intercepting telemetry from flight tests might help but would depend on knowing the intended aimpoints in a missile test, not just where the RVs actually landed.

[72] Given the open nature of US society and the lack of US efforts to impair operations by Soviet spy satellites, it would have been hard for the United States to replace the Minuteman II force covertly.

There were also internal US discussions through 1977 and much of 1978 about how to distinguish between a new type of ICBM or SLBM and a modification to an existing type and how to ban such new types. Many US participants wanted to classify a missile with a new and improved guidance system as a new type of ICBM or SLBM, even if this improvement did not involve any changes to the size, range, payload, or appearance of the missile. The Soviet Union objected strongly to any such provision, and Harold Brown eventually broke the internal US logjam by essentially agreeing with the Soviet approach that a new ICBM would have to visibly different from an existing type.[73] Nevertheless, US–Soviet arguments over exactly how to identify a "new type of ICBM" continued through Christmas of 1978.

Yet another issue pertained to long-range ALCMs. For a while, the United States wanted to exempt purely conventional ALCMs from treaty accountability, whereas the Soviets wanted to treat all long-range ALCMs the same way. The United States eventually accepted the Soviet position for fear that the Soviets would field *nominally* conventional long-range ALCMs on some aircraft that did not count as a heavy bomber (such as the Backfire). Verifying that all such missiles were, in fact, conventional would be extremely difficult.

Cyrus Vance met with his Soviet counterpart, Andrei Gromyko, in Moscow in December 1978, and they produced a draft that they thought would be close to the final agreement. When Vance returned to the United States, he encountered a hostile reaction from Harold Brown and Stansfield Turner (the director of the Central Intelligence Agency) over the lax treatment of encrypted telemetry in the Moscow draft. President Carter rejected the draft proposal and sent Cyrus Vance back to work on the telemetry issue again.

Further, the United States normalized relations with China in December 1978 and Chinese leader Deng Xiaoping visited the United States in January 1979. In February, China initiated a short and inconclusive war against Vietnam—a Soviet ally. These developments enraged and possibly frightened the Soviets. The impact on the SALT II talks is hard to determine.

Two final factors during the winter of 1978–1979 were the ill physical health of Leonid Brezhnev, the head of the Soviet Union, and the ill political health of President Carter. Brezhnev may have wanted to sign the treaty himself, instead of running the risk of letting things slide to his successor. In addition, by early 1979, the chances of Jimmy Carter making it to a second term appeared to be less than 50-50, and Brezhnev may have feared that the negotiations would break down entirely if they started over with a new US president.

Talks dragged on all through the winter of 1978–1979. On April 7, the Soviet ambassador to the United States, Anatoly Dobrynin, delivered a conciliatory message to Cyrus Vance. A full agreement appeared to be imminent, but negotiations dragged on again until June. Some of the new disputes pertained to whether SALT II should ban ICBMs and SLBMs from carrying penetration aids to enhance their survivability against BMD systems. (It is uncertain whether this issue had been a sticking point previously.) In any event, the treaty negotiators resolved the remaining issues and Brezhnev and Carter signed SALT II in Vienna on June 18. As previously noted, however, the US Senate never ratified the treaty.

SALT II contained the following numerical limits on delivery vehicles, which were equal for both signatories:

- 2,400 total delivery vehicles: ICBM launchers, SLBM launchers, and heavy bombers combined
  - This number would have been lowered to 2,250 by the end of 1981 had the treaty been ratified.

[73] The United States was much more concerned about ICBMs than about SLBMs, due to the greater range, payload, and accuracy of Soviet ICBMs in comparison with Soviet SLBMs. The later Trident D5 SLBM upset the apple cart with its combination of range and accuracy.

- 1,320 delivery vehicles with MIRVs: ICBM launchers plus SLBM launchers plus heavy bombers with air-launched ballistic missiles (ALBMs) or long-range ALCMs (even if conventional)
  - For ALCMs, the treaty referred to weapons with a range exceeding 600 kilometers. Neither country had any such ALCMs at the time, but the US AGM-86 ALCM was under development. (The United States had retired the Hound Dog ALCM, which had a range exceeding 600 kilometers.)
  - The Soviet Union did not succeed in getting each B-52 armed with long-range ALCMs to count as multiple delivery vehicles.
  - The treaty did not specify a range cutoff for ALBMs.
- 1,200 long-range ballistic missile launchers with MIRVs: ICBMs plus SLBMs
  - Once any ballistic missile of a given type had been tested with MIRVs, then all missiles of that type would be treated as carrying MIRVs.
- 820 ICBM launchers with MIRVs

In addition to the above numerical limits on delivery vehicles, SALT II banned certain types of activities and weapons, including the following:

- Increasing the number of warheads on existing types of ICBMs
- Building new land-based ICBM launchers
- Converting launchers for "light ICBMs" to launch "heavy ICBMs"
- Converting launchers for theater ballistic missiles to launch ICBMs
- Converting aircraft that are not heavy bombers (such as commercial aircraft) to carry long-range ALCMs or ALBMs
  - This addressed the Soviet concern described previously. (However, later US analyses on modifying the Boeing 747 to carry conventional ALCMs suggested that this would not be as easy to do as the Soviets feared.)
- Various new or different weapons (restrictions consistent with the US goal of avoiding competition in new types of weapons):
  - Long-range ballistic missiles (range exceeding 600 kilometers) on surface ships
  - Ballistic missile launchers or cruise missile launchers on the seabed
  - The Soviet SS-16 ICBM, because of its similarity to the SS-20 intermediate-range ballistic missile (IRBM)
  - Rapid-reload ICBM launchers
  - New types of ICBMs, except for one new type of "light ICBM" per signatory
  - "Heavy ICBMs" on mobile launchers

The treaty also limited each country to deploying one new type of "light ICBM." This was the SS-25 Sickle (also known as RT-2PM) for the Soviet Union and the LGM-118 Peacekeeper for the Unites States. (Calling the Peacekeeper a "light ICBM" was somewhat of a stretch, although it could fit in some Minuteman III silos.) Finally, the treaty contained some limits on the number of warheads per delivery vehicle and other characteristics of delivery vehicles and launchers:

- No more than 10 warheads per ICBM on the one new type of ICBM for each side
- No more than 10 warheads per ALBM
  - Neither country deployed any such missiles during the period in which SALT II was (unofficially) in effect.
- No more than 14 warheads per SLBM
  - The US Poseidon SLBM carried up to 14 MIRVs per missile, although the Poseidon had significantly less range than ICBMs and its warheads were smaller than ICBM warheads.
- No more than 28 ALCMs on any heavy bomber
- No more than 20 ALCMs on any heavy bomber of any existing type
- No more than one warhead per ALCM
- Limits on the size and payload weight of ballistic missiles
- Modernization of an ICBM silo not to increase the volume in the silo by more than 32 percent

The treaty defined an ICBM in exactly the same manner as the original SALT and again included all SLBMs without regard for the range of the missile. Unlike the original SALT, this treaty included "heavy bombers" in the overall limits. The treaty defined heavy bombers in a peculiar manner. A heavy bomber was any bomber meeting the following criteria:

- Could carry out the missions of a "heavy bomber" in a manner comparable to or better than the US B-52 or B-1 or the Soviet Tu-95 Bear or M-4 Bison
  - Applying the "comparable to or better than" provision would have been complex and subjective, given the lack of metrics in the treaty.
  - The B-1 was not in service until late 1984.
- Was equipped to carry ALBMs
- Was equipped to carry ALCMs with a range exceeding 600 kilometers
  - No country had such weapons in 1979, but the United States was well along in developing the AGM-86B nuclear ALCM, with a range of "more than 2,400 kilometers" according to some sources and 2,500 kilometers according to the Center for Strategic and International Studies (CSIS).
  - The US AGM-86A ALCM had a range exceeding 600 kilometers, and the United States built some of these missiles in 1977. However, the decision to cancel the B-1 led to a subsequent decision to cancel the AGM-86A, which did not have enough range to maximize utility of the B-52.

    - The earlier US AGM-28 Hound Dog supersonic cruise missile had a reported range of about 1,250 kilometers, but it had been retired by 1979 in favor of the supersonic AGM-69 Short-Range Attack Missile (SRAM), which had a reported range of only 200 kilometers. A B-52 could carry only two Hound Dogs but could carry 20 SRAMs. The SRAM was beneficial in terms of allowing a B-52 to avoid risk from SAMs located near its intended targets but had little effect on the B-52's geographic target coverage. The FB-111 also carried the SRAM, but the FB-111 did not count because of its short range combined with the short range of the SRAM.
  - This provision applied to both conventional and nuclear ALCMs. The negotiators may have assumed that long-range conventional ALCMs would be of limited utility in the future. This was true in 1979 and remained the case through much of the 1980s, but long-range conventional ALCMs are of considerable importance today.

The treaty did not count the Soviet Tu-22M Backfire medium bomber, the Soviet Tu-22 Blinder medium bomber, or the US FB-111A Aardvark against the numerical limits outlined above. The Backfire is still in service, in a modernized form, whereas the United States retired the FB-111A in 1991 and Russia retired the Blinder around 2000. The United States tried, but failed, to include the Backfire and the Blinder in treaty limits. It is uncertain whether the United States offered to include the FB-111A, but the Backfire was larger than the FB-111A and had a longer range. The treaty did not count any US NSNWs in Western Europe.

The treaty defined a cruise missile as a pilotless, guided, self-propelled weapon-delivery vehicle that sustains flight using aerodynamic lift over most of its flight path. The treaty did not define the term *self-propelled*. An ALCM would be any cruise carried by or flight-tested from an aircraft. The range of a cruise missile would be the distance flown before running out of fuel, plus any glide to Earth's surface after running out of fuel. This glide distance would be small for a subsonic cruise missile flying at low to medium altitude. The treaty did not define the term *ballistic missile*.

A protocol to the treaty contained additional restrictions:

- Each side agreed not to flight-test or deploy ALBMs.
  - This is consistent with the goal of avoiding competition in new types of weapons. However, the provision of counting any aircraft that carries an ALBM as a heavy bomber might have suppressed interest in ALBMs anyway.
- Each side agreed not to deploy SLCMs or GLCMs with a range exceeding 600 kilometers.
  - Both sides violated the provision on SLCMs, and the United States deployed a nuclear GLCM with a range exceeding 600 kilometers starting in 1983.
- Each side agreed not to flight-test or deploy SLCMs or GLCMs with more than one warhead per missile.

Finally, a protocol to the treaty listed US and Soviet strategic weapons as of 1979. These numbers, and the SALT II limits, appear in Table A-1.

As with SALT and the ABM Treaty, this treaty stated that both sides would rely primarily on national technical means for treaty verification and that neither side would undertake any activities to interfere with such verification (such as encrypting telemetry to interfere with determining whether an ICBM or SLBM carried multiple warheads during a flight test). There was no requirement for on-site inspections. Such inspections would have been helpful in, for example, determining how many missiles actually have MIRVs.

The Soviet Union allegedly violated SALT II by encrypting telemetry from flight tests of the SS-25 ICBM for several years. After US objections, the Soviet Union stopped encrypting such telemetry.

Table A-1. SALT II Limits Plus US and Soviet Force Levels

Type of System	United States	Soviet Union
Forces		
Fixed ICBM launchers	1,054	1,398
Mobile ICBM launchers	0	0
ICBM launchers with MIRVs	550	576
SLBM launchers	656	950
SLBM launchers with MIRVs	496	128
Heavy bombers	574	156
Heavy bombers equipped with long-range ALCMS	0	0
Heavy bombers equipped with ALBMs	0	0
ALBMs	0	0
Ballistic missiles with MIRVs	1,046	704
Bombers + ICBMs + SLBMs (delivery vehicles)	2,284	2,504
Limits		
ICBMs with MIRVs	820	820
ICBMs with MIRVs plus SLBMs with MIRVs	1,200	1,200
Delivery vehicles with MIRVs	1,320	1,320
Delivery vehicles (bombers + ICBMs + SLBMs)	2,400	2,400

Assessment: (1) The United States did not succeed in getting any explicit restrictions on the Soviet SS-9 ICBM or in counting the Blinder or Backfire bombers as strategic delivery vehicles. The Soviet Union did not succeed in getting limits on US ALCMs or GLCMs or in counting any US nuclear weapons in Europe against treaty limits. It is uncertain whether the Soviets ever proposed to count the US FB-111A against treaty limits. The Soviets succeeded in getting a ban on integrating long-range ALCMs on commercial aircraft. (2) SALT II was an improvement over the original SALT in terms of setting concrete numerical limits and in defining what weapons were included under its limits. (3) Notable problems included the failure to define the term *ballistic missile*, the failure to define the term *self-propelled* in the definition of a cruise missile, and the "comparable to or better than" provision in the definition of a heavy bomber. The lack of requirements for intrusive inspections made it harder to verify compliance than would have been the case with on-site inspections. (4) Considering that the treaty never had any official standing, bilateral compliance with the treaty was reasonably good, except for failure to comply with the protocol prohibition on fielding long-range SLCMs and GLCMs.

The Intermediate-Range Nuclear Forces (INF) Treaty of 1987

US President Ronald Reagan and Soviet President Mikhail Gorbachev signed the INF Treaty in December 1987. The treaty entered into force in 1988. It banned the United States and the Soviet Union from having ground-launched ballistic missiles or GLCMs with a maximum range between 500 and 5,500 kilometers. Despite its name, the treaty did not distinguish between conventional and nuclear weapons. In 1987, the Soviet Union had deployed more GLCMs and IRBMs than had the United States, so the Soviet Union had to retire a larger number of missiles (about 1,750) than did the United States (846).

The Soviet Union began deploying SS-20 IRBMs in Eastern Europe during the Carter administration. In November 1979, NATO adopted a dual-track approach of deploying 108 Pershing II IRBMs in West Germany and 464 Gryphon GLCMs in the United Kingdom, while initiating negotiations with the Soviet Union on limiting intermediate-range nuclear weapons in Europe (or perhaps globally).[74] Preliminary negotiations began in late 1980—at least seven years before the final agreement. The talks spanned the administrations of two US and four Soviet presidents. There was a hiatus in talks due to the end of the Carter administration. The Reagan administration began formal negotiations in late 1981.

Discussions between the United States and NATO led to the following goals for the INF talks:

- The limits for US and Soviet forces should be equal.
- The treaty should not limit NATO nuclear forces other than those of the United States.
- The limits should apply to US and Soviet systems wherever they were, not just in Europe.
- Nothing in the treaty should have an adverse effect on NATO conventional capabilities.
- The treaty should have better verification procedures than earlier agreements.

During the initial Reagan-era negotiations, the United States pursued a zero-zero approach, with no intermediate-range nuclear forces on either side. However, it is uncertain what the intended definition was for such forces. The negotiations did not go well, and the Soviets walked out in November 1983. Talks resumed in March 1985. In February 1986, the United States proposed a bilateral limit of 140 such weapons per country (globally or in Europe?). In 1987, emphasis swung back to the zero-zero approach that ended up in the actual treaty. The Soviet Union wanted to include 72 West German Pershing 1A missiles with US nuclear warheads in the treaty. The treaty did not do this, although West Germany made a unilateral decision to retire these missiles after the United States and the Soviet Union signed the INF Treaty.

The available unclassified sources do not provide a comprehensive picture of what the United States hoped to achieve in the INF negotiations, apart from the goals discussed above. President Gorbachev apparently hoped for a much broader agreement that includes strategic nuclear forces, theater nuclear forces (although it is uncertain whether his conception of theater nuclear forces was broader than what the treaty actually covered), and conventional forces in Europe, but the actual treaty dealt only with GLCMs and ground-launched ballistic missiles that fell within a defined range bin. The United States apparently wanted the lower limit of the range bin to be shorter than 500 kilometers, whereas the Soviet Union wanted a lower limit of more than 500 kilometers. The compromise result was 500 kilometers. It is uncertain whether there were disputes about the upper range limit. The INF Treaty value of 5,500 kilometers went on to become

[74] US Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements.*

the lower limit of the ICBM range bin in START. The earlier SALT and SALT II agreements did not have a specific lower cutoff range for ICBMs, but instead defined an ICBM as being able to reach any portion of the Soviet Union from the closest launch point in the United States (and vice versa).[75]

The treaty included verification by national technical means, as did SALT, SALT II, and the ABM Treaty, and both signatories agreed not to interfere with such verification by the other party. Unlike earlier treaties, the INF Treaty introduced provisions for on-site inspections that have been standard in most subsequent treaties.

The treaty placed no restrictions on air-launched or naval weapons. It contained the following definitions:[76]

- *Cruise missile* means a pilotless, self-propelled weapon-delivery vehicle that stays aloft by aerodynamic lift over most of its flight path.
  - The treaty did not define the term *self-propelled*. The US interpretation is that *self-propelled* means continuously powered, like an aircraft.[77]
  - The treaty defined the *range* of a *cruise missile* as the distance flown when the missile runs out of fuel. This definition is operationally meaningless for a high-speed, high-altitude cruise missile that can glide a long distance after running out of fuel. Unlike in SALT II, the term *range* did not include any distance glided after the missile exhausted its fuel.
- *Ballistic missile* means a weapon-delivery vehicle that has a ballistic trajectory over most of its flight path.
  - The treaty did not define the term *ballistic trajectory*.[78]

The INF Treaty was mostly successful for a decade or more. However, the last 20 years have seen three categories of developments that no one expected in 1987:

- Russia violated the treaty for several years before the United States—in response—announced plans to withdraw from the treaty in February 2019. Russia also claimed that the US Aegis Ashore BMD site in Romania violated the INF Treaty because the launcher tubes could accommodate Tomahawk cruise missiles in addition to SM-3 BMD interceptors and SM-6 surface-to-air missiles (SAMs). Russia never presented any evidence that the United States had actually deployed Tomahawk cruise missiles at this site.
- China, Iran, and North Korea all have sizable arsenals of (mostly conventional) missiles of the types banned by the INF Treaty.
  - At the time of the INF Treaty, by contrast, the United States and the Soviet Union had a near monopoly on weapons of the types banned by the INF Treaty, and all such weapons were nuclear.
  - This factor is outside the scope of this report, although it is strategically important.

[75] Savranskaya and Blanton, "INF Treaty and the Washington Summit."

[76] The full text of the INF Treaty is available at https://2009-2017.state.gov/t/avc/trty/102360.htm.

[77] Based on a personal discussion including APL personnel and the head of the division at the Pentagon that is responsible for treaty compliance (Office of the Under Secretary of Defense for Acquisition and Sustainment – Strategic Warfare).

[78] These observations on the two treaties come from studying the full text of the treaties and relevant appendixes to them.

- A new category of weapon—the boost-glide weapon—appeared. Such weapons could play much the same role as IRBMs without meeting the treaty definitions for a ballistic missile or a cruise missile.
  - This issue also applies to ICBMs and SLBMs, but these weapons were outside the scope of the INF Treaty.
  - The development of boost-glide weapons was not easily foreseeable in 1987.

Another factor relevant to the INF Treaty was its limited scope. It only applied to ground-launched missiles. In 1987, the United States had nuclear SLCMs (the Tomahawk Land-Attack Missile–Nuclear, or TLAM-N) on some SSNs and on *Iowa*-class battleships. With a reported range of 2,500 kilometers, TLAM-N could have threatened much of the western Soviet Union from launch points in the North Sea and the Norwegian Sea, and parts of eastern Siberia from launch points in the northwest Pacific. SSNs in the Arctic Ocean might have been able to reach more parts of the Soviet Union, but ice-free launch points would have usually been extremely close to the Soviet coast, and even points close to the coast would often have been iced over for much of the year. (Global warming is changing this by making more and more of the Arctic Ocean ice free for significant parts of the year.) By virtue of geography, the United States is more vulnerable to attack from SLCMs than was the Soviet Union. However, the Soviet SS-N-12 Sandbox SLCM (also known as P-500 Bazalt) had a reported range of only 550 kilometers, and much of its deployment was on surface ships, which would have difficulty getting close to the United States during a war. This missile had been operational for more than a decade in 1987. The SSC-X-4 Sling Shot SLCM (also known as RK-55 Relief) had a much longer range (possibly up to 3,000 kilometers), and *Akula*-class SSNs started carrying this missile around 1988. The current status of this missile is uncertain.

Assessment: The INF Treaty was initially successful and asymmetrically beneficial to the United States, in that the Soviet Union gave up more missiles than did the United States. Moreover, the introduction of on-site inspections was a step forward in treaty verification. The failure to include SLCMs left open a path for both countries to achieve much the same capability as with GLCMs (but not the short time of flight for IRBMs), and geography leaves the United States more vulnerable to SLCMs than was the Soviet Union. Finally, although the emergence of boost-glide weapons (IRBMs in disguise) could not easily have been anticipated in 1987, it would have been easy to prevent this loophole by having the treaty apply to "any land-based missile, of any type, with a maximum range between 500 and 5,500 kilometers." This is a lesson for the future.

The Strategic Arms Reduction Treaty (START) of 1991

On July 31, 1991, US President George H. W. Bush and Soviet President Mikhail Gorbachev signed START. The negotiations for START lasted about seven years. The Soviet Union subsequently broke up in December 1991. At that time, about 70 percent of the strategic nuclear weapons covered by START were in Russia, with the remainder being split between Ukraine, Kazakhstan, and Belarus. In May 1992, the United States, Russia, Ukraine, Belarus, and Kazakhstan signed a protocol to START that made all four of these former Soviet republics parties to the treaty. At the same time, Ukraine, Belarus, and Kazakhstan agreed to eliminate their nuclear weapons by the end of the seven-year reduction period spelled out in START and to sign the NPT.

The Senate approved START on October 1, 1992. The Russian Parliament consented to START on November 4, 1992, subject to de-nuclearization by the other three former Soviet republics. Belarus and Kazakhstan complied with these terms by early 1994. Ukraine finally complied with the Russian terms on November 16, 1994, and the treaty entered into effect on December 5, 1994 (and expired on December 5, 2009).

START was an extremely complex and detailed treaty relative to earlier treaties and to some later treaties. START also had the most extensive verification procedures of any of the ratified treaties described in this report. Further—and unlike SALT and SALT II—START required actual reductions in US and Soviet arsenals instead of merely putting a lid on future expansion. Finally, START introduced the concept of "counting rules." Such rules have been a feature of all such treaties since that time.

START employed the following definitions, some of which were carried over from the INF Treaty and some of which have been replicated in subsequent treaties:

- *Ballistic missile* means a weapon-delivery vehicle that has a ballistic trajectory over most of its flight path.
  - The treaty did not define the term *ballistic trajectory*.
- *Cruise missile* means a pilotless, self-propelled weapon-delivery vehicle that sustains flight using aerodynamic lift over most of its flight path.
  - The treaty did not define the term *self-propelled*. The US interpretation is that *self-propelled* means continuously powered, like an aircraft.
- The treaty defined the *range* of a *cruise missile* as the distance flown when the missile runs out of fuel, plus any glide to Earth's surface.
- *Heavy bomber* means a nuclear-capable aircraft with a one-way range exceeding 8,000 kilometers or any aircraft that carries a nuclear ALCM with a range exceeding 600 kilometers.
  - A bomber could carry purely conventional cruise missiles of any range without counting against START limits if that bomber were not equipped to carry any nuclear weapons.
  - A nuclear-capable aircraft with a one-way range of less than 8,000 kilometers could carry purely conventional cruise missiles of any range without counting against START limits if that bomber did not carry nuclear ALCMs with a range exceeding 600 kilometers.
- *Intercontinental ballistic missile (ICBM)* means a land-based ballistic missile (nuclear or conventional) with a maximum range exceeding 5,500 kilometers.
- *Submarine-launched ballistic missile (SLBM)* means a ballistic missile (nuclear or conventional), with a range exceeding 600 kilometers, of a type that has ever been carried by or launched from a submarine.
- *Air-launched cruise missile (ALCM)* means an air-to-surface cruise missile that had been test fired from or deployed on an aircraft since December 31, 1986, or any such weapon developed in the future.
- *Heavy ICBM* means an ICBM with a launch weight exceeding 106,000 kilograms or a throw weight exceeding 4,350 kilograms.
  - This term applied only to the Soviet/Russian SS-18 ICBM, which has a launch weight of 209,000 kilograms and a payload of 8,000 kilograms. The US LGM-118 Peacekeeper had a launch weight of 88,450 kilograms, and its maximum payload was about 4,200 kilograms.

- *Heavy SLBM* means an SLBM with a launch weight exceeding 106,000 kilograms or a throw weight exceeding 4,350 kilograms. No such SLBM has ever existed.
- *Air-to-surface ballistic missile* (ASBM, same thing as ALBM) means a ballistic missile (conventional or nuclear) with a range exceeding 600 kilometers that is intended for launch from the air.
- *Deployed ICBM* means an ICBM that is in a usable silo or on a mobile launcher vehicle (or railroad train).
- *Deployed SLBM* means an SLBM that is in a launch tube on an SSBN.
- *Deployed heavy bomber* means any heavy bomber other than a test or training aircraft. Heavy bombers in long-term depot maintenance were apparently considered as being deployed, unlike in New START.

START had the limits listed below, with counting rules appearing after the limits:

- 1,600 deployed delivery vehicles: deployed ICBMs and their associated launchers, deployed SLBMs and their associated launchers, and deployed heavy bombers
- 154 deployed heavy ICBMs (within the overall limit of 1,600, not in addition to it)
- 6,000 warheads attributed to deployed ICBMs, deployed SLBMs, and deployed heavy bombers
- 4,900 warheads attributed to deployed ICBMs and deployed SLBMs
- A combined throw weight of 3,600 metric tons for deployed ICBMs and deployed SLBMs
- 1,540 attributed warheads on heavy ICBMs

Although the term *deployed* appears in the limits listed above for delivery vehicles of various types, the meaning of *deployed delivery vehicles* in START is not identical to that in New START. The two treaties treat the word *deployed* the same regarding ballistic missiles. On the other hand, a heavy bomber in long-term depot maintenance would qualify as deployed under START but not under New START. START also referred to nondeployed ICBMs and SLBMs undergoing maintenance at facilities other than operational bases and had separate limits on the allowable numbers for such missiles (not reflected above and not limited under New START).

Both countries had to comply with these limits within seven years of the date that START entered into force, and they had to meet intermediate limits along the way. START had complex counting rules, which may be summarized approximately as follows:

- Each ICBM or SLBM of a then-existing type would count as a number of attributable warheads specified in the treaty. This number would be constant across a given type of ICBM or SLBM.
- Each ICBM or SLBM of a new type would count as the maximum number of (presumably dummy) warheads ever carried by an ICBM or SLBM of that type in a flight test.
- Each heavy bomber not equipped to carry long-range nuclear ALCMs would count as one warhead.
- Each US heavy bomber equipped to carry long-range nuclear ALCMs would count as 10 warheads, up to a maximum of 150 bombers.

  - Each such heavy bomber beyond 150 would count as the number of long-range nuclear ALCMs that the heavy bomber was equipped to carry (even if the United States did not have enough ALCMs to equip all such bombers to their capacity).
  - In practice, this applied only to the B-52, which could carry 20 long-range nuclear ALCMs. The United States built 193 B-52G aircraft and 102 B-52H aircraft, the two variants of the B-52 that carried the AGM-86 ALCM in the 1980s. The United States eliminated all B-52G aircraft by the end of the seven-year phase-in period for START.
- Each Soviet heavy bomber equipped to carry long-range nuclear ALCMs would count as eight warheads, up to a maximum of 180 bombers.
  - Each such heavy bomber beyond 180 would count as the number of long-range nuclear ALCMs that the heavy bomber was equipped to carry (even if the Soviet Union did not have enough ALCMs to equip all such bombers to their capacity).
  - In 1991, Soviet heavy bombers with long-range nuclear ALCMs were equipped to carry anywhere from 6 to 16 such missiles.

In addition, each signatory agreed not to do the following:

- Produce, flight-test, or deploy any new heavy ICBM or any heavy SLBM
- Convert SLBMs into mobile ICBMs
- Produce, flight-test, or deploy an ICBM or SLBM with more than 10 warheads per missile
- Produce, flight-test, or deploy an ICBM or SLBM with more than the number of warheads per missile attributed to it in the treaty
- Produce, flight-test, or deploy ASBMs/ALBMs
- Produce, flight-test, or deploy ICBMs that could be reloaded (in a silo or mobile launcher) in less than 12 hours
- Produce, flight-test, or deploy nuclear ALCMs armed with more than one warhead per missile
- Produce, flight-test, or deploy a ballistic missile with a range exceeding 600 kilometers on any sea-based launch system other than a submarine
- Produce, flight-test, or deploy launchers for ballistic missiles or cruise missiles on the seabed
- Produce, flight-test, or deploy nuclear weapons of any type on balloons, blimps, or dirigibles
- Integrate nuclear weapons on a long-range aircraft (range exceeding 8,000 kilometers) of a type that was not originally designed as a bomber. This presumably referred to integrating nuclear weapons on long-range civil aircraft. (This provision addressed a Soviet concern about possible militarization of the US Boeing 747.)
- Convert heavy bombers that are not equipped to carry long-range nuclear ALCMs into heavy bombers that are equipped to carry long-range nuclear ALCMs

- Base strategic offensive arms outside their national territory
- Base weapons of mass destruction (an undefined term) in space (but there was already a multilateral 1967 treaty against doing this)

As with all earlier treaties, START included verification by national technical means, and both signatories agreed not to interfere with such verification by the other party. Unlike earlier treaties, START included provisions for data exchanges, notifications, and on-site inspections to gather information about forces and activities limited by the treaty. These features were more complex and intrusive—with many pages of rules and definitions and provisions of many types—than in any later treaty that entered into force. For example, START included continuous portal monitoring at missile assembly plants. In addition, the number of on-site inspections could be large, the notice for such inspections could be short, and the size of the inspection teams could be large.

The text of START did not explicitly limit nuclear or conventional SLCMs. A side agreement limited each signatory to 880 (nuclear?) SLCMs that had a range exceeding 600 kilometers. Another side agreement prohibited the Soviet Tu-22 Backfire bomber (which did not count as a heavy bomber) from carrying any nuclear ALCM with a range exceeding 500 kilometers (not the 600 kilometers from the body of the treaty).

Assessment: START was arguably the high-water mark of arms control in terms of detail, specificity, and verification procedures. However, as with the INF Treaty, it failed to define the term *ballistic trajectory* or *self-propelled* (in reference to cruise missiles). The treaty did not anticipate the emergence of boost-glide missiles (which could function just like ICBMs or SLBMs), nor did it limit intercontinental GLCMs. A simple fix to some of these issues would have been to define a land-based intercontinental missile as any land-based missile, of whatever type or technology, with a range exceeding 5,500 kilometers and then treat any such missile (ballistic, boost-glide, cruise, or something not yet developed) in the same manner as an ICBM. This approach would not have worked easily for weapons at sea, because of the explicitly different treatment for SLCMs in relation to SLBMs. Nevertheless, START was an excellent treaty and could serve as a partial model for the future, apart from the extremely high limits by today's standards.

The Presidential Nuclear Initiatives (PNIs) of 1991

On September 27, 1991, President George H. W. Bush announced several unilateral reductions to US nuclear forces and modernization:

- The United States removed all short-range ground-launched nuclear weapons from all overseas locations and eventually destroyed these weapons.
- The United States also removed fighter-delivered nuclear bombs from South Korea, although the September PNI did not specifically mention this provision. (The US government returned these bombs to the United States with no commitment to destroy them.)
- The United States terminated development of a new medium-range (range of about 400 kilometers) supersonic nuclear cruise missile, the AGM-131 SRAM II, which would have been used by the B-1B and B-2 bombers. (The B-2 was under development in 1991 and reached operational capability in 1999.)

- The United States terminated development of a new mobile ICBM and abandoned plans for mobile deployment of the Peacekeeper ICBM.
- The United States removed all theater nuclear weapons from submarines, surface ships, and naval aircraft. This left SLBMs as the only deployed US naval nuclear weapons, although there was no commitment to prompt destruction of the Tomahawk nuclear SLCMs.
  - The United States dismantled the nuclear SLCMs during the Obama administration but dismantled the other weapons sooner.
- The United States terminated production of the AGM-129 Advanced Cruise Missile (a stealthy long-range cruise missile), which was intended to replace or supplement the AGM-86 ALCM on the B-52.
  - This decision came slightly later than the main PNI, but it may be reasonable to consider it as related to the PNI.
  - The Air Force decided to retire the AGM-129 in March 2007, so the AGM-86 ALCM has outlasted its (first) intended replacement.
- In 1992, the United States reduced the procurement objective for the B-2 bomber from 132 aircraft to 75. The Clinton administration later reduced the number to 21. The reduction to 75 was not part of the Bush PNI per se but may be thought of as related since it happened only a few months later.

In October 1991, Soviet President Mikhail Gorbachev announced his own PNI in response to the US version. The Soviet Union agreed to do the following:

- Destroy all warheads for nuclear artillery, nuclear land mines, and short-range theater nuclear missiles
- Remove all nuclear warheads from SAMs and remove all nuclear weapons from naval aircraft, surface ships, and submarines other than SSBNs
- Terminate development of mobile ICBMs and end programs to build mobile ground vehicle launchers for existing ICBMs
  - It is uncertain whether this pledge applied to ICBMs that were already under development or only to initiating new development efforts.
- Reduce Soviet warhead levels to 1,000 warheads below the numbers required in START by December 5, 2001

Unlike the various treaties mentioned in this report, the PNIs were not legally binding, and the two countries could rescind them without advance notice. Moreover, there were no accepted verification procedures. The extent of initial Russian compliance with the Soviet PNI of 1991 is uncertain, but Russia now has various nuclear weapons of types that President Gorbachev pledged to eliminate (or remove from active service) in 1991. Examples include the SS-27 mobile ICBM (which was already under development in 1991), theater ballistic missiles such as the SS-26, short-range battlefield weapons (although possibly not artillery shells), SLCMs on submarines and possibly surface ships (if Russian SLCMs have nuclear versions), and SAMs.

Assessment: The PNIs were not treaties and had no legal status. Hence, a meaningful comparison with treaties is difficult. However, the United States remains in compliance with the US PNI of 1991, unless the United States fields the nuclear SLCM endorsed in the 2018 Nuclear Posture Review or some other weapon of a type that President George H. W. Bush committed to eliminating in 1991. Russia has not done the same.

The Second START (START II) of 1993

On January 3, 1993, US President George H. W. Bush and Russian President Boris Yeltsin signed START II. This was less than 18 months after Bush and Gorbachev signed START, which had a planned duration of 15 years. Further, the US Senate and the Russian Duma had already ratified START, except for a provision by Russia requiring de-nuclearization by Ukraine, Belarus, and Kazakhstan before START could enter into force. The motivation for pursuing a follow-on treaty so soon after START is unclear.

Treaty ratification went slowly in both countries. The Senate finally ratified the treaty on January 26, 1996. The Russian Parliament (Duma) nominally ratified the treaty on April 14, 2000, but this ratification was contingent on US modification of the treaty to include preservation of the ABM Treaty of 1972. The Senate never voted on a treaty variant with this provision included. The United States announced its intention to withdraw from the ABM Treaty in December 2001 and Russia then withdrew from START II.

START II was similar to START in terms of definitions and verification procedures, although the verification procedures were slightly more extensive than before. For example, US and Russian personnel would have been allowed to witness the destruction of ICBM silos and to examine bombers up close to verify the number of nuclear weapons that a bomber was equipped to carry. On the other hand, the limits were considerably lower than in START, the counting rules were different for bombers, and there were additional prohibitions on weapons.

Unlike earlier treaties, START II limited only the number of warheads, not the number of delivery vehicles. START II had the limits listed below (with intermediate limits along the way), and counting rules appeared after the limits:

- 3,500 warheads attributed to deployed ICBMs, deployed SLBMs, and deployed heavy bombers
- 1,750 warheads attributed to deployed SLBMs
  - The United States converted four SSBNs into conventionally armed SSGNs because of this limit, even though it never entered into force.

The counting rules were considerably different from START:

- Each ICBM counted as one warhead, and ICBMs were limited to one warhead per missile.
- Each SLBM counted as the number of warheads declared in the treaty and did not vary across SLBMs of a given type.
  - This number could be less than the maximum number previously carried, but there were provisions for verifying that SLBMs had been downloaded to the declared number of warheads per missile.

- Each heavy bomber counted as the maximum number of nuclear weapons that it could carry, with no preferential treatment for bombers that did not carry long-range nuclear ALCMs.
  - For example, a B-2 would have counted as 16 warheads under START II, compared to one warhead under START.
  - In some cases, the number of warheads attributed to a type of bomber may have exceeded the number of real weapons available for use by that type of bomber.
  - The United States removed the B-1B from the nuclear role as a result of START II. However, the B-1B is not stealthy, and it had no viable nuclear standoff weapon after the United States terminated SRAM II. The United States also retired the B-52G due to START II.

US forces in 1993 greatly exceeded the limits in START II, especially with the counting rules for bombers. More research would be needed to determine whether START II would have demanded significantly greater US reductions than Russian reductions. Table A-2 lists bomber-counting rules from START and START II. The rules in START II were very adverse to the United States, but somewhat less so for Russia.

Table A-2. Initial US and Russian Bomber-Counting Rules from START II

Type of Bomber	Nationality	Attribution Number under START II (START)
B-52G (later retired)	US	12 (10)
B-52H	US	20 (10)
B-1B (later converted to be purely conventional)	US	16 (1)
B-2	US	16 (1)
Bear B (retired by early 2000s)	Russian	1 (?)[a]
Bear G (retired by early 2000s)	Russian	2 (?)[a]
Bear H6	Russian	6 (8)
Bear H16 (different version of Bear H)	Russian	16 (8)
Blackjack	Russian	12 (8?)[a]

[a] It is uncertain whether these early-model Bear bombers ever carried long-range nuclear ALCMs (the factor that determined whether a bomber counted as 1 warhead or 10 under START). Blackjack now carries long-range nuclear ALCMs, with a load of 12, but it is uncertain whether this was the case in the early 1990s.

A key provision of START II was its ban on MIRVed ICBMs. The goal of this ban was to increase strategic stability by reducing the incentives for a first strike or for launching ICBMs on warning of an incoming attack. Suppose that the United States and Russia each had 1,000 accurate silo-based ICBMs, and that each ICBM had five warheads. A first strike could allocate three RVs against each ICBM silo of the other country. This might lead to destruction of nearly all ICBMs in the country being attacked (absent launch on warning) while leaving the attacker with 400 ICBMs and 2,000 warheads on those ICBMs.

Assessment: START II was a radical departure from earlier treaties in terms of abolishing the limits on delivery vehicles, banning MIRVed ICBMs, and imposing severe counting rules for heavy bombers. The ban on MIRVed ICBMs may have appeared conceptually reasonable at the time but was of questionable consistency with emerging technology. From the 1960s through the early 1990s, silo-based ICBMs were usually more accurate than SLBMs (and often drastically so), because of precise knowledge of the ICBM launch coordinates. Moreover, the United States did not think that Russian SLBMs had a yield–accuracy combination that would allow them to destroy US ICBM silos in 1993. However, the United States had recently introduced the Trident D5, an accurate MIRVed SLBM with a longer range than earlier US or Russian SLBMs. Since 1993, the range and accuracy of Russian MIRVed SLBMs has also improved. While SSBNs cannot attack each other in the way that ICBMs can (hence reducing the incentive to strike first), modern SLBMs pose a serious threat to ICBM silos and could be used in a disarming first strike. Finally, Russia now heavily emphasizes MIRVed ICBMs, so bringing back the ban on such weapons would almost certainly be a nonstarter in future negotiations. Overall, START would be a better model for future negotiations than would START II, except that a future treaty would have much lower limits than START did.

The Strategic Offense Reduction Treaty (SORT) of 2002

On May 24, 2002, US President George W. Bush and Russian President Vladimir Putin signed SORT in Moscow, after about 15 months of negotiations. SORT is sometimes referred to as "The Treaty of Moscow," presumably because it was signed in Moscow. Unlike START II, SORT met with prompt legislative approval and entered into force on June 1, 2003. SORT was scheduled to last through December 31, 2012, but was superseded by New START in 2011. Finally, SORT did not supersede START. The START limits, verification procedures, and other restrictions remained in effect until START expired in 2009 (although the SORT limits were much lower than under START).

Like START II, SORT limited only warheads, not delivery vehicles, but the verification procedures were very weak compared to START or START II, and there were peculiar accounting procedures unique to SORT.

SORT limited each signatory to 2,200 strategic nuclear warheads, but the United States and Russia were not required to get down to that number until the day before the treaty was set to expire, and with no interim limits along the way. (START and START II, by contrast, had intermediate limits that had to be met along the way to the final limits.) In other words, the limits would apply for only one day. (However, New START superseded SORT before getting to that one day.) The treaty itself lays out no counting rules for determining whether each country complied with the limit of 2,200 for the one day when those limits would have been in effect. An article-by-article analysis of the treaty[79] to assist Senate deliberations indicated that the US interpretation was as follows:

- Unlike earlier treaties, SORT would apply only to nuclear weapons.

[79] This accompanied the treaty text and the transmittal letters sending the treaty from President Bush and the secretary of state (Colin Powell) to the Senate. "The Moscow Treaty," Treaty Doc. 107–8.

- Each deployed ICBM or SLBM would count as the number of nuclear warheads actually carried, and this could vary from missile to missile within a given type.
  - However, the United States downloaded all Minuteman III ICBMs to one warhead per missile and removed the Peacekeeper ICBM from service. The United States retained the Peacekeeper booster stacks for use as light space-launch vehicles.
  - Warheads removed from ICBMs or SLBMs to reduce their accountability need not be destroyed but would have to be stored at locations other than the ICBM or SSBN bases. This would permit a return to higher warhead loadings after SORT expired.
- Bombers did not count against treaty limits at all, possibly because of their utility in conventional war. However, nuclear weapons stored at US and Russian bases for nuclear-capable bombers (Minot Air Force Base, Whiteman Air Force Base, and Barksdale Air Force Base for the United States) counted against the limits. Each nuclear bomb or nuclear cruise missile counted as one warhead.
  - Nuclear weapons removed from bomber bases (e.g., the AGM-86 ALCM, the B61 bomb, and the B83 bomb for the United States) need not be destroyed. For example, the United States could move many air-delivered nuclear weapons from the bomber bases to the nuclear storage facility at Kirtland Air Force Base and then return them to bomber bases in 2013.
  - The number of nuclear weapons for bombers—especially long-range weapons—is arguably more important in operational terms than the number of bombers (as in SALT II) or the fleet-wide number of connection points for nuclear weapons (as in START II). However, these weapons are small in comparison with bombers, and it is much easier to verify the number of bombers than the number of weapons for bombers. The number of connection points for nuclear weapons on each bomber is not conceptually difficult to verify, but it requires robust on-site inspections.

The material sent to the Senate along with the treaty did not explain how Russia interpreted the nonexistent counting rules from the treaty. There were numerous issues with this treaty, although they did not achieve maximum relevance until START expired in December 2009:

- The treaty contained no explicit provision prohibiting measures to interfere with treaty verification by national technical means. (However, START prohibited such measures until December 2009 and New START did so again starting in February 2011.)
- Unlike the INF Treaty, START, and START II, SORT did not provide for any on-site inspections to verify compliance with the treaty limits.
  - However, START provided for such inspections until early December 2009, and New START provided for somewhat scaled-down inspections after it entered into effect in February 2011.
  - Evidently, President Reagan's exhortation to "trust, but verify" went out the window or got lost in translation.
- The treaty would have enabled a relatively prompt buildup in deployed warheads in 2013 and 2014 by bringing ICBM RVs, SLBM RVs, nuclear bombs, and nuclear ALCMs back from off-base storage to the operational bases for bombers, ICBMs, and SSBNs.

  - New START preempted this issue when it entered into effect in February 2011.

- The treaty contained no interim levels on the road to 2,200 warheads, and each signatory could withdraw from the treaty with only three months' notice (compared to six months in most other treaties). This would have allowed either the United States or Russia to take no action based on SORT and then withdraw from the treaty in September 2012.
  - New START likewise preempted this issue when it entered into effect in February 2011.
  - Unlike SORT, New START had interim levels that had to be met on the way to meeting the final levels in February 2018, and it requires six months' notice before withdrawal. Hence, it would not have been possible to stay at the levels of 2010 until late 2017 and then withdraw from the treaty.

Assessment: At the time of SORT, the United States thought that its relationship with Russia was on a desirable long-term trajectory (along with relationships between Russia and other Western democracies) and that Russia was slowly evolving into a Western-style democracy. Unfortunately, events since 2002 have shown otherwise. (However, START and START II also came along during an era of optimism, but those two treaties contained scrupulous verification procedures, definitions, and counting rules.) Nothing about SORT should serve as a model for a future treaty to take the place of New START, except possibly accounting for the number of nuclear weapons available for prompt use by bombers.

New START 2010

A section early in this report describes the provisions contained in New START. This subsection deals with negotiations on New START. At the time of President Obama's inauguration in 2009, there were no ongoing negotiations on a successor to START, and START was going to expire on December 5, 2009. SORT was scheduled to last through December 31, 2012, but it suffered from various issues as described above, including lack of data exchanges and virtually nonexistent verification provisions. (START had robust provisions for data exchanges and verifications, but only through December 5, 2009.)

As additional background information, the spring 2009 report of the bipartisan Perry–Schlesinger commission devoted a chapter to arms control.[80] Although the impact of this report on US policy is hard to assess, it is plausible that it played a role. Hence, this appendix contains an extract from that chapter:

> The potential contributions of arms control are relatively straightforward. It may provide assurances to each side about the intentions driving modernization programs. It may lend predictability to the future of the bilateral relationship, a benefit to the United States and its allies and friends. U.S.-Russian arms control can also reinforce the NPT.
>
> Moreover, at a time when the United States is considering how to reduce nuclear dangers globally, it is essential that it pursue cooperative, binding measures with others. In view of the prospective

[80] The chairperson of the commission was William Perry, who was secretary of defense for part of the Clinton administration. The vice-chairman was James Schlesinger, who had served as secretary of defense under Presidents Nixon and Ford and as secretary of energy during the Carter administration. The committee had ten other members. Perry et al., *America's Strategic Posture*, 65–71.

START negotiations and the U.S. role in extending deterrence to others, substantial unilateral reductions in operationally deployed strategic nuclear warheads would not be wise. The Commission does not believe that unilateral nuclear reductions by the United States would have any positive impact on countries like North Korea and Iran. But some other nations may not show the nuclear restraint the United States desires or support nonproliferation efforts if the nuclear weapon states take no further agreed steps to decrease their reliance on nuclear arms.

It is essential also to remember that the arms control process is not synonymous with arms reduction. Control occurs at agreed levels, deemed stable by parties to an agreement after careful analytical work. Any reductions require such work and it has preceded every important reduction so far accomplished. Numbers are not the main point—stability, security, verification, and compliance are.

In the effort to renew the U.S.-Russian arms control process, the first step should be modest and straightforward. It is more important to reinvigorate the strategic arms control process than to strive for bold new initiatives. Toward this end, Presidents Obama and Medvedev agreed in early April 2009 to negotiate a new arms control treaty before the expiration of START. A mutual reduction of operationally deployed strategic nuclear weapons in some increment should be achievable. This first reduction could be a modest one, but the objective should be to do what can be done in the short term to rejuvenate the process and ensure that strategic arms control survives the end of START I at the end of 2009.

Recalling that reductions in nuclear forces should proceed only through bilateral agreements, the United States and Russia should address limits on both launchers and warheads and discuss how to adapt the comprehensive START verification measures to any new commitments. Success in taking this first step would help create the political will to proceed to follow-on steps that include effective verification.

The United States and Russia should also begin at an early stage to explore the challenges of deeper nuclear reductions. They are numerous. As the number of operationally deployed strategic nuclear weapons shrinks in proportion of the rest of the strategic posture, features other than numbers become more important. The challenges of finding stabilizing, balanced postures will become only more pronounced as deeper reductions require the participation of additional states. Among the challenges that must be explored are the following:

- How should non-strategic nuclear weapons be accounted for? The imbalance favoring Russia is worrisome, including for allies, and it will become more worrisome as the number of strategic weapons is decreased. Dealing with this imbalance is urgent and, indeed, some commissioners would give priority to this over taking further steps to reduce the number of strategic nuclear weapons.
- How should the non-nuclear strike capabilities be accounted for? Under START counting rules, strategic systems are counted as nuclear, whether or not they carry nuclear payloads. This approach could become less viable as nuclear numbers decline.

- How will the theater force balances between Russia and China (and others, potentially) be accounted for? . . .
- How will the different defensive capabilities of the United States, Russia, and China affect strategic balances and stability? The United States is pursuing a limited defense against limited missile attack and Russia retains nuclear-armed interceptors ringing Moscow.
- How will it be possible to verify compliance with warhead reductions?
- What types of hedges will different nations consider necessary and how can they be balanced so that no one perceives a potential disadvantage if competition for strategic advantage should be renewed by another actor?

Simple answers to most of these questions do not exist. But answers to at least some of these questions must be found for substantial additional reductions in nuclear weapons to become possible. Simple numerical objectives cannot substitute for the type of rigorous analysis of the requirements of security and stability that should . . . guide the design of the strategic force.

To address the challenges of bringing non-strategic nuclear forces (NSNF) into the overall balance, the United States must deal with a number of arms control issues. A first priority is to ensure that the INF treaty does not collapse. For many Americans, this treaty is largely an historical footnote. . . . The INF treaty is far more prominent in Russia's arms control debate. Russian concerns about the treaty crested in 2007 with a series of high-level statements threatening to withdraw. The Bush administration was able to persuade Russia to agree to a renewed effort to globalize the treaty. The Obama administration has signaled its commitment to this globalization effort. Diplomatic efforts have been made to expand INF membership to all countries with missiles of the specified ranges. But this seems unpromising, as it would require states as varied as Israel, Iran, Pakistan, India, North Korea, and China to relinquish such capabilities. The fate of the treaty is a matter of considerable importance to U.S. allies in both Europe and Asia.

The United States will need to consider additional initiatives on those NSNF not constrained by the INF treaty —i.e., tactical nuclear weapons. U.S. policy should be guided by two principles. First, the United States should seek substantial reductions in the large force of Russian NSNF. Second, no changes to the U.S. force posture should be made without comprehensive consultations with all U.S. allies (and within NATO as such). All allies depending on the U.S. nuclear umbrella should be assured that any changes in its forces do not imply a weakening of U.S. extended nuclear deterrence guarantees. . . . Some allies have made it clear to the Commission that such consultations would play a positive role in renewing confidence in U.S. security assurances.

The report notes the following findings and recommendations:[81]

Findings

(1) Arms control should and can play an important role in reducing nuclear dangers.

(2) In both Washington and Moscow, the moment appears ripe to renew the arms control process.

[81] Perry et al., *America's Strategic Posture*, 65–71.

(3) The imbalance of non-strategic nuclear weapons will become more prominent and worrisome as strategic reductions continue and will require new arms control approaches. . .

(4) For the United States to reduce its deployed nuclear forces, it is essential to move by agreement with Russia.

Recommendations

(1) Pursue a step-by-step approach with Russia on arms control. This is a process that will play out over decades.

(2) Make the first step on U.S.-Russian arms control modest and straightforward in order to rejuvenate the process and ensure that there is a successor to the START I agreement before it expires. . .

(3) Begin to characterize and study the numerous challenges that would come with any further reductions in the number of operationally deployed strategic nuclear weapons.

(4) Sustain the commitment to the INF treaty and commit to new efforts to work in partnership with Russia and NATO allies to negotiate reductions in non-strategic nuclear forces.

(5) Develop and pursue options for advancing U.S. interests in stability in outer space and in increasing warning and decision-time. The options should include the possibility of negotiated measures.

(6) Take the lead in renewing strategic dialogue with a broad set of states interested in strategic stability, including not just Russia and China but also U.S. allies in both Europe and Asia.

(7) Work to come to an understanding with Russia on missile defense. . .

(8) Reinvest in the institutional capacities needed to define and implement effective arms control strategies. The pattern of underinvestment over the last two decades must be reversed.

We now move on to consider the New START negotiations. The United States and Russia began preliminary negotiations on a successor to START in early 2008, but the United States wanted a short and simple agreement much like SORT, whereas Russia wanted a detailed treaty like START. In addition, there were no negotiations between Election Day and Inauguration Day, and these positions were so far apart that it would be reasonable to classify the situation in January 2009 as "no negotiations in progress."

As of January 2009, there was concern within the Obama administration about the recent Russian aggression in Georgia, but the consensus was that arms control was too important to be sacrificed or delayed because of the brief Russia–Georgia war. Further, some observers within the United States felt that Georgia contributed to starting the war. US President Barack Obama and Russian President Dimitri Medvedev agreed to begin negotiations on New START on April 1, 2009. The United States and Russia agreed on New START in barely over a year, not counting time for ratification by the US Senate and the Russian Duma.[82] This was far shorter than the amount of time devoted to most negotiations on prior treaties. Table A-3 below illustrates this.[83]

[82] Gottemoeller, *Negotiating the New START Treaty*.

[83] McFaul, *From Cold War to Hot Peace*.

Table A-3. Time Devoted to Negotiating Various Treaties

Treaty	Months to Negotiate	Did Treaty Supersede Anything?
SALT	30	No
ABM Treaty	30	No
SALT II	79	Would have had it been ratified
INF Treaty	86	No
START	84	Yes
START II[a]	7	Would have had it been ratified
SORT[a]	15	No, ran in parallel with START
New START	12	Yes
Average before New START	47	Not applicable
Median before New START	30	Not applicable

[a]The motivation for negotiating START II so rapidly is unclear. START would have lasted more than 18 years from the date of the July 1991 signing ceremony for START. Similarly, there was no external pressure to negotiate SORT rapidly, with START on track to last until December 2009.

Negotiations on New START began in London in April. The heads of the two negotiating teams were Rose Gottemoeller for the United States and Anatoly Antonov for Russia. The negotiations mostly took place in Geneva, Switzerland. The US and Russian negotiating teams did most of the work on New START, as would be expected. However, Admiral Michael Mullen (the chairman of the US Joint Chiefs of Staff) and General Nikolai Makarov (the chief of the Russian General Staff) met in September 2009 and again in January 2010. Similarly, General (retired) James Jones (the US national security advisor) conducted discussions with high-ranking personnel within the Russian Ministry of Defense. Presidents Obama and Medvedev also met and discussed New START in July 2009 and again while at the Copenhagen Climate Change Conference in December 2009. In addition, Presidents Obama and Medvedev discussed the treaty negotiations via telephone on several occasions.

There is a final complication with the New START negotiations. Vladimir Putin had served as president for eight years, but the Russian constitution prohibited him from serving three consecutive terms. (This is no longer the case.) Dimitri Medvedev won the Russian presidential election in 2008 and served for four years, before Putin resumed office as president. Vladimir Putin was the prime minister during the New START negotiations. It is uncertain how much power Medvedev really had. Was Putin pulling the strings secretly? If Medvedev were really in charge, did he make concessions that Putin would not have made (and probably will not make in any such negotiations in the next few years)?

The US and Russian delegations apparently agreed on three broad principles near the beginning of negotiations:

(1) The treaty would focus on strategic offensive arms and would not place any limits on BMD.[84]

[84] Of the treaties discussed in this report, only New START was negotiated after US withdrawal from the ABM Treaty, which had previously placed limits on US and Soviet/Russian BMD.

- Russia was concerned about the US decision to deploy BMD in Europe. The US goal was protection against Iranian missiles, and the small scale of the US defenses would have made it easy for Russia to overwhelm those defenses. Nevertheless, Russia was quite piqued about this.[85]
- Russia was also concerned about US national BMD, although the US national BMD system is small and may have little capability to handle advanced countermeasures of the sort that Russia could implement easily (and possibly has). Russia understood that the US Ground-based Midcourse Defense (GMD) system could not withstand a Russian first strike, but it feared that US defenses could withstand a Russian retaliatory strike after a US first strike.
- The United States should have been, and probably was, concerned by Russian efforts on NSNWs.
- Hence, the decision to focus only on strategic offensive weapons may have represented concessions by both sides.

(2) The limits would be lower than in SORT.

- The counting rules for bombers were so drastically different from those in SORT that it is hard to know whether the limits were actually lower in New START. (The bomber-counting rules in SORT differed radically from those in SALT II, START, START II, and New START. SALT and the INF Treaty did not apply to bombers.)

(3) There would be comprehensive verification procedures.

- At this point, there appeared to be agreement on allowing 18 on-site inspections per. The original START had multiple types of inspections, with an aggregate of about 30 per year.

Whereas US press leaks caused problems in negotiations on several earlier treaties, a Russian press article in April caused issues for New START. The Russian article, which claimed that Antonov was too weak to get the best of the "tough" US female negotiator, undermined Antonov's credibility.[86] The US team lead's subsequent decision to meet with several women from the Russian team (possibly with no men attending) further inflamed misogyny in Russia.

The next round of negotiations occurred in Rome in late April. The Russians did not make any detailed proposals, but they tried to revive having limits on BMD in the treaty. This directly contradicted the apparent agreement from only three weeks earlier. The Rome talks recessed with little or no apparent progress.

The next round of negotiations occurred in Moscow, starting in late May. Presidents Obama and Medvedev planned to meet in July (and actually did so), and the US team wanted to make progress before that meeting. The Russians again dramatically reversed positions and argued for a brief and vague treaty like SORT. This was a complete role reversal since late 2008, when the United States wanted a treaty similar to SORT and the Russians wanted a treaty similar to START (but with lower limits). The Russians also revived attempts from previous treaty negotiations to include British and French nuclear forces on the US side of the ledger, even though the United States had no control over whether those two countries used nuclear weapons, or over what targets they might hit if they did go nuclear. Further, the US and Russian delegations

[85] The final Obama administration plan was to deploy two Aegis Ashore sites, one in Deveselu, Romania, and one in Redzikowo, Poland. This is still the US plan. The site in Romania is operational. The site in Poland is on track to be operational in 2022.

[86] Gottemoeller, *Negotiating the New START Treaty*.

differed on the relative limits for delivery vehicles and warheads (although exact numbers are lacking). The United States wanted higher limits on delivery vehicles and lower limits on warheads, which might improve strategic stability by making a successful preemptive attack more difficult. The Russians, by contrast, wanted higher limits on warheads and lower limits on delivery vehicles, reflecting their preference for ICBMs with a large number of MIRVs per missile. The Russians also seemed to think that START provisions were prejudicial to mobile ICBMs (which Russia possessed but the United States did not). Details on this Russian objection are not known to me, nor is it clear how, or whether, the wording in New START addressed these Russian concerns.

By September 2009, there was general agreement that New START should have a limit of about 1,500 to 1,675 deployed warheads and anywhere from 500 to 1,100 delivery vehicles (a very wide range). The United States introduced a proposal to have two separate limits on delivery vehicles—one for deployed delivery vehicles and one for total delivery vehicles. Russia apparently accepted this idea. There also appeared to be fairly close agreement on the number of on-site inspections permitted per year (fewer than under START) and the amount of advance notice required before such inspections.

START expired on December 5, with agreement on a new treaty apparently close at hand. Then Russia threw a monkey wrench into the machinery. The Russian delegation submitted a new proposal in the middle of December that changed things that the United States thought that Russia had already accepted, including the following:

- Reviving limits on US BMD
  - This occurred on several occasions throughout the negotiations, with the last one in a phone call between Presidents Obama and Medvedev on February 24, 2010.
- Reducing the number of on-site inspections per year from 18 to 12
- Increasing the amount of warning time required before an on-site inspection could occur
  - The United States feared that requiring a large amount of warning would invite the Russians to deploy mobile ICBMs into the field before a US on-site inspection, thereby interfering with attempts to count missiles and warheads per missile.
- Going back to having only one limit on deployed delivery vehicles, instead of having one limit for deployed delivery vehicles and a higher limit for total delivery vehicles.
  - The United States wanted to have a limit on total delivery vehicles in order to verify how many nondeployed delivery vehicles existed. For example, if Russia had a large number of nonaccountable, nondeployed delivery vehicles, this could facilitate a rapid breakout from treaty limits.

Also in December, Vladimir Putin—who was then the prime minister—gave a speech that was critical of "Russian weakness" in the negotiations. He further said that any successor to START should limit US missile defenses.[87] At this point, the prospects for a near-term agreement appeared grim.

After the second Mullen–Makarov meeting in January 2010, the negotiations got back on track. It is uncertain exactly why this happened, or whether the Mullen–Makarov meeting played a key role in this.

[87] Gottemoeller, *Negotiating the New START Treaty*.

Similarly, it is not clear what the relative roles of President Medvedev and Prime Minister Putin were in stimulating the suddenly renewed Russian interest in making the negotiations work.

Things once again appeared to be on track. Then, on February 24, President Obama discussed the negotiation with President Medvedev on the phone, with the apparent expectation that they could sign the treaty within a few weeks. President Medvedev surprised the United States by yet again trying to revive having limits on US BMD in the treaty. For a few days, the negotiations appeared to be on the brink of collapse.

At the beginning of March, Russia retracted its last attempt to include BMD in the treaty. The Russians also agreed to accept the US proposal to prohibit encryption of telemetry in missile flight tests. It is uncertain whether disagreements over the number of on-site inspections per year continued into March, but the actual treaty provided for 18 inspections per year—the US position from September 2009. Minor disagreements on the treaty limits continued into early March. The United States wanted limits of 700 deployed delivery vehicles, 800 total delivery vehicles, and 1,500 deployed warheads. Russia wanted limits of 700 deployed delivery vehicles and 1,550 deployed warheads, with no limit on total delivery vehicles. The negotiating teams reached a compromise on 700, 800, and 1,550. The negotiating teams produced the final draft of the treaty on March 24, leading to signatures by Presidents Obama and Medvedev about two weeks later. Soon thereafter, Russia issued a separate, unilateral document stating that it would regard major US increases in national BMD to be inconsistent with New START.

Ratification of New START did not go smoothly. The final vote on December 22, 2010, was 71-26 in favor of approval, with three senators absent or not voting. (Approval requires two-thirds of the senators who are present and voting.) Only 11 Republicans voted in favor of the treaty. Had the vote been delayed until 2011, the treaty would have needed at least 14 Republican votes for approval, assuming that all 47 Republican senators were present for the vote. By contrast, the Senate vote on START in 1992 was 93-6.[88]

Assessment: The main body of this report already contains an assessment of the strong and weak points of New START as signed and ratified. The short amount of time available to negotiate New START—much less than the amount of time dedicated to SALT, the ABM Treaty, SALT II, the INF Treaty, and START—complicates comparisons with previous treaties.

Key US objectives in the negotiations included reinstatement of robust provisions for verification and data exchange, whereas Russia initially wanted to obtain limits on US BMD systems. Russia also made a transient attempt to include British and French nuclear forces in the treaty limits as if they were US weapons. The actual treaty provided for robust data exchanges and robust verification provisions, with no limits on US BMD systems and no accountability for British or French nuclear forces. (This was the first treaty negotiated entirely after US withdrawal from the ABM Treaty. No treaty of this sort ever included British or French forces.) On the other hand, the treaty placed no limits on Russian NSNWs, and it required greater cuts to US strategic forces than to Russian strategic forces.

[88] Some of the votes against the treaty were for reasons unrelated to the content of the treaty. One Republican senator voted against New START because he was opposed to President Obama's decision to allow gay people to serve openly in the military, for example.

The available information does not answer the following questions:

- Whether the United States had a desired outcome in mind (apart from continuing robust provisions for verification and data exchange and excluding BMD from the treaty) at the outset of the negotiations
  - For example, did the United States have specific numerical limits in mind by summer 2009?
- Whether the United States tried, but failed, to address some of the previously identified issues on definitions and weapon types (e.g., intercontinental GLCMs, long-range nuclear hypersonic boost-glide weapons (HBGWs), intercontinental nuclear torpedoes, etc.)
  - If there were failed attempts, failure could have been due to lack of time, lack of leverage, or both.
- Whether there was ever any agreement on what kinds of systems might qualify as new kinds of strategic offensive arms
- Why New START contains definitions that Russia is now exploiting (e.g., not automatically counting or banning nuclear ballistic missiles on aircraft, the way START did)
- Whether internal US discussions addressed the Russian advantage in NSNWs and how much this might matter

Finally, the Obama administration recognized the limited scope of New START and wanted to pursue follow-on negotiations that never occurred. Further, the Senate included guidance to do so for tactical nuclear weapons in its consent to ratification: "The Senate calls upon the President to pursue, following consultation with allies, an agreement with the Russian Federation that would address the disparity between the tactical nuclear weapons stockpiles of the Russian Federation and of the United States and would secure and reduce tactical nuclear weapons in a verifiable manner."[89]

[89] Resolution of Ratification, Treaty Document 111-5.

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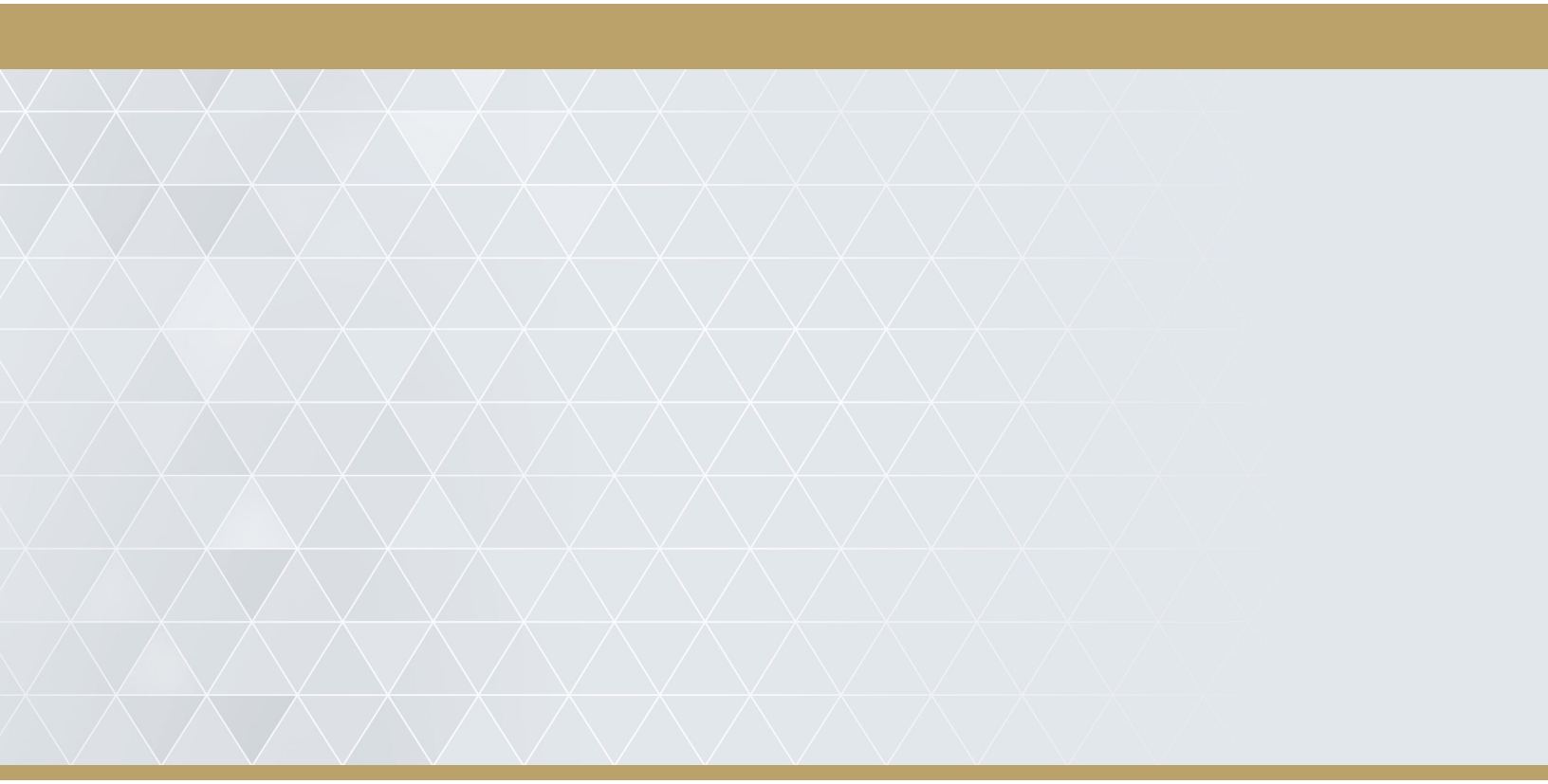
Dennis Evans is a member of the Principal Professional Staff at APL. Before joining APL in June 2013, he worked for the Defense Department from 1982 through May 2013. For the last 18 months of his government career, he was head of the Tactical Air Forces Division in the Office of the Secretary of Defense, Cost Assessment and Program Evaluation (OSD CAPE). Before moving to the Tactical Air Forces Division, he was head of the Strategic, Defensive, and Space Programs Division in OSD CAPE from 2003 to 2011. He was an analyst in this division from 1994 through 2003 and worked for the US Army National Ground Intelligence Center from 1982 through 1994. He received a Meritorious Executive Presidential Rank Award in 2010. He has a PhD in physics from the University of Virginia.



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