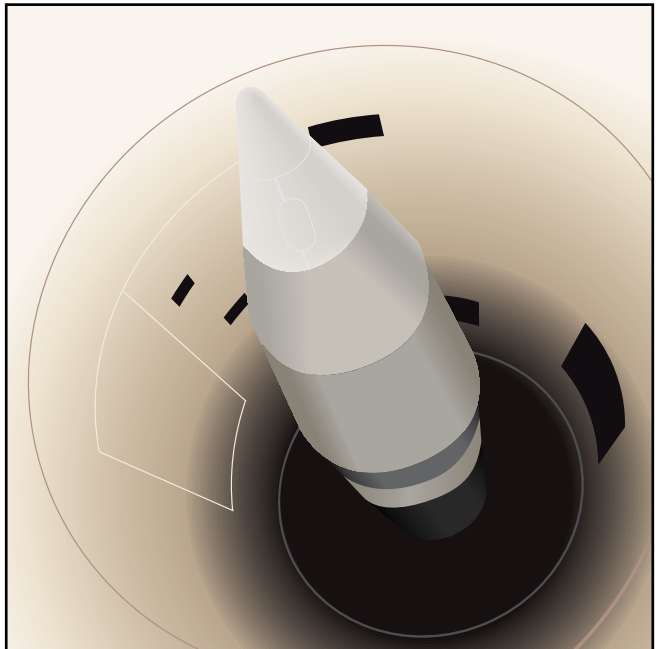
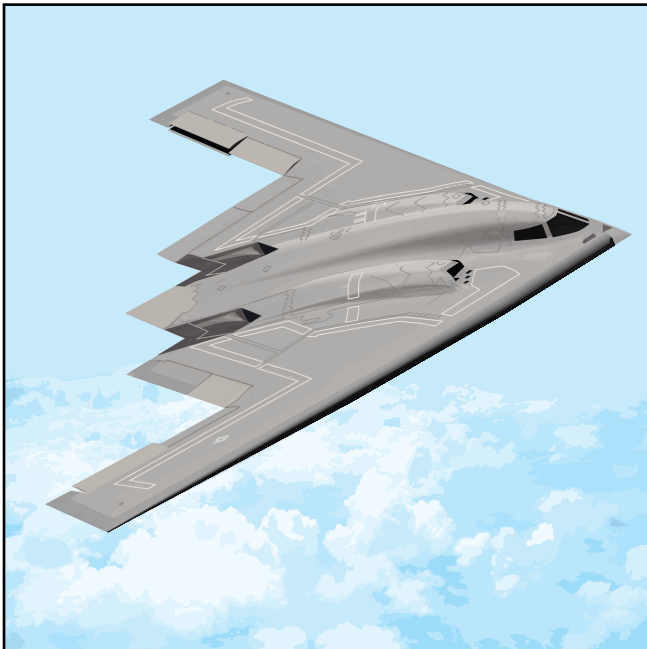
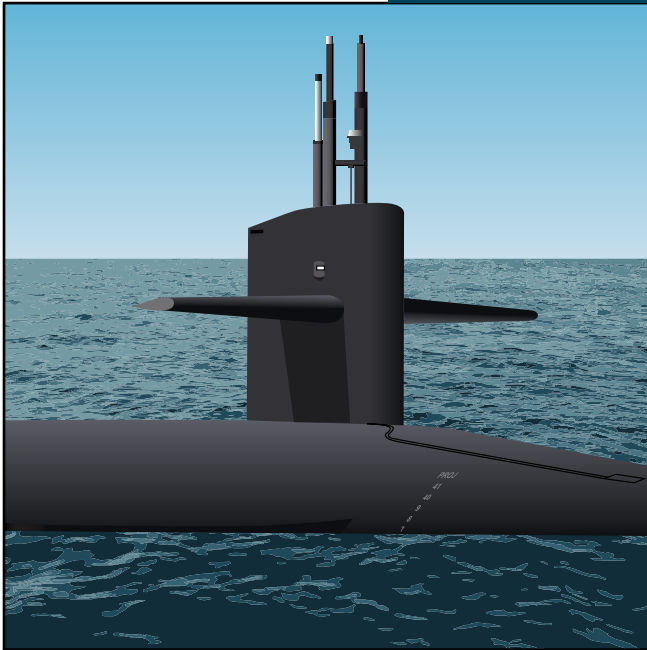


# CBO

## The Potential Costs of Expanding U.S. Strategic Nuclear Forces If the New START Treaty Expires



AUGUST 2020

## At a Glance

The New START Treaty will expire in February 2021 unless the United States and Russia agree to extend it for up to five years. Expiration of the treaty would end several decades of continuous coverage under arms control agreements that limit strategic nuclear forces and provide transparency. If the treaty expired in 2021, the United States and Russia could respond by maintaining the status quo. Alternatively, they could take various actions to compensate for the lack of treaty limits, perhaps to address a real or perceived buildup of forces by the other party.

The Congressional Budget Office was asked to examine what the costs would be if the United States pursued one type of outcome: increasing its deployed strategic nuclear forces from no more than 1,550 warheads as specified in New START to the levels specified in the three most recent agreements—the Moscow, START II, and START I treaties. Because forces could be expanded in many ways to meet those levels, CBO looked at a range of outcomes and their costs.

- Expanding forces to Moscow Treaty limits (1,700 to 2,200 warheads) would not increase the Department of Defense's (DoD's) costs relative to its current plans, which call for fielding a new generation of strategic nuclear delivery vehicles to replace the current generation. CBO estimates that DoD's production costs (not including development or operation costs) for implementing its current plans would total \$240 billion over the next few decades.
- Expanding forces to START II limits (3,000 to 3,500 warheads) or to START I limits (6,000 warheads) could be accomplished by increasing the number of warheads on each missile (which CBO refers to as the lower-cost approach) or by increasing the number of delivery vehicles (missiles, submarines, and bombers), which CBO refers to as the more flexible approach, or by some combination of the two.
- Increasing warhead loadings to reach the START II limits would incur about \$100 million in onetime costs for DoD. Increasing the number of delivery vehicles while maintaining current warhead loadings would increase DoD's onetime costs by up to \$172 billion over several decades and annual operating costs by \$3 billion to \$8 billion. (All costs are in fiscal year 2020 dollars.)
- If DoD expanded forces to START I limits using the lower-cost approach, its onetime costs would rise by \$88 billion to \$149 billion and its annual costs by \$4 billion to \$10 billion. Under the more flexible approach, DoD's onetime costs could increase by \$410 billion to \$439 billion and its annual costs by \$24 billion to \$28 billion. Total production costs would be nearly triple what DoD is currently planning to spend on production over the next few decades.
- Although some of those strategies would require the production of additional warheads, those estimates do not include additional costs for the Department of Energy to produce more warheads. The estimates also exclude costs for DoD to establish new operating bases and training facilities, if necessary, or to expand production capability for delivery vehicles and the platforms that carry them (to accelerate production if that is desired). Costs, therefore, would probably be higher—in some cases, considerably so—than CBO estimates.
- Expanding its forces could take the United States many years. Available warheads could be uploaded relatively quickly, but additional delivery systems and warheads would probably not be available before the late 2030s or early 2040s. Most of the additional costs of expanding forces would thus occur a few decades from now.



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## Notes

Unless this report indicates otherwise, all years referred to are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end.

Numbers in the text and tables may not add up to totals because of rounding.

In this report, “cost” refers to budget authority, the amount that would need to be appropriated to implement the Administration’s plans. All costs are in fiscal year 2020 dollars.

On the cover (clockwise from upper left): an Ohio class submarine, a B-52 bomber, a Minuteman III intercontinental ballistic missile, and a B-2 bomber.

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# The Potential Costs of Expanding U.S. Strategic Nuclear Forces If the New START Treaty Expires

## Summary

The New Strategic Arms Reduction Treaty (New START) between the United States and Russia will expire in February 2021 unless both parties agree to an extension, which could last for up to five years. That treaty places limits on the number of deployed strategic nuclear warheads (1,550) and delivery systems (800 missile launchers and bombers, 700 of which may be deployed at any given time) that each country may field.

How and when the United States or Russia would respond to the expiration of New START is unclear. To help policymakers understand the budgetary implications of one potential course of action the United States could take, the Congressional Budget Office was asked to examine the potential costs that the Department of Defense (DoD) might incur if the United States chose to increase its strategic nuclear forces to levels that are roughly consistent with the limits under three earlier arms control treaties.

## What Could Happen If New START Expired?

If the New START treaty was allowed to expire, the size of the nuclear arsenals of the United States and Russia would be without limits for the first time in decades. The transparency and confidence-building procedures included in New START and previous treaties would cease, in which case both parties would lose the means to have direct knowledge of their adversary's capabilities. In the absence of on-site inspections, data exchanges, and limits on the encryption of flight text data, uncertainty about each other's forces would grow over time.

Many responses to the end of strategic nuclear arms control would be possible, including some that would not affect the size of strategic nuclear forces. For example, uncertainty about the other party's forces might lead the United States to expand its intelligence capabilities or to hedge against uncertainty about the other party's intentions by expanding missile defenses. Conversely, the United States might choose to emphasize conventional

deterrence by expanding its conventional missile forces or to increase its capabilities for regional conflict by expanding nonstrategic nuclear forces.

In terms of strategic nuclear forces, many different responses also are possible. Each party might opt to make no changes to its current plans for nuclear forces for many years. Or one party might choose to expand its forces, either to seek an advantage or because, without the ability to inspect the other's forces, it was concerned that the other is building up its arsenal and wants to hedge against that uncertainty. Or both parties might choose to expand their forces, perhaps significantly. The lack of constraints on ballistic missile defenses could further complicate that dynamic. (The United States withdrew from the ABM Treaty, which limited the number and locations of Russian and U.S. defenses against long-range missiles, in 2002.)

## How Did CBO Analyze the Issue?

CBO was asked to estimate the costs of increasing deployed U.S. strategic nuclear forces to the levels specified in three previous arms control treaties: the Moscow Treaty (1,700 to 2,200 warheads), the START II treaty (3,000 to 3,500 warheads), and the START I treaty (6,000 warheads). Although each treaty had a different protocol for counting warheads, for this analysis CBO used the rules for the Moscow Treaty because they most closely reflect the number of nuclear weapons actually deployed.

The United States could field a wide variety of force structures, each with very different costs, to reach those levels. To illustrate both ends of the distribution of potential forces and their associated costs, CBO examined two approaches for expanding forces at each warhead level.

- A lower-cost and less flexible approach would increase the number of warheads allocated to each missile and bomber to, or near to, its maximum (an approach

Table 1.

**Approaches for Fielding Nuclear Warheads at Selected Treaty Limits**

Approach	Description	Total Number of SDVs	Additional Costs for DoD (Billions of 2020 dollars)	
			One-Time Acquisition Costs	Annual Operation and Sustainment Costs
<b>Moscow Treaty</b>				
No Change From Current Plans	Keep the plans for current-generation and next-generation forces as they are	As planned	0	0
<b>START II</b>				
Lower Cost (Upload only)	Reach START II levels with current-generation or planned next-generation forces by uploading ICBMs and SLBMs to highest levels	As planned	0.1	0
More Flexible	Expand next-generation forces to 3,000 warheads at current SLBM and ICBM warhead loadings	1,004 to 1,221	114 to 172	3 to 8
<b>START I</b>				
Lower Cost	Expand next-generation forces to 6,000 warheads by uploading warheads to high levels; purchase sufficient new SDVs	1,043 to 1,359	88 to 149	4 to 10
More Flexible	Expand next-generation forces to 6,000 warheads at current ICBM loadings; purchase sufficient new SDVs to reach limit of 1,600	1,544 to 1,600	410 to 439	24 to 28

Source: Congressional Budget Office.

Costs are for production of delivery systems only and do not include research and development costs or the Department of Energy's costs to produce, sustain, or store more nuclear warheads (if necessary).

The lower-cost approach would increase the number of warheads on delivery systems (known as uploading) and minimize the number of additional delivery systems; the more flexible approach would purchase additional delivery systems to reach the desired warhead levels, preserving as much as possible the flexibility provided by today's smaller number of warheads on each delivery vehicle. Other approaches to expand forces would lie between those two approaches.

Under the Moscow Treaty, warheads are limited to 1,700 to 2,000, and there are no limits on SDVs (ballistic missiles and bombers). Under START II, warheads are limited to 3,000 to 3,500, and there are no limits on SDVs. Under START I, warheads are limited to 6,000 and SDVs to 1,600.

DoD = Department of Defense; ICBM = intercontinental ballistic missile; SDV = strategic delivery vehicle; SLBM = submarine-launched ballistic missile; START = Strategic Arms Reduction Treaty.

known as uploading) and minimize the number of additional delivery systems purchased, if any.

- **A more flexible and higher-cost approach** would purchase enough delivery systems to reach the desired total numbers of warheads while maintaining (as nearly as possible) the current number of warheads allocated to each missile and bomber.

DoD also could choose to field a force that lies between those two approaches. To estimate costs, CBO used methods from its previous work on nuclear forces.<sup>1</sup>

### What Did CBO Find?

If the New START treaty expired, the United States could choose to make no changes to its current plans for nuclear forces, in which case it would incur no additional costs. If the United States chose to increase its forces in response to the expiration of the treaty, modest expansions could be relatively inexpensive and could be done quickly. Larger expansions could be quite costly, however, and could take several decades to accomplish (see Table 1). Accelerating production of additional forces would probably have only a small effect on that timeline and could increase costs.

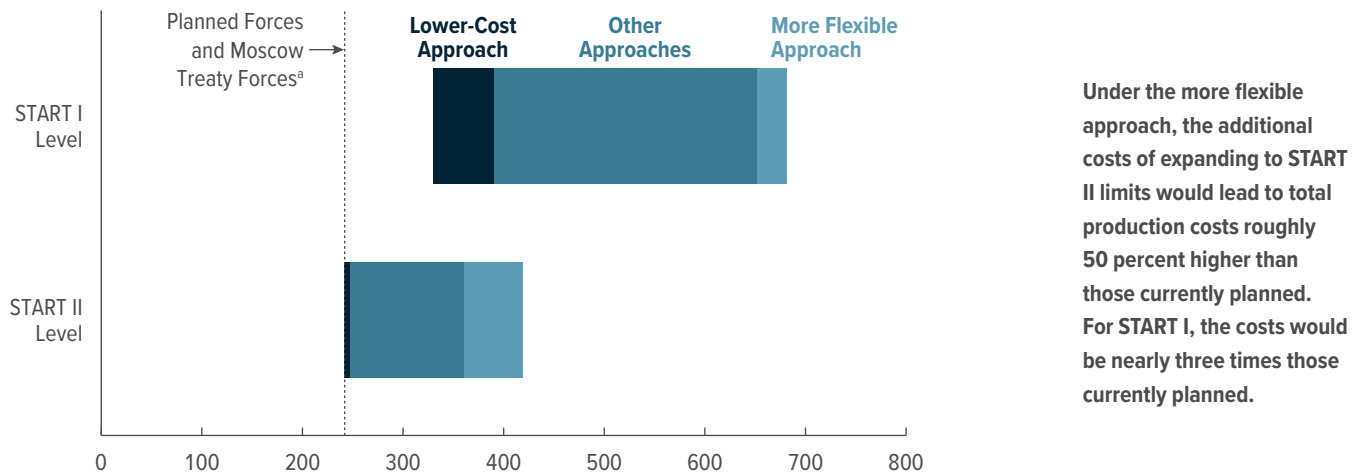
- Expanding forces to the Moscow Treaty limits would have no effect on DoD's costs, because current and

1. See Congressional Budget Office, *Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046* (October 2017), [www.cbo.gov/publication/53211](http://www.cbo.gov/publication/53211).

Figure 1.

### Estimated Total DoD Production Costs for Planned Next-Generation Nuclear Forces and Expanded Nuclear Forces at Different Force Levels

Billions of Fiscal Year 2020 Dollars



Source: Congressional Budget Office.

DoD = Department of Defense; START = Strategic Arms Reduction Treaty.

Costs are for production of delivery systems only and do not include research and development costs or the Department of Energy’s costs to produce, sustain, or store more nuclear warheads (if necessary).

The lower-cost approach would increase the number of warheads and minimize the number of additional delivery systems; the more flexible approach would purchase additional delivery systems to reach the desired number of warheads, preserving as much as possible the flexibility provided by today’s smaller number of warheads on each delivery vehicle. Other approaches to expand forces would lie between those two approaches.

a. Current and planned next-generation forces are both already at Moscow Treaty limits, so there would be no additional costs.

planned next-generation forces are both already at those limits.

- Expanding forces to START II limits could be relatively inexpensive if DoD used a lower-cost approach that involved uploading warheads only: about \$100 million in onetime costs for DoD (with no additional ongoing operation and sustainment costs) for both current and next-generation forces, CBO estimates. If DoD used a more flexible approach that involved purchasing enough delivery systems to maintain current warhead loading levels, that expansion would be much more expensive, eventually totaling \$114 billion to \$172 billion in acquisition costs over several decades and \$3 billion to \$8 billion in additional annual costs after the expanded forces were in place. The additional costs of expanding to START II limits under the more flexible approach would lead to total production costs roughly 50 percent higher than currently planned (see Figure 1).

- Expanding forces to START I limits would require even more new delivery systems and warheads. Under a lower-cost approach that minimized the number of additional delivery systems, DoD would incur onetime costs of \$88 billion to \$149 billion over several decades to buy additional delivery vehicles and \$4 billion to \$10 billion in additional operation and sustainment costs each year, in CBO’s estimation. Under a more flexible approach that maintained as much as possible the current number of warheads loaded on missiles and allocated to bombers by having DoD purchase enough delivery systems, CBO estimates that DoD would incur onetime costs eventually totaling \$410 billion to \$439 billion to purchase additional systems as well as additional annual operation and sustainment costs (beyond those for planned forces) of \$24 billion to \$28 billion after the expanded forces were in place. The additional costs of expanding to START I limits under the more flexible approach would lead to



production costs nearly three times those currently planned (see Figure 1).

For comparison, the costs to produce the currently planned quantities of next-generation delivery systems is about \$240 billion, CBO estimates, not including development costs.

### What Costs Were Excluded From This Analysis?

The figures cited in this report do not include the Department of Energy's (DOE's) costs of producing or maintaining additional warheads. Most information about the nuclear stockpile is classified, so it is difficult to determine whether and how many additional warheads would be needed and thus what additional funding would be required. Those costs could be considerable, though, for all but modest increases in forces.

CBO's estimates also exclude DoD's costs of establishing new operating bases and training facilities (if needed) and DoD's costs of expanding production capability for delivery systems (if needed because production is accelerated). CBO also excluded the costs of other actions that the United States might take if New START expired without another agreement in place, including expanding U.S. intelligence capabilities, strengthening missile defenses, increasing long-range conventional (that is, nonnuclear) missile forces, or expanding short-range nuclear forces.

### Background on the Treaty and Arguments For and Against Its Extension

The New START treaty is the latest in a series of strategic nuclear arms control treaties—following START I, START II, and the Moscow Treaty—between the United States and Russia (or the Soviet Union).<sup>2</sup> Those four treaties, which together span more than 25 years of continuous coverage, placed increasingly stringent limits on the size (and sometimes the capability) of each country's

strategic nuclear arsenal (see Table 2).<sup>3</sup> The New START treaty limits each country to 800 total deployed and nondeployed strategic delivery vehicles (SDVs) and missile launchers, 700 deployed SDVs, and 1,550 deployed warheads. Those limits represent about a 50 percent decrease in “accountable” (counting toward the total) SDVs and a 75 percent decrease in accountable warheads from the limits in the START I treaty (although the rules for counting warheads differed markedly between the two treaties). The New START treaty will expire in February 2021 unless both Russia and the United States agree to extend it for up to five years.

In addition to placing limits on the size of strategic nuclear forces, the New START treaty (like the others before it) provides extensive verification, data exchange, and confidence-building measures that allow each party insight into the other's capabilities. In New START, those measures include the following:

- Up to 18 on-site inspections each year (and the right to verify the number of warheads on an SDV of the inspector's choice);
- Biannual declarations of the total number of SDVs, the number of warheads on each type of SDV, and the bases where they are located;
- Notification whenever the status of any SDV changes (if it switches from deployed to not deployed, for example, or if it is relocated to a different base); and
- A pledge to not interfere with the other party's national technical means (which primarily refers to satellite imagery and electronic signals collection during testing), including not concealing SDVs from satellite observation.

Whether the New START treaty should be extended has been the subject of debate. Administration officials have said that the United States would prefer to pursue a new trilateral treaty that would include both Russia and China.<sup>4</sup> Statements from Russian officials have generally

2. The four most recent U.S.–Russian nuclear strategic arms control agreements are (in chronological order): the Treaty on the Reduction and Limitation of Strategic Offensive Arms (known as START I); the START II treaty, which was signed by the U.S. and Russian presidents but was never fully ratified and never entered into force; the Strategic Offensive Reductions Treaty (or the Moscow Treaty); and the Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (known as the New Strategic Arms Reduction Treaty, or New START). For details on those agreements, see Amy F. Woolf, Paul K. Kerr, and Mary Beth D. Nikitin, *Arms Control and Nonproliferation: A Catalog of Treaties and Agreements*, Report for Congress RL33865 (Congressional Research Service, updated March 26, 2020).

3. Nuclear weapons are referred to as strategic if the delivery system (ground-launched missile, submarine-launched missile, or bomber) is capable of delivering them over long ranges, typically 3,000 miles or more. Nuclear weapons that are deliverable over shorter ranges are referred to as nonstrategic, or tactical, weapons.

4. See Department of State, Office of the Spokesperson, “Briefing With Senior State Department Official on the New START” (March 9, 2020), <https://go.usa.gov/xwt94>.



Table 2.

**Details of Recent Strategic Arms Control Treaties**

	New START	Moscow (SORT)	START II <sup>a</sup>	START I
<b>Timeline</b>				
Entry Into Force	2011	2003	n.a.	1994
Deadline to Meet Limits	2018	2012	n.a.	2001
Expiration	2021	2011 <sup>b</sup>	n.a.	2009
<b>Limits on Forces</b>				
Number of Strategic Delivery Vehicles	800	n.a.	n.a.	1,600
Number of Deployed Strategic Delivery Vehicles	700	n.a.	n.a.	n.a.
Number of Warheads	1,550	1,700 to 2,200	3,000 to 3,500	6,000
<b>Warhead Counting Rules</b>				
Description	Deployed bombers count as 1 warhead each; deployed ICBMs and SLBMs count as the actual number of warheads deployed rather than a fixed maximum value	No counting rules described in the treaty's text; the United States informed Russian negotiators it would use actual deployed warheads on ICBMs and SLBMs and bomber weapons deployed on bombers or stored at bomber bases	Phased out bomber discounts from START I (see the next panel) but allowed ICBMs and SLBMs to count as fewer than the maximum under some conditions	Warhead count set to the maximum number tested on each platform, except the first 150 bombers that carry cruise missiles were discounted to count as 10 warheads each (compared with 20 maximum on the B-52); bombers that carry only bombs count as 1 warhead each
Warheads on Current Forces as Calculated Using Each Treaty's Counting Rules	1,467	1,962	2,760	3,920

Source: Congressional Budget Office, using information from the Department of State, the Nuclear Threat Initiative, and the Arms Control Association.

ICBM = intercontinental ballistic missile; SLBM = submarine-launched ballistic missile; SORT = Strategic Offensive Reductions Treaty; START = Strategic Arms Reduction Treaty; n.a. = not applicable.

a. The START II treaty was negotiated and signed, but it was never fully ratified and never entered into force. Both sides largely complied with its terms, however.

b. The Moscow treaty was not scheduled to expire until 2012. However, it was superseded by New START when that treaty went into effect.

supported the extension of New START.<sup>5</sup> China has stated that it has “no intention to participate” in trilateral arms control negotiations.<sup>6</sup>

### Arguments Against Extension

Opponents of extending the treaty often cite a history of Russian violations of other treaties as a reason to not extend this one. Other arguments against extension are centered on shortcomings of the New START treaty:

Opponents contend that even though the treaty may have met U.S. and allied national security requirements in 2010, it no longer does because it does not cover new developments, including growth in the number of Russian shorter-range nuclear weapons capable of striking North Atlantic Treaty Organization (NATO) allies of the United States.<sup>7</sup> (New START places no limits on nonstrategic nuclear weapons, of which Russia has substantially more than the United States.)

In addition, opponents argue that the treaty does not cover new exotic systems that Russia has developed while

5. See Ankit Panda, “Putin: Russia Ready to Extend New START With U.S. ‘Without Any Preconditions,’” *The Diplomat* (December 6, 2019), <https://tinyurl.com/ycbpssyn>.

6. See Agence France-Presse, “China Says It Has ‘No Intention’ of Joining Arms Talks With U.S. and Russia,” *South China Morning Post* (January 22, 2020), <https://tinyurl.com/y7je8o8g>.

7. See Eric Edelman and Franklin C. Miller, “Russia Is Beefing Up Its Nuclear Arsenal; Here’s What the U.S. Needs to Do,” *Politico* (December 31, 2019), <https://tinyurl.com/sgej9z6>.

New START has been in force and, given the bilateral nature of the treaty, places no constraints on China's expanding nuclear forces. Those analysts often argue that there is no rush to extend the treaty and that holding out on extension could be used as leverage to negotiate improvements to the existing agreement or perhaps a new trilateral agreement that includes China.<sup>8</sup> Other critics argue that Russia uses arms control as a tool for competition by locking in advantages through the terms of the treaty.<sup>9</sup> One analysis asserts that New START's approach of counting the actual number of deployed warheads and disregarding the potential for loading more warheads on SDVs has positioned Russia to be able to expand its forces much more rapidly than the United States. That conclusion is based on assertions that Russia's intercontinental ballistic missiles (ICBMs) have the capacity to carry many more warheads than they do currently and that Russia has the ability to manufacture thousands of new warheads each year.<sup>10</sup>

### Arguments For Extension

Proponents of extending the treaty offer counter-arguments. They contend that Russia has consistently complied with the New START treaty (despite violating some earlier treaties). Proponents also argue that engaging China in arms control talks is a worthwhile goal but will be difficult and that extending New START would provide "a necessary foundation from which to pursue more ambitious arms control talks."<sup>11</sup> Moreover, extending New START would provide time for what would probably be long and extensive negotiations for a multilateral arms control agreement or for making changes to New START. For example, including nonstrategic weapons in a modified New START or a new bilateral agreement would take time because Russia would probably ask for limits on U.S. missile defenses in return.<sup>12</sup>

8. See Rebecca L. Heinrichs, "Automatically Extending New START Will Not Increase Stability," *Real Clear Defense* (February 28, 2020), <https://tinyurl.com/yak99rrq>.

9. See Thomas G. Mahnken, *Forging the Tools of 21st Century Great Power Competition* (Center for Strategic and Budgetary Analysis, 2020).

10. See Mark B. Schneider, "Russian Nuclear Force Expansion and the Failure of Arms Control," *Real Clear Defense* (October 29, 2019), <https://tinyurl.com/y7ldmfa8>.

11. See Kingston Reif, *Responses to Common Criticisms About Extending New START*, Arms Control Association Issue Brief, vol. 12, no. 1 (February 5, 2020), <https://tinyurl.com/ybuhx3fk>.

12. See Frank A. Rose, Brookings Institution, "Deterrence, Modernization, and Alliance Cohesion: The Case for Extending

Additionally, proponents point out that, as a signatory to the international Non-Proliferation Treaty, the United States, along with all nations possessing nuclear weapons, is obligated to pursue reductions in its nuclear arsenal.<sup>13</sup> One analysis that assessed the military implications of the expiration of New START concluded that the United States would lose insight into Russian forces that was provided by on-site inspections; that loss, in turn, would probably lead to increased costs associated with expanding intelligence capabilities or personnel and would also probably lead to a costly expansion of planned U.S. nuclear modernization programs.<sup>14</sup> That analysis argued that Russia has the ability to upload and produce more warheads quickly, which would enable that country to expand its strategic nuclear forces at a faster rate than the United States could (at least initially). That potential Russian advantage is a reason to extend New START, according to proponents, not to let it expire.

### Possible U.S. Responses to New START's Expiration

The United States might keep its current plans for nuclear forces unchanged, even if it decides not to renew New START. According to public reports from shortly after the New START treaty went into force, DoD concluded that Russia "would not be able to achieve a militarily significant advantage by any plausible expansion of its strategic nuclear forces, even in a cheating or breakout scenario under the New START Treaty, primarily because of the inherent survivability of the planned U.S. strategic force structure, particularly the Ohio class ballistic missile submarines, a number of which are at sea at any given time."<sup>15</sup> The United States might conclude that that assessment is still valid even if New START has expired.

Whether the United States chose to increase its nuclear forces might depend on the circumstances. For example,

New START With Russia," *Order From Chaos* (blog entry, January 16, 2020), <https://tinyurl.com/ycmszay5>.

13. See Thomas Countryman, "Russia, China, Arms Control, and the Value of New START," *Arms Control Today* (November 2019), <https://tinyurl.com/yanfmw3n>.

14. See Frank G. Klotz, *The Military Case for Extending the New START Agreement* (RAND Corporation, February 2020), [www.rand.org/pubs/perspectives/PE350.html](http://www.rand.org/pubs/perspectives/PE350.html).

15. See Department of Defense, as cited in Hans Kristensen, Federation of American Scientists, "DoD: Strategic Stability Not Threatened Even by Greater Russian Nuclear Forces," *Strategic Security Blog* (October 10, 2012) <https://fas.org/blogs/security/2012/10/strategicstability/>.

if Russia uploaded warheads onto its ICBMs but did not increase the number of ICBMs, the United States might opt not to act, if the current U.S. force was deemed adequate to cover the assigned targets. If Russia's uploading of warheads passed a certain point, however, a decision might be made that too large a Russian numerical advantage would cause foreign policy problems. In that case, even if the United States still felt there was no military reason to expand its force, it might do so to avoid problems that could affect crisis management, unnerve U.S. allies, or embolden Russian leaders to threaten use of nuclear weapons. In another case, if neither Russia nor the United States increased their forces after the treaty's expiration but China did, either Moscow or Washington (or both) might decide that additional nuclear forces were needed.

A U.S. response, should one occur, could happen soon after the treaty expired or in later years. If the treaty was not extended, the resulting lack of transparency and on-site inspections over time could lead to increasing U.S. uncertainty about Russian forces and could create pressure to act. As a hedge against that uncertainty, U.S. planners might decide to expand strategic nuclear forces.

Such an expansion could occur in a number of ways. CBO was asked to analyze a range of potential costs that might be incurred if forces were expanded to levels consistent with the limits established under three previous arms control treaties (see Table 2 on page 5).

In addition to expanding strategic nuclear forces (or instead of doing so), the United States could take other actions if the treaty was not extended: It could expand its intelligence capabilities, for instance, or it could expand its missile defenses, conventional forces, or nonstrategic nuclear forces (that is, nuclear weapons that are delivered by shorter-range systems, like certain tactical aircraft). Those actions could be spurred by a real or perceived expansion of Russian forces, concern about uncertainty of the state of Russian nuclear forces in the absence of verification, or some other stimulus. Taking any of those actions (or, as is more likely to occur, taking a combination of two or more of them, possibly in addition to expanding strategic nuclear forces) could impose costs on the United States. CBO has not estimated those costs, however, given the significant uncertainty about what actions might be taken and to what extent.

### Maintain the Status Quo

The United States could decide that its forces, as currently planned, are appropriate and sufficient for the

geopolitical environment, even in the absence of treaties that constrain strategic nuclear forces and permit inspections and other transparency measures. Current plans already call for the development of new technologies in several areas (some of which are described below) to respond to advances in the capabilities of potential adversaries.

Not expanding U.S. strategic nuclear forces in response to an expansion of Russian strategic nuclear forces would represent a change in U.S. strategy. Historically, the United States has generally pursued a deterrence strategy that features elements of both punishment and denial to varying degrees. According to that strategy, the best way to avoid nuclear war is to deny the adversary any plausible notion of victory, however it defines victory, at any level of nuclear conflict, from limited strikes through an all-out nuclear exchange.<sup>16</sup> That strategy could change for a number of reasons, however, including a decision to fund other defense priorities instead.

Hewing to the status quo would not increase DoD's costs beyond those it expects to incur for currently planned programs.

### Expand U.S. Intelligence Capabilities

The United States fields a variety of satellites, both classified and unclassified, to collect intelligence about adversaries through high-resolution imagery, infrared detection of missile launches, interception of electromagnetic communication, and other methods. Without insight into Russian strategic forces from on-site inspections and other transparency measures provided by a treaty, the United States would probably need to rely more heavily on satellite intelligence; moreover, it might feel the need to increase the number of satellites in orbit or purchase more commercial satellite imagery (or both) and bolster its capabilities to analyze intelligence data.<sup>17</sup> Those approaches are not without risk, however. The New START treaty, like the treaties that preceded it, prohibits interference with the other party's national technical means (a catchall term for intelligence and national security satellites and other means to verify treaty compliance). If that prohibition expired, U.S. satellites would

16. For more details, see Congressional Budget Office, *Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046* (October 2017), pp. 24–25, [www.cbo.gov/publication/53211](http://www.cbo.gov/publication/53211).

17. For a more detailed discussion of the consequences of the lack of transparency into Russian forces, see Vince Manzo, *Nuclear Arms Control Without a Treaty? Risks and Options After New START*, Deterrence and Arms Control Paper no. 1 (CNA Corporation, March 2019), pp. 38–49, [www.cna.org/research/NAC](http://www.cna.org/research/NAC).

be at risk of interference ranging from performance degradation (through jamming or other techniques) to destruction from a direct attack.<sup>18</sup>

If the United States decided to replace or augment its intelligence systems, the costs could be sizable. High-capability satellites can be expensive—for example, producing the fifth and sixth geostationary satellites in the Space-Based Infrared Satellite-High system, an unclassified missile launch detection constellation, cost an average of about \$1.1 billion each (in 2020 dollars).

Because it is unclear what steps, if any, the United States would take to compensate for the loss of monitoring and transparency measures that would have been provided under New START, CBO did not estimate those costs.

### Expand Missile Defenses

The United States could strengthen its defenses against long-range ballistic missiles if it concluded that the risk of a nuclear attack from Russia had increased or that stronger defenses would be prudent in the face of uncertainty about the state of Russian nuclear forces. Such an expansion in missile defenses would constitute a significant policy change, however. Previous statements of U.S. missile defense policy, including the 2019 Missile Defense Review, have held that missile defenses of the homeland were intended to counter long-range missile attacks from rogue states and that nuclear deterrence was intended to address the nuclear threat from Russia and China.

Currently, U.S. missile defense comes primarily from the Ground-Based Midcourse Defense (GMD) system, which comprises silo-based long-range interceptor missiles in Alaska and California, supported by an array of radars around the world. That system is complemented by Aegis Ballistic Missile Defense interceptors based both on ships and at ground sites; a test is slated for later this year to determine the efficacy of Aegis against ICBMs. The 2019 Missile Defense Review stated that GMD could be expanded by building new silos at the Alaska base if “emerging threat conditions” suggested they were needed.<sup>19</sup>

18. See Theresa Hitchens, “End of New START Could Risk U.S. Sats: Aerospace Corp.,” *Breaking Defense* (January 15, 2020), <https://tinyurl.com/yassuhrk>.

19. See Department of Defense, *Missile Defense Review* (January 2019), p. XVI, <https://go.usa.gov/xwtmx> (PDF, 26.6 MB).

Building 40 new silos at the Alaska GMD base and purchasing interceptors for them would cost about \$5 billion, CBO estimates. That amount is very uncertain, though, because the GMD program is in the early stages of a complete redesign.<sup>20</sup> The United States also could choose to expand or accelerate the development of other missile defense systems, including those designed to counter new hypersonic weapons (described in the next section), which would result in additional costs.

### Expand Conventional Missile Forces

The United States could choose to increase its conventional (that is, nonnuclear) capabilities to strengthen deterrence, if an expansion was deemed necessary to respond to an unconstrained Russian strategic nuclear force. One way to do that would be to accelerate or otherwise expand development programs for hypersonic weapons or conventional intermediate-range ballistic missiles (IRBMs). Both of those types of weapons are already under development for conventional missions to counter Russia’s and China’s antiaccess strategies.<sup>21</sup> Those weapons also could be designed to perform some missions that in the past might have required nuclear weapons, like striking high-value or hardened targets at long range on short notice.

Hypersonic weapons have three salient characteristics, all of which give them advantages over other weapons and make them difficult to defend against:

- They can travel at least five times the speed of sound (or Mach 5, which is equivalent to about 3,800 miles per hour or 1.7 kilometers, or km, per second) for at least part of their trajectory;
- They spend a significant fraction of their trajectory (the midcourse phase) flying through the upper atmosphere and use the atmosphere to provide lift; and

20. See Congressional Budget Office, *Assessing the Cost of the Recommendations of the 2019 Missile Defense Review* (forthcoming).

21. Antiaccess strategies are actions that would impede the deployment of U.S. forces into the combat theater, limit the locations from which those forces could effectively operate, or force them to operate from locations farther from the locus of conflict than they would normally prefer. See Roger Cliff and others, *Entering the Dragon’s Lair: Chinese Antiaccess Strategies and Their Implications for the United States* (RAND, 2007).

- They have the ability to maneuver to avoid enemy defenses in the midcourse phase.

Several U.S. programs are seeking to develop hypersonic weapons, including hypersonic glide weapons (which are launched with a rocket booster and then use aerodynamic lift to maneuver and to extend their range). At least one program is developing a hypersonic cruise missile (which is launched with a rocket booster to gain enough speed to enable it to use an exotic engine called a scramjet to reach hypersonic speeds). Some of those programs have begun flight-testing their prototypes.

The United States also could choose to accelerate or expand its development and fielding of ground-launched IRBMs now that it is no longer constrained by the Intermediate-Range Nuclear Forces treaty. That treaty barred the United States and Russia from possessing ground-launched cruise or ballistic missiles with ranges between 500 km and 5,500 km (or 300 miles to 3,400 miles). Citing an ongoing Russian violation of the treaty, the United States recently withdrew from it. Currently, at least one program is working on developing a conventionally armed IRBM.

Programs to develop hypersonic and IRBM weapons are in the early stages, so their development and production costs are not yet known. For that reason, CBO did not estimate those costs.

### Expand Nonstrategic Nuclear Forces

The United States currently fields only one type of nonstrategic nuclear weapon, the B61 bomb, which is carried by F-15E tactical aircraft as well as NATO allies' aircraft.<sup>22</sup> According to one report, about 150 of those bombs are based in Europe in support of NATO, and some are stored in the United States.<sup>23</sup> Unclassified sources estimate that Russia, by comparison, maintains a substantially larger stockpile of about 1,800 nonstrategic

warheads that can be delivered by several different vehicles.<sup>24</sup>

Citing Russia's advantage in the number and types of nonstrategic nuclear weapons it fields, the most recent Nuclear Posture Review (NPR), released in January 2018, called for putting the United States on a path to expand its nonstrategic nuclear forces by developing and fielding a new nuclear-armed, sea-launched cruise missile (SLCM). DoD is analyzing alternatives to determine the concept for the SLCM.

In 2019, CBO estimated that the cost of fielding a SLCM would be about \$9 billion (in current dollars). CBO assumed that the design of the SLCM would draw heavily from the Long-Range Standoff (LRSO) weapon, a nuclear-armed, air-launched cruise missile now in development.<sup>25</sup> (CBO's estimate did not include the costs to integrate the SLCMs onto the ships selected to carry them or associated costs like nuclear-specific training, weapon storage, or security.)

If the United States felt that conditions warranted additional expansion of nonstrategic nuclear forces, it could develop nuclear warheads for hypersonic missiles or IRBMs (discussed in the previous section) or add nuclear capability to one of the Navy's tactical aircraft. Those approaches would incur additional costs; operation costs for training, weapon storage, and security could be substantial, particularly if nuclear weapons were deployed on platforms that do not currently carry them.

### Strategic Nuclear Forces and Broad Approaches for Their Expansion

The Department of Defense operates a strategic nuclear force that complies with the limits specified in the New START treaty (up to 1,550 warheads and 800 delivery vehicles and missile launchers, 700 of which can be deployed). Those forces are aging, so DoD has started replacing them—a process that will continue over the next few decades. If the United States decided to expand its strategic nuclear forces, DoD could do so in two ways: by uploading warheads on currently

22. There are several versions of the B61 bomb. Some are carried by tactical aircraft for nonstrategic missions, whereas others are carried by B-2 bombers for strategic missions. The Department of Energy's B61-12 life-extension program, which is currently in the design phase, will combine the current types into a single version that can perform both strategic and nonstrategic missions.

23. Those bombs also can be carried by NATO partners' aircraft. See Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* (January 2020), <https://thebulletin.org/2020/01/united-states-nuclear-forces-2020/>.

24. See Hans M. Kristensen and Matt Korda, "Russian Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* (March 2020), <https://thebulletin.org/2020/03/russian-nuclear-forces-2020/>.

25. See Congressional Budget Office, *Projected Costs of U.S. Nuclear Forces, 2019 to 2028* (January 2019), p. 4, [www.cbo.gov/publication/54914](http://www.cbo.gov/publication/54914).



fielded delivery systems or by fielding additional delivery systems. Any substantial expansion of U.S. forces in response to a real or perceived Russian buildup would probably include a combination of the two.

To develop the approaches used in this analysis, which would increase nuclear forces to the limits set in previous treaties, CBO considered force structures comprising either currently deployed systems or next-generation systems that are being developed to replace the current-generation systems. Reconstituting nuclear forces as they had been deployed (or had planned to be deployed) when the previous treaties were in force is not possible. Many of the systems that were in service then have been out of production for decades and have since been retired, have had their inventory substantially reduced, or have been converted to serve only nonnuclear roles.

### Current and Planned Nuclear Forces

For many years, U.S. strategic nuclear forces have been made up of three components: intercontinental ballistic missiles, ballistic missile submarines (SSBNs) carrying long-range submarine-launched ballistic missiles (SLBMs), and long-range bombers carrying nuclear bombs or nuclear-armed cruise missiles; together, those forces are commonly referred to as the triad. The Department of Defense currently fields these systems:

- Ohio class SSBNs that are configured to carry 20 D5 SLBMs,
- Silo-based Minuteman III ICBMs,
- B-52H bombers that carry Air-Launched Cruise Missiles (ALCMs), and
- B-2A bombers that carry B61 and B83 bombs. (For quantities and other details for all of those systems, see Table 3, top panel).

Nearly all of those systems are nearing the end of their operational life, and many have undergone one or more life-extension programs (LEPs). Over the past decade, DoD has been designing replacements for those systems, most of which are slated to enter production over the next five years or so. The next-generation systems will comprise the following:

- Columbia class SSBNs carrying 16 existing D5 SLBMs and, eventually, newly constructed SLBMs using an updated design of the D5 missile,

- Ground-Based Strategic Deterrent (GBSD) ICBMs in refurbished Minuteman III silos,
- B-52H bombers with new engines and other refurbishments carrying LRSO cruise missiles, and
- New B-21 bombers, which will be capable of carrying both B61 nuclear bombs and LRSOs. (For details, see Table 3, bottom panel).<sup>26</sup>

At planned rates of production, those new systems will not be fully in place until the early 2040s.

As configured, current- and next-generation forces comply with New START's limits on delivery systems and deployed warheads, according to the definitions and counting rules laid out in that treaty. The rules with the greatest impact are those that affect how warheads are counted: Deployed ICBMs and SLBMs count as the actual number of warheads they carry, whereas deployed bombers count for only a single warhead each (regardless of how many warheads they carry). To meet the 1,550-warhead limit, therefore, current forces carry an average of 4.2 warheads on each deployed SLBM (individual SLBMs might carry any number up to the maximum load of 8), deployed Minuteman III ICBMs carry 1 warhead each (by U.S. policy, out of a maximum of 3 for that missile), and deployed bombers count as 1 warhead each (see the description in Table 2 on page 5).<sup>27</sup>

### Expansion by Uploading Additional Warheads

Current versions of SLBMs and ICBMs are capable of carrying more warheads than they typically do under New START. Similarly, the next generation of delivery vehicles would also have the capacity to carry more warheads than they most likely would be allowed to do under New START rules if the treaty remained in force (see Table 3).

26. For more details on those modernization programs, see Congressional Budget Office, *Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046* (October 2017), [www.cbo.gov/publication/53211](http://www.cbo.gov/publication/53211).

27. The counting rule for bombers was chosen to balance the facts that bombers are capable of carrying nuclear weapons but that neither the United States nor Russia keeps bombers loaded with those weapons on a day-to-day basis. See Senate Committee on Foreign Relations, *Treaty With Russia on Measures for Further Reduction and Limitation of Strategic Offensive Arms (The New START Treaty)*, Exec. Report 111-6 (October 1, 2010), [www.congress.gov/111/crpt/erpt6/CRPT-111erpt6.pdf](http://www.congress.gov/111/crpt/erpt6/CRPT-111erpt6.pdf) (701 MB).

Table 3.

**U.S. Nuclear Forces, as Currently Planned**

Triad Component	Delivery Systems Under Current Plans	Warheads If Delivery Systems Loaded to Maximum Capacity	How Deployed Warheads Would Count Under Treaty Counting Rules		Comments
			New START	Moscow	
<b>Current Generation of Forces</b>					
SSBNs	14 Ohio class submarines with 280 D5 SLBMs (20 per submarine)	2,240	1,008	1,008	8 warheads maximum per SLBM; currently deployed average about 4.2 per SLBM
ICBMs	450 silos with 400 MMIII missiles	1,200	400	400	3 warheads maximum per ICBM; actual deployed ICBMs have 1 each by policy
Bombers	43 B-52Hs and 20 B-2As	1,180	56	524	20 warheads maximum per B-52; 16 warheads per B-2
<b>Total</b>	<b>791</b>	<b>4,620</b>	<b>1,464</b>	<b>1,932</b>	
<b>Next Generation of Forces</b>					
SSBNs	12 Columbia class submarines with 192 D5 SLBMs (16 per submarine)	1,536	739	739	8 warheads maximum per SLBM; deployed average 4.2 per SLBM
ICBMs	450 silos with 400 GBSD missiles	1,200	400	400	3 warheads maximum per ICBM; 1 warhead per deployed ICBM
Bombers	43 B-52Hs and 100 B-21s	1,660	128	740	20 warheads maximum per B-52; 8 warheads per B-21
<b>Total</b>	<b>783</b>	<b>4,396</b>	<b>1,267</b>	<b>1,879</b>	

Source: Congressional Budget Office.

GBSD = Ground-Based Strategic Deterrent; ICBM = intercontinental ballistic missile; MMIII = Minuteman III; SLBM = submarine-launched ballistic missile; SSBN = ballistic missile submarine; START = Strategic Arms Reduction Treaty.

If enough warheads of the correct types were available, the current generation of forces could carry up to about 4,600, and the next generation of forces (when fully fielded) could carry up to about 4,400, CBO estimates. (Those numbers are theoretical maximums; they include full weapon loads on all bombers and incorporate the idealized assumption that all delivery systems would be in good repair and available.)<sup>28</sup> That approach would be roughly consistent with the counting rules of the START I treaty, which did not distinguish between deployed and nondeployed delivery vehicles and which attributed to

each delivery vehicle the maximum number of warheads used in any test of that system (except for bombers, which counted as fewer warheads than they were capable of carrying).

In all likelihood, however, the United States would not be able to field that many warheads in practice, primarily because they would not be available. According to the most recent unclassified data released by the Department of Defense, the United States' nuclear stockpile totaled 3,822 warheads as of 2017.<sup>29</sup> Another estimate, from an oft-cited public analysis of U.S. nuclear forces, puts the number of strategic warheads at 3,570, comprising 800 ICBM warheads, 1,920 SLBM warheads, and 850 bomber warheads (with an additional 230 nonstrategic warheads), as well as about 2,000 warheads that

28. For this analysis, CBO's estimates of next-generation forces incorporate the assumption that the B-21 bomber could carry up to eight nuclear weapons, half the number that the B-2A can carry. The actual number and types of nuclear weapons the B-21 will carry have not been publicly disclosed. For a public analysis of the potential capabilities of the B-21, see David Cenciotti and Tom Denerly, "Let's Have a Look at the New B-21 'Raider' Stealth Bomber Renderings the Air Force Has Just Released," *The Aviationist* (January 31, 2020), <https://tinyurl.com/ya6kvudz>.

29. See Department of Defense, "U.S. Nuclear Weapons Claims and Responses" (April 2019), <https://go.usa.gov/xwtvc> (PDF, 2.82 MB).



have been retired and are awaiting dismantlement.<sup>30</sup> Those estimates, if accurate, suggest that it would not be possible to load any of the three components of the triad to their full potential capacity or to field any configuration of nuclear forces with more than about 3,800 warheads, without either returning retired warheads to active service or producing new warheads, either of which could incur substantial costs and delays. CBO has not estimated those costs in this analysis because it is not clear to what extent those actions would be required.

At times, the number of available delivery systems would probably be smaller than CBO estimates, too. As current-generation delivery systems were retired and were replaced by newly produced next-generation systems, a period of reduced inventory would probably occur, particularly for SSBNs; if the program stays on schedule, the United States is expected to have 10 of them for several years (down from 14 now) before reaching the planned goal of 12. Maintaining current-generation systems at high levels of availability as they near the end of their operational life also might prove difficult.<sup>31</sup>

In addition to the practical reasons for fielding ICBMs and SLBMs at less than their full warhead loading, that configuration might make sense for operational and policy reasons. Many nuclear analysts have argued that placing more than one warhead on silo-based ICBMs (which have fixed and widely known locations) is strategically destabilizing because those missiles present an inviting target: By attacking such an ICBM, an adversary could destroy multiple warheads at once and gain an advantage. The 2010 Nuclear Posture Review established a U.S. policy to field only single-warhead ICBMs, and the 2018 NPR continued that policy. Operationally, increasing the weight that a missile has to carry reduces

its maximum range, so carrying the full load of warheads on an ICBM might require changing its assigned targets. Similarly, loading SLBMs with more warheads could force SSBNs to operate in areas closer to their targets (as they did during the Cold War). That configuration would require more time for the submarines to transit to and from their operating areas at the beginning and end of their deployments and would reduce planners' flexibility in choosing operating areas.

### Expansion by Fielding Additional Delivery Vehicles

The United States could expand its nuclear forces by fielding additional strategic delivery vehicles—an approach that would provide limited options for growth with the current generation of delivery vehicles but more options for the next generation of vehicles. Those additional purchases of next-generation systems would probably not be available for decades, however, unless production capacity for DoD's delivery systems and DOE's nuclear production facilities was expanded, which would require a significant investment.

**Current-Generation Delivery Vehicles.** Potentially, the number of deployed current-generation delivery vehicles could be increased from the current 700 to as many as about 880 (the number that the United States had before New START) without producing new systems, probably within several years of the decision to do so. Expanding the number of current-generation delivery vehicles beyond 880, however, is unlikely to occur. All of those systems have been in service for many years, and replacement systems are in development. For those reasons, CBO did not consider the possibility of producing additional current-generation systems.

To meet the limits for deployed delivery vehicles under the New START treaty, the United States had to reduce its inventory of each type of vehicle. To do so, it took three actions: disabling four SLBM launch tubes on each Ohio class SSBN (decreasing the number of operational tubes from 24 to 20 per submarine), removing 50 Minuteman III ICBMs from their silos, and converting about 30 B-52H bombers to conventional-only missions.

Increasing the number of deployed delivery vehicles would mean reversing at least one of those actions. The most straightforward would be increasing the number of deployed ICBMs by returning up to 50 missiles to their silos, because the United States elected to keep the 50 emptied silos in an operational status to serve

30. That estimate combines weapons in the active and inactive stockpiles. Weapons in the inactive stockpile have had certain limited-lifetime components removed to reduce maintenance requirements. If needed, those weapons could be returned to active status; the time required to do so would depend on the condition of each weapon, whether it was up to date on life extensions and other modifications that active weapons of its type received, and the availability of limited-lifetime components, particularly tritium. For an unclassified analysis of the size and composition of the U.S. stockpile, see Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* (January 2020), <https://thebulletin.org/2020/01/united-states-nuclear-forces-2020/>.

31. See Rachel S. Cohen, "Report: ICBMs to Fall Short of Mission Needs in 2026," *Air Force Magazine* (March 30, 2020), <https://tinyurl.com/ycrfymmt>.

as backups during the GBSB program's planned silo refurbishment. The total stock of Minuteman III missiles is limited, though, so placing additional missiles in silos might adversely affect their testing and reliability program.<sup>32</sup> Before the missiles were removed, the Air Force estimated that the costs of removing them from their silos and storing them would be \$20 million (in current dollars) over the 2014–2018 period. Returning the missiles to their silos might incur similar costs, although some of those silos would probably be left empty to facilitate refurbishment.

Some analysts have argued that it may be possible to reverse the changes made to SSBN tubes or B-52H bombers as a means to expand the number of current-generation delivery systems. Those actions—if possible—could probably be accomplished more quickly and at a lower cost than purchasing new next-generation delivery vehicles.

**Next-Generation Delivery Vehicles.** Expanding the number of next-generation delivery systems could be accomplished by increasing the number produced. Production of each of those systems is expected to run for many years. If the additional units were produced at the end of the planned production run for each system, the full complement of additional systems would probably not be available before the mid-2040s.

If DoD funded additional production facilities, then it might be possible to get those extra systems deployed sooner by accelerating their production. Construction costs could be substantial, though, particularly for SSBNs. And even if production started sooner than planned, it would still take many years to produce the desired quantity of delivery vehicles.

### **Costs of Producing New Nuclear Systems**

The main contributors to the costs of producing new nuclear systems are the costs to purchase additional delivery vehicles and the costs to produce new warheads. CBO used analyses from its previous reports to estimate the marginal costs of producing additional delivery systems and warheads. But CBO's estimates of the costs to expand nuclear forces to treaty levels do not include DOE's costs to produce additional warheads, because information about the current inventory of weapons is classified so it is not clear how many warheads would be required.

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32. Ibid.

The estimates also do not include other potential sources of substantial costs: the cost to sustain new warheads for the delivery systems to carry, should that be necessary; the cost to add production capacity for delivery systems or for warheads, should that be necessary; and the cost to establish and operate new bases for the delivery systems, should those be required.

### **Costs of Purchasing Additional Delivery Vehicles**

To estimate the costs of producing additional delivery systems—submarines, missiles, and bombers—CBO grouped those systems into sets (see Table 4). For example, the estimated cost for an SSBN includes the cost of the submarine plus the cost of 18 SLBMs, comprising the 16 that a single SSBN carries plus 2 spares. Using that general approach, CBO estimates that purchasing one outfitted Columbia class SSBN would cost \$8.5 billion, one launch control center's worth of silos and ICBMs would cost \$1.0 billion, and one B-21 with LRSO cruise missiles would cost about \$0.5 billion (all in 2020 dollars).

Unlike ICBMs and SSBNs, which are exclusively nuclear systems, bombers perform both nuclear and non-nuclear missions. CBO's estimates include the full cost of additional B-21 bombers because they are needed to reach the desired levels of nuclear forces. Those aircraft also would be available to perform nonnuclear missions, however, and thus would increase U.S. conventional capabilities as well.

Those estimates draw heavily on previously published CBO analyses. In particular, CBO's approach for estimating the production costs for delivery systems in this report is the same one it used in its 2017 report on the 30-year costs of nuclear forces.<sup>33</sup> Production costs were estimated using a model in which additional production would occur at the end of the planned production run, when the unit cost of produced units is typically at its lowest. Those production runs are currently scheduled to be completed in the late 2030s or early 2040s. If additional delivery systems were desired earlier, it might be necessary to construct additional production facilities, but CBO did not estimate the costs to do so.

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33. Costs in this report have been updated to 2020 dollars. For details on the methodology CBO used, see Congressional Budget Office, *Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046* (October 2017), Appendix A, [www.cbo.gov/publication/53211](http://www.cbo.gov/publication/53211).

Table 4.

**CBO's Estimates of DoD's Marginal Costs of Purchasing Additional Next-Generation Delivery Vehicles**

Triad Component	Items Purchased	Maximum Warhead Capacity Added	Marginal One-Time Acquisition Cost (Billions of 2020 dollars)	Additional Annual Operation and Sustainment Costs (Millions of 2020 dollars)	Department of Energy's Additional Costs to Produce, Sustain, and Store New Warheads	Comments
SSBNs	1 Columbia class SSBN and 18 D5 SLBMs	128	8.5	180	Not estimated	Includes 2 spare SLBMs
ICBMs	10 silos and 11 GBSD ICBMs	30	1.0	20	Not estimated	ICBMs are grouped as 10 per launch control center; includes 1 spare ICBM
Bombers	1 B-21 and 10 LRSO cruise missiles	8	0.5	40	Not estimated	Includes 2 spare LRSOs

Source: Congressional Budget Office, using information from the Department of Defense.

Marginal cost is the cost added by producing one additional unit of a product or service.

CBO did not estimate DoD's costs of new bases or new facilities for training and maintenance (if needed).

GBSD = Ground-Based Strategic Deterrent; ICBM = intercontinental ballistic missile; LRSO = Long-Range Standoff weapon; SLBM = submarine-launched ballistic missile; SSBN = strategic ballistic missile submarine.

CBO's estimates of marginal operation and sustainment costs are based on the actual costs of analogous systems.<sup>34</sup> They incorporate the assumption that, as the size of the fleet changes, half of all operation and sustainment costs would be fixed, and half would vary linearly with the size of the force. If the size of the fleet doubled, for instance, the fixed half of operation and sustainment costs would stay the same, whereas the variable half of those costs would double, resulting in operation and sustainment costs for the double-sized fleet that were 150 percent of the costs of the original fleet.

### Costs of Producing New Warheads

Expanding the number of warheads in the stockpile could add to costs in two ways: The additional warheads would need to be produced, and larger production facilities might need to be built to support a larger stockpile.

Although CBO could not estimate the total costs for the Department of Energy to produce enough new warheads to reach the limits under the various treaties, it was able to roughly estimate the average cost of producing each additional warhead by gauging the average marginal cost to produce a new warhead of a type that is already in the stockpile. (That estimate does not include the costs to develop the design and procedures for producing

the warhead.) DOE is in the process of performing life extensions on essentially all of the types of warheads in the stockpile. Drawing on analysis done for a previous report, CBO estimates that the average production cost per warhead for those LEPs would be about \$9 million to \$12 million, assuming that there was a one-to-one replacement of warheads in the existing active stockpile.

One variable that would affect the costs of producing new warheads is whether enough plutonium pits of the appropriate type would be available.<sup>35</sup> Life-extension programs generally reuse a plutonium pit from an existing warhead, but there may not be enough existing pits to support a substantial increase in the size of the stockpile. DOE is in the planning stages for a new plutonium pit facility, but completion would be years away. Based on an analysis of DOE's information about operating costs for that facility when it reaches full production capacity of 50 pits per year, CBO estimates that the marginal cost of producing a pit would be about \$6 million. Combining that cost with the other warhead production costs yields a rough marginal cost estimate of \$15 million to \$20 million per warhead. Thus, if 3,000 new warheads were required to expand U.S. forces to the START I limit of 6,000, for example, the total

34. Sustainment means providing incremental upgrades to a system over time, often by adding components that are easier to maintain or that add capability.

35. A pit is a hollow shell of fissile material, such as plutonium, at the core of a modern nuclear weapon. Detonation of the weapon begins with the implosion of the pit. Each type of nuclear weapon generally uses a custom-designed pit.

cost for new warheads would be about \$45 billion to \$60 billion. That estimate is highly uncertain, though, primarily because it is not clear how well LEP costs serve as an analogue for the costs of producing a new warhead.

If the number of warheads in the stockpile was expanded, DOE might need to make some changes to its weapons complex beyond those it already has planned. Many of its production facilities are more than 40 years old. Over the past several years, DOE has developed a plan to rebuild much of the infrastructure used to produce the components that make up nuclear warheads: the plutonium pits; strategic materials, such as tritium; and other nonnuclear components, including radiation-hardened electronics and the conventional explosives used to begin the nuclear chain reaction in the warhead.

In its fiscal year 2021 budget submission, DOE estimated that it would need \$15.5 billion (in current dollars) to modernize its production facilities over the 2021–2025 period, and additional funding for that effort is slated to run through the mid-2040s. If DOE's planned facilities are sized to support a future stockpile that is the same size as the current one, though, and later the decision is made to expand the stockpile substantially, those planned facilities might need to be expanded as well. DOE also would have to increase its capacity to maintain a larger stockpile. Those changes, if necessary, would incur additional costs, possibly substantial, particularly if the United States returned its nuclear forces to START I levels.

### Costs of Expanding Strategic Nuclear Forces to the Limits Under Previous Treaties

Because it is unclear how the United States might expand its strategic nuclear forces if New START expired, CBO looked at a range of possible outcomes using the limits under the Moscow Treaty, the START II treaty, and the START I treaty. Each treaty had a unique set of rules for counting the number of warheads and delivery vehicles. To make the possible outcomes under the various treaties easier to compare, CBO used a single set of counting rules—those from the Moscow Treaty, which come the closest to counting the actual number of deployed warheads (see Box 1).

#### CBO's Approach

The United States could expand its nuclear forces by uploading warheads on missiles, fielding additional

delivery systems, or doing both. Because myriad combinations are possible, CBO estimated costs for the full range of possible combinations but focused on two general approaches—one at each end of the spectrum—to show the range of potential costs:

- A lower-cost and less flexible approach under which the United States would expand its nuclear forces primarily by uploading warheads on missiles and increasing the number of warheads allocated to each bomber to, or nearly to, the maximum level while fielding as few additional delivery systems as possible; and
- A more flexible and higher-cost approach under which the United States would expand its nuclear forces primarily by fielding additional delivery systems while maintaining, to the extent possible, the current levels of warhead loading on missiles and warheads allocated to bombers.

The lower-cost approach would be less expensive generally because it would lead to the purchase of fewer new delivery systems. The more flexible approach would be more expensive generally, but it would allow expanded forces to operate in a manner similar to that of current forces by maintaining current warhead loadings.

Increasing the number of warheads on missiles reduces their maximum range. Under the lower-cost approach, fully loaded ICBMs might not be able to reach all of their currently assigned targets, and SSBNs might have to change their operating areas to reach all of their current targets. Having fewer warheads on delivery vehicles—as the more flexible approach would do—might provide more capability to execute limited nuclear strikes, yielding more flexibility in managing nuclear escalation.

**Criteria That CBO Considered.** In constructing potential force structures, CBO considered only those in which warheads would be distributed among the components of the triad in proportions that were roughly similar to those of current forces and planned next-generation forces (when possible). Historically, each component of the triad has been thought to make a unique contribution to deterrence, so fielding an expanded force with a structure close to that of current

## Box 1.

**Counting Rules Used in This Analysis**

To estimate the potential costs of expanding strategic nuclear forces to the levels defined in the Moscow, START II, and START I arms control treaties, the Congressional Budget Office needed to select an appropriate method for counting the number of warheads for a given set of nuclear forces. Each treaty has a set of negotiated counting rules to calculate the number of “accountable” warheads of each party to determine if they comply with the treaty’s limits.<sup>1</sup> Generally, those rules were customized to address concerns about the makeup of the forces at the time; for example, when the START I treaty was negotiated in 1991, the United States was concerned about Russia fielding large intercontinental ballistic missiles (ICBMs) capable of carrying many warheads, so the rules count each missile as having the maximum number of warheads that a missile can carry rather than the (smaller) number with which it might typically be outfitted. Because of those idiosyncrasies, the numbers of accountable warheads can differ markedly depending on which counting rules are applied to a given force (see Table 2 on page 5).

For consistency in comparing illustrative forces, CBO selected a single set of counting rules—those used for the Moscow Treaty in 2002—to determine the number of accountable warheads for each of the forces. Specifically, CBO used the rules

1. Accountable warheads are those that count toward the maximum overall limits provided for in the treaty. They are not necessarily the same as the actual number of deployed warheads.

described in the transmittal documents submitting the treaty to the Congress: the actual number of warheads on deployed ICBMs and submarine-launched ballistic missiles (SLBMs), plus the number of warheads either loaded on deployed bombers or stored at active bomber bases.<sup>2</sup>

That formulation corresponds roughly to the number of warheads that the United States could bring to bear within a few weeks during a crisis and thus has a meaningful operational basis, particularly in a world without limits on nuclear forces. On the basis of its analysis of U.S. annual reports on treaty implementation and unclassified analyses of the makeup of U.S. strategic forces, CBO estimates that the number of accountable bomber warheads when the Moscow Treaty was in force was approximately half of the maximum warhead capacity for the deployed bomber force. In CBO’s application of the Moscow Treaty’s counting rules, deployed ICBMs include silos that have ICBMs in them, and deployed SLBMs include all missiles carried by submarines that are not being overhauled. CBO’s application of those rules also incorporates the assumption that 90 percent of delivery systems are deployed.

2. See “Message From The President of the United States Transmitting the Treaty Between the United States of America and the Russian Federation on Strategic Offensive Reduction, Signed at Moscow on May 24, 2002,” Senate Treaty Document 107-8, [www.congress.gov/107/cdoc/tdoc8/CDOC-107tdoc8.pdf](http://www.congress.gov/107/cdoc/tdoc8/CDOC-107tdoc8.pdf) (522 KB).

or planned forces would maintain a similar mix of those deterrence features.<sup>36</sup>

Applying the Moscow Treaty’s counting rules to current-generation forces means that about half of accountable warheads are carried on SLBMs, and ICBMs and bombers each account for about one-quarter of warheads. Similarly, for next-generation forces as currently

36. In brief, SSBNs provide survivable nuclear weapons and thus guarantee the ability to execute a retaliatory second strike if an adversary strikes the United States; ICBMs provide rapid response and a large number of targets that raise the threshold for a potential adversary’s disarming first strike; and bombers provide flexibility by allowing leaders to ramp up operations quickly (to signal intent to an adversary) and by being able to be recalled after launch if circumstances change. For more details, see Congressional Budget Office, *Approaches for Managing the Costs of Nuclear Forces, 2017 to 2046* (October 2017), Chapter 3, [www.cbo.gov/publication/53211](http://www.cbo.gov/publication/53211).

planned, SLBMs and bombers would each account for about 40 percent of warheads under those counting rules, and ICBMs would account for about 20 percent. CBO considered force structures that fit roughly within the range between those two cases.

In addition, CBO considered only expanded forces that would use the same delivery systems as currently planned—that is, Columbia class SSBNs, GBSD silo-based ICBMs, B-52H bombers, and B-21 bombers. The United States could consider developing other delivery systems, though, particularly if forces were expanded substantially. For example, DoD’s original analysis of alternatives that led to creation of the GBSD program also considered a mobile ICBM concept.<sup>37</sup> Development

37. See Jason Sherman, “Trump Administration Wants to Retain Option for Road-Mobile GBSD Variant,” *Inside Defense* (July 18, 2019), <https://tinyurl.com/y85fq6zz>.



of a new delivery system would incur additional costs, but it could lead to lower overall costs than those of the other force structures considered in this report, and the United States could choose to pursue it for operational or financial reasons. However, CBO did not consider the development of any new delivery systems in estimating the costs of expanded forces.

**CBO's Estimates of Costs.** To show the range of DoD's potential costs under each treaty, CBO estimated the costs of the full range of possible combinations of forces that added up to the treaty's limit on warheads and still met the criteria described above. Those combinations were based on varying the number of components: SSBNs and the warheads carried by each SLBM on those submarines, ICBMs and the warheads carried by each of those missiles, and B-21 bombers. (The number of B-52 bombers was not varied.)

Unlike ICBMs and SSBNs, which are exclusively nuclear systems, bombers perform both nuclear and nonnuclear missions. CBO's estimates include the full cost of additional B-21 bombers because they would be needed to reach the desired levels of nuclear forces. Those aircraft also would be available to perform nonnuclear missions, however, and thus would increase U.S. conventional capabilities as well.

For treaties that have a range for the maximum number of warheads they allow, CBO assessed the cost of forces at the lower end of that limit—1,700 for the Moscow Treaty and 3,000 for the START II treaty. CBO did not consider decreasing any components of the triad; in other words, it excluded configurations that would field fewer than the planned number of delivery systems of any type or that would load missile warheads at an average of less than 4 per SLBM or 1 per ICBM.

The resulting set of possible configurations provided a range of potential costs. Force configurations that correspond to what CBO has referred to as the lower-cost approach (which favors uploading warheads over purchasing any new delivery systems) generally have costs at the low end of the distribution for a given treaty; configurations that correspond to the more flexible approach (which prioritizes purchasing enough delivery systems to require little or no uploading of warheads on missiles beyond current levels) generally have costs at the high end of the distribution. Those two approaches are meant to illustrate what force structures and costs would

look like at the ends of the cost distribution. Many other approaches and configurations are possible.

Regardless of the approach chosen, actual costs for the forces in each range would probably exceed CBO's estimates because they exclude two types of costs.

- First, they exclude any costs incurred by DOE for additional warheads. If production of new warheads was necessary to reach the levels for a certain treaty, the process could take longer, and DOE could incur substantial costs.
- Second, they exclude any costs for DoD to build additional weapons storage and maintenance facilities at bases or to establish operations at any additional bases, if those became necessary.

CBO has not estimated those costs because it is not clear whether and to what extent new warheads or new facilities might be needed. The size of those excluded costs probably increases with the extent of the expansion of DoD's forces, so greater expansion means more costs that are not included in CBO's estimates.

### **Costs of Expanding Forces to Moscow Treaty Limits**

Under the Moscow Treaty's counting rules, both the current generation of forces and the planned next generation of forces would meet its limit of 1,700 to 2,200 warheads with no changes and, thus, would not incur any additional costs (see Table 3 on page 11). Although that limit is higher than currently allowed under New START, more warheads are counted toward that limit under the Moscow Treaty's counting rules, which fully account for the weapons that have been assigned to bombers. Under New START's counting rules, by contrast, each bomber accounts for only one warhead.

### **Costs of Expanding Forces to START II Treaty Limits**

CBO examined two approaches to constructing forces that would carry 3,000 to 3,500 warheads, the number allowed under the START II treaty.<sup>38</sup> The lower-cost approach would upload warheads on existing and next-generation forces, and the more flexible approach would purchase enough additional next-generation delivery vehicles to reach START II limits using warhead

38. START II's limits on warheads were to be implemented in two phases. This analysis uses the more restrictive limits from the second phase.

Table 5.

**Examples of Nuclear Force Structures That Could Be Implemented to Reach START II Warhead Limits**

Triad Component	Delivery Systems	Warheads at Maximum Capacity	Deployed Warheads (CBO's estimate)	DoD's Additional Costs (Billions of 2020 dollars)		Department of Energy's Additional Costs to Produce, Sustain, and Store New Warheads	Comments
				One-Time Acquisition Costs	Annual Operation and Sustainment Costs		
<b>Lower-Cost and Less Flexible Approach</b>							
SSBNs	12 Columbia class submarines with 192 D5 SLBMs	1,536	1,408	0	0	Not estimated	No additional SSBNs; 8 warheads per SLBM, on average
ICBMs	450 silos with 405 GBSD missiles	1,350	810	0	0	Not estimated	No additional ICBMs; 2 warheads per ICBM, on average
Bombers	43 B-52Hs and 100 B-21s	1,660	782	0	0	Not estimated	No additional bombers; warheads at about half-full bomber capacity
<b>Total</b>	<b>785</b>	<b>4,546</b>	<b>3,000</b>	<b>0<sup>a</sup></b>	<b>0</b>		
<b>More Flexible and Higher-Cost Approach</b>							
SSBNs	19 Columbia class submarines with 304 D5 SLBMs	2,432	1,169	60	1	Not estimated	7 additional SSBNs with SLBMs; 4.3 warheads per SLBM, on average
ICBMs	550 silos with 495 GBSD missiles	1,650	495	10	0	Not estimated	100 additional ICBMs; 1 warhead per ICBM
Bombers	43 B-52Hs and 266 B-21s	2,988	1,336	91	7	Not estimated	166 additional B-21s with LRSOs; warheads at about half-full bomber capacity
<b>Total</b>	<b>1,163</b>	<b>7,070</b>	<b>3,000</b>	<b>160<sup>b</sup></b>	<b>8<sup>b</sup></b>		

Source: Congressional Budget Office.

The approaches described in this table are two illustrative examples of the many force structures that CBO included in its cost range for expanding U.S. forces to START II treaty levels. The costs are estimated using the marginal cost factors from Table 4. The lower-cost approach to increasing warheads to START II limits (3,000 to 3,500) would increase the number of warheads on each missile; the more flexible approach would increase the number of delivery vehicles.

DoD = Department of Defense; GBSD = Ground-Based Strategic Deterrent; ICBM = intercontinental ballistic missile; LRSO = Long-Range Standoff weapon; SLBM = submarine-launched ballistic missile; SSBN = strategic ballistic missile submarine; START = Strategic Arms Reduction Treaty.

- a. Under the lower-cost approach, warheads could be uploaded only at a onetime additional cost of about \$100 million. That approach might require the production of new warheads, but CBO did not estimate the costs to do so.
- b. The more flexible approach could incur costs for new warhead production, sustainment and infrastructure, production facilities for new delivery systems, and new bases and training facilities; CBO did not estimate the costs for any of those items, however.

loadings as they are today (to preserve the flexibility provided by that configuration).

**Lower-Cost Approach.** The United States could reach the START II warhead limit for the current and next generation of forces by increasing warhead loadings to near their maximum capacity on ICBMs and SLBMs and increasing the number of warheads allocated to bombers to near their maximum capacity (see Table 5, top panel). If enough warheads of the appropriate types were available, increasing warhead loadings to that extent could probably be accomplished within a few years, CBO estimates, and would cost about \$100 million

(based on the cost that DoD has reported for removing warheads from delivery systems to comply with the limit under the New START treaty).

Increasing the number of warheads to 3,000 or more would put the total number close to the current stockpile of 3,800 active and inactive warheads. Probably only a few force structures, if any, could be fielded solely by uploading warheads without producing any new warheads. And producing new warheads would extend the time required to reach the START II warhead levels and would boost costs (which CBO did not estimate).



**More Flexible Approach.** The United States could expand to START II warhead levels for next-generation forces by purchasing additional delivery systems. Warhead loading levels would stay close to their current values (4.2 per SLBM, on average, and 1 per ICBM), and warheads allocated to the bomber fleet would remain at about half of the maximum capacity. That more flexible approach would incur additional onetime acquisition costs of between \$114 billion and \$172 billion over several decades and additional operation and sustainment costs of between \$3 billion and \$8 billion a year, CBO estimates. Those costs would depend on the mix of additional delivery systems purchased to preserve the current relative distribution of warheads among the triad's components.

As an example, one potential configuration of forces would require DoD to purchase 7 additional Columbia class SSBNs and associated missiles, 100 additional GBSD ICBMs and associated infrastructure, and 166 additional B-21 bombers with cruise missiles (see Table 5 on page 18, bottom panel).<sup>39</sup> To field and maintain such a force, DoD would incur onetime acquisition costs of \$160 billion and operating and sustainment costs of \$8 billion a year, CBO estimates. Any additional costs for DOE would elevate those totals.

The more flexible approach would probably require the production of new warheads, which would increase costs. CBO did not estimate those additional costs.

### Costs of Expanding Forces to START I Treaty Limits

CBO used the same two approaches to illustrate the range of possible forces under START I, which limits the number of warheads to a total of 6,000 and the number of delivery systems to 1,600.<sup>40</sup> The lower-cost approach would emphasize uploading forces and would require the purchase of as few additional systems as possible. The more flexible approach would emphasize warhead loadings that were roughly similar to those of current forces.

39. The addition of 100 ICBMs comprises adding 100 silos and 110 missiles. CBO's estimate of the number of deployed warheads incorporates the assumption that missiles would be deployed in 90 percent of those silos (that is, they are loaded into a silo) at any given time, which is consistent with the current fraction of ICBMs deployed by DoD. The remaining missiles would be added to the Air Force's inventory and would be available for deployment if that was desired.

40. CBO did not apply the sublimits that the treaty created for how the warheads would be distributed among the components of the triad, because the treaty is no longer in effect.

Because the 6,000-warhead limit would exceed the maximum capacity of both current- and next-generation forces, reaching it would require the purchase of additional delivery systems—a prospect that would be feasible only for next-generation forces.

**Lower-Cost Approach.** To minimize the number of additional delivery systems needed under the lower-cost approach, ICBMs and SLBMs could be uploaded to the greatest extent possible, and the bomber fleet could be sized to match maximum capacity to warheads allocated to the fleet. If missiles were at their full loading (8 warheads per SLBM and 3 warheads per ICBM), reaching 6,000 deployed warheads would cost DoD \$88 billion to \$149 billion in additional onetime acquisition costs and \$4 billion to \$10 billion a year in additional operation and sustainment costs. The costs would depend on the makeup of the additional delivery systems purchased, although any configuration would need to maintain roughly the same relative distribution of warheads among the components of the triad.

One potential configuration of forces would comprise 3 additional Columbia class SSBNs with missiles, 150 additional GBSD ICBMs, and 153 additional B-21 bombers with cruise missiles. That setup would cost DoD an additional \$124 billion in acquisition costs and \$7 billion annually in additional operation and sustainment costs (see Table 6, top panel).<sup>41</sup>

The lower-cost approach would probably require the production of new warheads, which could substantially increase costs. CBO did not estimate those additional costs.

**More Flexible Approach.** It is not possible to reach 6,000 warheads while fully preserving the levels of warhead loading in the current force and remaining below the START I limit of 1,600 delivery systems. To remain below the limit on delivery vehicles, CBO considered force configurations that would load a single warhead on all ICBMs (maintaining current U.S. policy) and load SLBMs to near their maximum value. Those force configurations would not maintain the current relative

41. The addition of 150 ICBMs comprises adding 150 silos and 165 missiles. CBO's estimate of the number of deployed warheads incorporates the assumption that missiles would be deployed in 90 percent of those silos (that is, they are loaded into a silo) at any given time, which is consistent with the current fraction of ICBMs deployed by DoD. The remaining missiles would be added to the Air Force's inventory and would be available for deployment if that was desired.

Table 6.

**Examples of Nuclear Force Structures That Could Be Implemented to Reach START I Warhead Limits**

Triad Component	Delivery Systems	Warheads at Maximum Capacity	Deployed Warheads (CBO's estimate)	DoD's Additional Costs (Billions of 2020 dollars)		Department of Energy's Additional Costs to Produce, Sustain, and Store New Warheads	Comments
				One-Time Acquisition Costs	Annual Operation and Sustainment Costs		
<b>Lower-Cost and Less Flexible Approach</b>							
SSBNs	15 Columbia class submarines with 240 D5 SLBMs	1,920	1,792	26	1	Not estimated	3 additional SSBNs with SLBMs; 8 warheads per SLBM, on average
ICBMs	600 silos with 540 GBSD missiles	1,800	1,620	14	0	Not estimated	150 additional ICBMs; 3 warheads per ICBM, on average
Bombers	43 B-52Hs and 253 B-21s	2,884	2,576	84	6	Not estimated	153 additional B-21s with LRSOs; warheads at full bomber capacity
<b>Total</b>	<b>1,059</b>	<b>6,604</b>	<b>5,988</b>	<b>124</b>	<b>7</b>		
<b>More Flexible and Higher-Cost Approach</b>							
SSBNs	24 Columbia class submarines with 384 D5 SLBMs	3,072	2,746	102	2	Not estimated	12 additional SSBNs with SLBMs; 7.8 warheads per SLBM, on average
ICBMs	450 silos with 405 GBSD missiles	1,350	405	0	0	Not estimated	No additional ICBMs; 1 warhead per ICBM
Bombers	43 B-52Hs and 686 B-21s	6,348	2,850	321	24	Not estimated	586 additional B-21s with LRSOs; warheads at half-full bomber capacity
<b>Total</b>	<b>1,563</b>	<b>10,770</b>	<b>6,001</b>	<b>423</b>	<b>26</b>		

Source: Congressional Budget Office.

The approaches described in this table are two illustrative examples of the many force structures that CBO included in its cost range for expanding U.S. forces to START I treaty levels. The costs are estimated using the marginal cost factors from Table 4. The lower-cost approach to increasing warheads to START I's limit of 6,000 would increase the number of warheads on each missile and purchase the minimum number of delivery vehicles necessary to reach the limit; the more flexible approach would maintain as much as possible the current number of warheads loaded on missiles and allocated to bombers by purchasing enough delivery systems.

Both the lower-cost and more flexible approaches could incur costs for new warhead production, sustainment and infrastructure, production facilities for new delivery systems, and new bases and training facilities; CBO did not estimate the costs for any of those items, however.

DoD = Department of Defense; GBSD = Ground-Based Strategic Deterrent; ICBM = intercontinental ballistic missile; LRSO = Long-Range Standoff weapon; SLBM = submarine-launched ballistic missile; SSBN = strategic ballistic missile submarine; START = Strategic Arms Reduction Treaty.

distribution of warheads among the components of the triad—the ICBM component would carry a smaller fraction of warheads than it does currently. Under those conditions, DoD would incur \$410 billion to \$439 billion in additional onetime acquisition costs and \$24 billion to \$28 billion in additional annual operation and sustainment costs, CBO estimates. The range of costs reflects the makeup of additional delivery systems purchased.

One potential configuration would add 12 Columbia class SSBNs with missiles and 586 B-21 bombers with

cruise missiles to the force but would not change the number of GBSD ICBMs. Such a force would cost DoD \$423 billion in additional onetime acquisition costs and \$26 billion in additional operation and sustainment costs each year, in CBO's estimation (see Table 6, bottom panel).

The more flexible approach would probably require the production of new warheads, which could substantially increase costs. CBO did not estimate those additional costs.



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## About This Document

This Congressional Budget Office report was prepared at the request of the Chairman of the House Armed Services Committee and the Ranking Member of the Senate Foreign Relations Committee. In keeping with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Michael Bennett prepared the report with assistance from Joshua Wolfram, a visiting fellow at CBO from the Air Force, and with guidance from David Mosher and Edward G. Keating. Raymond J. Hall assisted in the research. John Kerman fact-checked the report.

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CBO continually seeks feedback to make its work as useful as possible. Please send any comments to [communications@cbo.gov](mailto:communications@cbo.gov).

A handwritten signature in black ink, appearing to read "Phillip L. Swagel".

Phillip L. Swagel  
Director  
August 2020