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Russia's Nuclear Weapons: Doctrine, Forces, and Modernization

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SUMMARY

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Russia's Nuclear Weapons: Doctrine, Forces, and Modernization

Russia's nuclear forces consist of both long-range, strategic systems—including intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and heavy bombers—and shorter- and medium-range delivery systems. Russia is modernizing its nuclear forces, replacing Soviet-era systems with new missiles, submarines and aircraft while developing new types of delivery systems. Although Russia's number of nuclear weapons has declined sharply since the end of Cold War, it retains a stockpile of thousands of warheads, with more than 1,500 warheads deployed on missiles and bombers capable of reaching U.S. territory.

Doctrine and Deployment

During the Cold War, the Soviet Union valued nuclear weapons for both their political and military attributes. While Moscow pledged that it would not be the first to use nuclear weapons in a conflict, many analysts and scholars believed the Soviet Union integrated nuclear weapons into its warfighting plans. After the Cold War, Russia did not retain the Soviet "no first use" policy, and it has revised its nuclear doctrine several times to respond to concerns about its security environment and the capabilities of its conventional forces. When combined with military exercises and Russian officials' public statements, this evolving doctrine seems to indicate that Russia has potentially placed a greater reliance on nuclear weapons and may threaten to use them during regional conflicts. This doctrine has led some U.S. analysts to conclude that Russia has adopted an "escalate to de-escalate" strategy, where it might threaten to use nuclear weapons if it were losing a conflict with a NATO member, in an effort to convince the United States and its NATO allies to withdraw from the conflict. Russian officials, along with some scholars and observers in the United States and Europe, dispute this interpretation; however, concerns about this doctrine have informed recommendations for changes in the U.S. nuclear posture.

Russia's current modernization cycle for its nuclear forces began in the early 2000s and is likely to conclude in the 2020s. In addition, in March 2018, Russian President Vladimir Putin announced that Russia was developing new types of nuclear systems. While some see these weapons as a Russian attempt to achieve a measure of superiority over the United States, others note that they likely represent a Russian response to concerns about emerging U.S. missile defense capabilities. These new Russian systems include, among others, a heavy ICBM with the ability to carry multiple warheads, a hypersonic glide vehicle, an autonomous underwater vehicle, and a nuclear-powered cruise missile. The hypersonic glide vehicle, carried on an existing long-range ballistic missile, entered service in late 2019.

Arms Control Agreements

Over the years, the United States has signed bilateral arms control agreements with the Soviet Union and then Russia that have limited and reduced the number of warheads carried on their nuclear delivery systems. Early agreements did little to reduce the size of Soviet forces, as the Soviet Union developed and deployed missiles with multiple warheads. However, the 1991 Strategic Arms Reduction Treaty, combined with financial difficulties that slowed Russia's nuclear modernization plans, sharply reduced the number of deployed warheads in the Russian force. The 2010 New START Treaty added modest reductions to this record but still served to limit the size of the Russian force and maintain the transparency afforded by the monitoring and verification provisions in the treaty.

Congressional Interest

Some Members of Congress have expressed growing concerns about the challenges Russia poses to the United States and its allies. In this context, Members of Congress may address a number of questions about Russian nuclear forces as they debate the U.S. nuclear force structure and plans for U.S. nuclear modernization. Congress may review debates about whether the U.S. modernization programs are needed to maintain the U.S. nuclear deterrent, or whether such programs may fuel an arms race with Russia. Congress may also assess whether Russia will be able to expand its forces in ways that threaten U.S. security if the United States and Russia do not continue to limit their forces under the New START Treaty. Finally, Congress may review the debates within the expert community about Russian nuclear doctrine when deciding whether the United States needs to develop new capabilities to deter Russian use of nuclear weapons.

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Introduction

Relations between the United States and Russia have shifted over time—sometimes reassuring and sometimes concerning—yet most experts agree that Russia is the only nation that poses, through its arsenal of nuclear weapons, an existential threat to the United States. While its nuclear arms have declined sharply in quantity since the end of the Cold War, Russia retains a stockpile of thousands of nuclear weapons, with more than 1,500 warheads deployed on missiles and bombers capable of reaching U.S. territory.[1] The United States has always viewed these weapons as a potential threat to U.S. security and survival. It has not only maintained a nuclear deterrent to counter this threat, it has also signed numerous arms control treaties with the Soviet Union and later Russia in an effort to restrain and reduce the number and capabilities of nuclear weapons. The collapse of the 1987 Intermediate-range Nuclear Forces (INF) Treaty[2] and the eventual expiration of the 2010 New Strategic Arms Reduction Treaty (New START)[3] in 2026 may signal the end to mutual restraint and limits on such weapons.

The 2018 National Defense Strategy identified the reemergence of long-term, strategic competition with Russia and China as the "the central challenge to U.S. prosperity and security." It noted that Russia seeks "to shatter the North Atlantic Treaty Organization and change European and Middle East security and economic structures to its favor." It argued that the challenge from Russia is clear when its malign behavior is "coupled with its expanding and modernizing nuclear arsenal."[4] The Biden Administration's Interim National Security Strategic Guidance, issued in March 2021, stated that "Russia remains determined to enhance its global influence and play a disruptive role on the world stage."[5]

The 2018 Nuclear Posture Review (NPR) amplified this theme, noting that "Russia has demonstrated its willingness to use force to alter the map of Europe and impose its will on its neighbors, backed by implicit and explicit nuclear first-use threats."[6] The NPR described changes to Russia's nuclear doctrine and catalogued Russia's efforts to modernize its nuclear forces, arguing that these efforts have "increased, and will continue to increase, [Russia's] warhead delivery capacity, and provides Russia with the ability to rapidly expand its deployed warhead numbers."[7]

Congress has shown growing concern about the challenges Russia poses to the United States and its allies. It has expressed concerns about Russia's nuclear doctrine and nuclear modernization programs and has held hearings focused on Russia's compliance with arms control agreements

[1] U.S. State Department, *New START Treaty Aggregate Numbers of Strategic Offensive Arms*, Fact Sheet, Washington, DC, July 2019, https://2017-2021.state.gov/new-start-treaty-aggregate-numbers-of-strategic-offensive-arms-10/index.html. See, also, Hans Kristensen and Matt Korda, "Russian nuclear forces, 2019," *Bulletin of the Atomic Scientists*, 2019, 75/2, p. 74, https://www.tandfonline.com/doi/full/10.1080/00963402.2019.1580891.

[2] CRS Insight IN10985, *U.S. Withdrawal from the INF Treaty*, by Amy F. Woolf.

[3] On February 3, 2021, the United States and Russia agreed to extend New START through 2026, an option permitted in the text of the treaty. See CRS Report R41219, *The New START Treaty: Central Limits and Key Provisions*, by Amy F. Woolf.

[4] U.S. Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America*, Washington, DC, January 2018, p. 2, https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.

[5] The White House, *Interim National Security Strategic Guidance*, Washington, DC, March 2021, p. 8, https://www.whitehouse.gov/wp-content/uploads/2021/03/NSC-1v2.pdf.

[6] Department of Defense, Nuclear Posture Review, Washington, DC, February 2, 2018, p. 6, https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINALREPORT.PDF.

[7] Ibid., p. 9.

and the future of the arms control process. Moreover, Members have raised questions about whether U.S. and Russian nuclear modernization programs, combined with the potential demise of restraints on U.S. and Russian nuclear forces, may be fueling an arms race and undermining strategic stability.

This report seeks to advise this debate by providing information about Russia's nuclear doctrine, its current nuclear force structure, and its ongoing nuclear modernization programs. It begins with a brief summary of recent developments related to Russia's nuclear forces, then is divided into five sections. The first section describes Russia's nuclear strategy and focuses on ways in which that strategy differs from that of the Soviet Union. The second section provides a historical overview of the Soviet Union's nuclear force structure. The third section details Russia's current force structure, including its long-range intercontinental ballistic missiles (ICBM), submarine-launched ballistic missiles (SLBM), and heavy bombers and shorter-range nonstrategic nuclear weapons. This section also highlights key elements of relevant infrastructure, including early warning, command and control, production, testing, and warhead storage. It also describes the key modernization programs that Russia is pursuing to maintain and, in some cases, expand its nuclear arsenal. The fourth section focuses on how arms control has affected the size and structure of Russia's nuclear forces. The fifth section discusses several potential issues for Congress.

Recent Developments

Strategic Force Exercises

On February 19, 2022, Russia conducted "a planned exercise of the strategic deterrence forces" under the "the leadership of the Supreme Commander of the Armed Forces of the Russian Federation Vladimir Putin."[8] Units from the Aerospace Forces, the Southern Military District, the Strategic Missile Forces, and the Northern and Black Sea Fleets all participated. According to General Gerasimov, the exercise was designed to practice "the strategic offensive forces operations to inflict guaranteed defeat on the enemy." It began with simulated warfighting with long-range conventional precision weapons, followed by the use of strategic offensive nuclear forces to retaliate in a prompt counter-strike after a nuclear attack on Russia.[9]

During the exercise, Russia conducted test launches of many of the weapons that are described in this report. They included the Zirkon and Kinzhal hypersonic missiles, the Yars (SS-24) mobile ICBM, a Sineva SLBM, and air-launched cruise missiles launched from Tu-95 bombers. The exercise also included tests of the Kalibr sea-launched cruise missile and the Iskander ground-launched cruise missile. While Russia normally conducts major strategic exercises later in the calendar year, some analysts have speculated that it held this version amid its buildup of forces around Ukraine as a reminder, and warning, of its nuclear capabilities.

Belarus

On February 27, voters in Belarus approved a constitutional amendment that essentially renounced the country's neutral and nonnuclear status. The Soviet Union had deployed SS-25 mobile ICBMs in Belarus during the 1980s, but following the collapse of the Soviet Union,

[8] Sergey Savostyanov, "Russia to conduct exercises of strategic deterrence forces under Putin's leadership," *TASS*, February 18, 2022, https://tass.ru/armiya-i-opk/13752607.

[9] https://twitter.com/KomissarWhipla/status/1495697475583287296.

Belarus returned these missiles to Russia and adopted the constitutional provisions supporting its nonnuclear status. The new amendment does not approve the immediate deployment of nuclear weapons, but it does allow the country to host Russian weapons at bases in Belarus. President Lukashenko has indicated that Belarus would be willing to do so if the country were "threatened by the West." Specifically, he noted that he could ask Russia to return nuclear weapons to Belarus if NATO transferred nuclear weapons to Poland or Lithuania, nations that share borders with Belarus.[10]

Raising the Alert Status of Nuclear Weapons

On February 27, during a meeting with his Defense Minister and the Chief of the General Staff, Russia's President Vladimir Putin declared that he was putting his nuclear forces into "special combat readiness," essentially raising their alert status, as he continued to press forward in his invasion of Ukraine.[11] While he did not specify how this step would change the status of his nuclear forces, he indicated that he was issuing this order in response to the escalating economic sanctions and "aggressive statements" from the United States and its NATO partners.[12] This announcement followed President Putin's statement, made during his speech announcing the start of the incursion into Ukraine, that "no matter who tries to stand in our way or all the more so create threats for our country and our people, they must know that Russia will respond immediately, and the consequences will be such as you have never seen in your entire history.... All the necessary decisions in this regard have been taken. I hope that my words will be heard."

Some analysts have speculated that the changes this announcement might make to Russia's nuclear force posture could affect only the command and control system, allowing more rapid communications if Russia sought to raise the alert level further or to prepare the weapons for use. Others outlined a number of steps that might be visible if Russia sought to move the weapons to a posture that was more ready for use, including sending submarines to sea and loading cruise missiles on bombers.[13] Regardless, on February 28, the Pentagon indicated that it had not seen any changes in Russia's nuclear forces as a result of the increase in their alert level.[14]

While most analysts heard, at least, an implicit nuclear threat in President Putin's statements, few argued that the change in the alert status represented an explicit threat to employ nuclear weapons in attacks against Ukraine. Instead, most argued that President Putin was seeking to bully or coerce the United States and NATO so that they would limit their support for Ukraine and cease their interventions in the conflict. The United States and NATO have made clear that they do not intend to intervene in the conflict with the military force, and U.S. officials indicated that the United States would not alter its nuclear alert status in response to Russia's actions. Nevertheless,

[10] Matthias Williams and David Ljunggren, "Belarus referendum approves proposal to renounce non-nuclear status," *Reuters*, February 27, 2022.

[11] David E. Sanger and William J. Broad, "Putin Declares a Nuclear Alert, and Biden Seeks De-escalation," *New York Times*, February 27, 2022, https://www.nytimes.com/2022/02/27/us/politics/putin-nuclear-alert-biden-deescalation.html.

[12] Missy Ryan, Karoun Demirjian, John Hudson, and Shane Harris, "With Russian nuclear forces on alert, Ukraine crisis enters more dangerous phase," *Washington Post*, February 27, 2022, https://www.washingtonpost.com/national-security/2022/02/27/ukraine-russia-nuclear-alert/.

[13] James Cameron, "Here's what 'high combat alert' for Russia's nuclear forces means," *Washington Post*, February 28, 2022, https://www.washingtonpost.com/politics/2022/02/28/heres-what-high-combat-alert-russias-nuclear-forces-means/.

[14] Valerie Insinna, "No 'noticeable' changes to Russian nuclear posture: US official," *Defense News*, February 28, 2022, https://breakingdefense.com/2022/02/no-noticeable-changes-to-russian-nuclear-posture-us-official/.

Administration officials and analysts outside government have all cautioned that nuclear signaling, whether verbal or through changes in alert status, could raise the risk of miscalculation and inadvertent escalation.[15]

Strategy and Doctrine

Soviet Doctrine

The Soviet Union valued nuclear weapons for both their political and military attributes. From a political perspective, nuclear weapons served as a measure of Soviet status, while nuclear parity with the United States offered the Soviet Union prestige and influence in international affairs. From a military perspective, the Soviet Union considered nuclear weapons to be instrumental to its plans for fighting and prevailing in a conventional war that escalated to a nuclear one. As a leading Russian analyst has written, "for the first quarter-century of the nuclear age, the fundamental assumption of Soviet military doctrine was that, if a global war was unleashed by the 'imperialist West,' the Soviet Union would defeat the enemy and achieve victory, despite the enormous ensuing damage."[16]

Soviet views on nuclear weapons gradually evolved as the United States and the Soviet Union engaged in arms control talks in the wake of the 1962 Cuban Missile Crisis, and as the Soviet Union achieved parity with the United States. During the 1960s, both countries recognized the reality of the concept of "Mutually Assured Destruction" (MAD)—a situation in which both sides had nuclear retaliatory capabilities that prevented either side from prevailing in an all-out nuclear war. Analysts argue that the reality that neither side could initiate a nuclear war without facing the certainty of a devastating retaliatory attack from the other was codified in the agreements negotiated during the Strategic Arms Limitation Talks (SALT). With the signing of the 1972 Anti-Ballistic Missile (ABM) Treaty, both sides accepted limits on their ability to protect themselves from a retaliatory nuclear attack, thus presumably reducing incentives for either side to engage in a nuclear first strike.

The Soviet Union offered rhetorical support to the nonuse of nuclear weapons throughout the 1960s and 1970s. At the time, this approach placed the Soviet Union on the moral high ground with nonaligned nations during the negotiations on the Nuclear Nonproliferation Treaty. The United States and its NATO allies refused to adopt a similar pledge, maintaining a "flexible response" policy that allowed for the possible use of nuclear weapons in response to a massive conventional attack by the Soviet Union and its Warsaw Pact allies. At the same time, however, most U.S. analysts doubted that Soviet support for the nonuse of nuclear weapons actually influenced Soviet warfighting plans, even though Soviet-Warsaw Pact advantages in conventional forces along the Central European front meant that the Soviet Union would not necessarily need to use nuclear weapons first.

U.S. and NATO skepticism about a Soviet nonuse policy reflected concerns about the Soviet military buildup of a vast arsenal of battlefield and shorter-range nuclear delivery systems. These systems could have been employed on a European battlefield in the event of a conflict with the United States and NATO. On the other hand, interviews with Soviet military officials have

[15] Caitlin Talmadge, "The Ukraine crisis is now a nuclear crisis," *Washinton Post*, February 27, 2022, https://www.washingtonpost.com/politics/2022/02/27/ukraine-crisis-is-now-nuclear-crisis/.

[16] Alexey Arbatov, "Understanding the US-Russia Nuclear Schism," Survival, 59/2, March 2017, https://www.tandfonline.com/doi/pdf/10.1080/00396338.2017.1302189?needAccess=true.

suggested that this theater nuclear buildup was intended to "reduce the probability of NATO's first use [of nuclear weapons] and thereby to keep the war conventional."[17]

In addition, many U.S. commentators feared that the Soviet Union might launch a "bolt from the blue" attack against U.S. territory even in the absence of escalation from a conflict in Europe. Other military analysts suspect that the Soviet Union would not have initiated such an attack and likely did not have the capability to conduct an disarming attack against U.S. nuclear forces—a capability that would have been needed to restrain the effectiveness of a U.S. retaliatory strike.[18] Instead, the Soviet Union might have launched its weapons on warning of an imminent attack, which has sometimes been translated as a *retaliatory reciprocal counter strike*, or in a *retaliatory strike* after initial nuclear detonations on Soviet soil. Many believe that, in practice, the Soviet Union planned only for these latter retaliatory strikes.[19]

Regardless, some scholars argue that the Soviet leadership likely retained the option of launching a first strike against the United States. Improvements to the accuracy of U.S. ballistic missiles raised concerns in the Soviet Union about the ability of retaliatory forces to survive a U.S. attack. For Soviet leaders, the increasing vulnerability of Soviet missile silos called into question the stability of mutual deterrence and possibly raised questions about the Soviet Union's international standing and bargaining position in arms control negotiations with the United States.[20]

In 1982, General Secretary Leonid Brezhnev officially announced that the Soviet Union would not be the first nation to use nuclear weapons in a conflict. When General Secretary Brezhnev formally enunciated the Soviet no-first-use policy in the 1980s, actual Soviet military doctrine may have become more consistent with this declaratory doctrine, as the Soviet military hoped to keep a conflict in the European theater conventional. In addition, by the end of the decade, and especially in the aftermath of the accident at the Chernobyl Nuclear Power Plant, Soviet leader Mikhail Gorbachev believed that the use of nuclear weapons would lead to catastrophic consequences.[21]

Russian Nuclear Doctrine

Evolving Doctrine

Russia has altered and adjusted Soviet nuclear doctrine to meet the circumstances of the post-Cold War world. In 1993, Russia explicitly rejected the Soviet Union's no-first-use pledge, in part because of the weakness of its conventional forces at the time. Russia has subsequently revised its military doctrine and national security concept several times over the past few decades, with successive versions in the 1990s appearing to place a greater reliance on nuclear weapons.[22] For

[17] See BDM Federal, Inc., "Soviet Intentions 1965-1985," p. 44, https://nsarchive2.gwu.edu/nukevault/ebb285/doc02_I_ch3.pdf.

[18] Pavel Podvig, "The Window of Vulnerability That Wasn't: Soviet Military Buildup in the 1970s—A Research Note," *International Security*, vol. 33, no. 1 (summer 2008), pp. 118-138.

[19] Pavel Podvig, "Does Russia have a Launch-on-Warning Posture? The Soviet Union Didn't," Russian Strategic Nuclear Forces, April 29, 2019, http://russianforces.org/blog/2019/04/does_russia_have_a_launch-on-w.shtml.

[20] Brendan R. Green and Austin Long, "The MAD Who Wasn't There: Soviet Reactions to the Late Cold War Nuclear Balance," *Security Studies*, 26/2017, https://www.tandfonline.com/doi/full/10.1080/09636412.2017.1331639.

[21] See, for example, William Taubman, *Gorbachev: His Life and Times* (W.W. Norton and Company, 2017).

[22] See "Comparison of the Russian Military Doctrine 1993, 2000, 2010, and 2014," Offiziere.ch, undated, https://www.offiziere.ch/wp-content/uploads-001/2015/08/Comparison-of-the-Russian-Military-Doctrine-1993-2000-2010-and-2014.pdf.

example, the national security concept issued in 1997 allowed for the use of nuclear weapons "in case of a threat to the existence of the Russian Federation as an independent sovereign state."[23] The military doctrine published in 2000 expanded the circumstances in which Russia might use nuclear weapons, including in response to attacks using weapons of mass destruction against Russia or its allies, as well as in response to "large-scale aggression utilizing conventional weapons in situations critical to the national security of the Russian Federation."[24]

These revisions have led to questions about whether Russia would employ nuclear weapons preemptively in a regional war or only in response to the use of nuclear weapons in a broader conflict. In mid-2009, Nikolai Patrushev, the head of Russia's Security Council, hinted that Russia would have the option to launch a "preemptive nuclear strike" against an aggressor "using conventional weapons in an all-out, regional, or even local war."[25]

However, when Russia updated its military doctrine in 2010, it did not specifically provide for the preemptive use of nuclear weapons. Instead, the doctrine stated that Russia "reserves the right to utilize nuclear weapons in response to the utilization of nuclear and other types of weapons of mass destruction against it and (or) its allies, and also in the event of aggression against the Russian Federation involving the use of conventional weapons when the very existence of the state is under threat."[26] Compared with the 2000 version, which allowed for nuclear use "in situations critical to the national security of the Russian Federation," this change seemed to narrow the conditions for nuclear weapons use.[27] The language on nuclear weapons in Russia's most current 2014 military doctrine is similar to that in the 2010 doctrine.

In Early June 2020, Russia released a new document, titled "On Basic Principles of State Policy of the Russian Federation on Nuclear Deterrence," that outlined the threats and circumstances that could lead to Russia's use of nuclear weapons.[28] This document specifically notes that Russia "considers nuclear weapons exclusively as a means of deterrence." It states that Russia's nuclear deterrence policy "is defensive by nature, it is aimed at maintaining the nuclear forces potential at the level sufficient for nuclear deterrence, and guarantees protection of national sovereignty and territorial integrity of the State, and deterrence of a potential adversary from aggression against the Russian Federation and/or its allies." It emphasizes that Russia maintains forces that could "inflict guaranteed unacceptable damage on a potential adversary … in any circumstances"[29]

The document lists a number of threats that Russia might face and circumstances under which it might consider the use of nuclear weapons. It indicates that Russia could respond with nuclear weapons when it has received "reliable data on a launch of ballistic missiles attacking the territory of the Russian Federation and/or its allies" and in response to the "use of nuclear weapons or other types of weapons of mass destruction by an adversary against the Russian

[23] Ibid.

[24] Nikolai Sokov, "Russia's 2000 Military Doctrine," Nuclear Threat Initiative, undated, https://www.nti.org/analysis/articles/russias-2000-military-doctrine/.

[25] David Nowak, "Report: Russia to allow Pre-emptive Nukes," Associated Press, October 14, 2009.

[26] See text of the 2010 Russian Military Doctrine, February 5, 2010, at https://carnegieendowment.org/files/2010russia_military_doctrine.pdf.

[27] Nikolai Sokov, "The New, 2010 Russian Military Doctrine: The Nuclear Angle," Center for Nonproliferation Studies, CNS Feature Story, Monterey, CA, February 5, 2010, https://www.nonproliferation.org/new-2010-russian-military-doctrine/.

[28] Ministry of Foreign Affairs of the Russian Federation, *On Basic Principles of State Policy of the Russian Federation*, Moscow, June 2, 2020, https://www.mid.ru/en/web/guest/foreign_policy/international_safety/disarmament/-/asset_publisher/rp0fiUBmANaH/content/id/4152094.

[29] Ibid. Paras 4, 5 and 10.

Federation and/or its allies." It could also respond with nuclear weapons following an "attack by adversary against critical governmental or military sites of the Russian Federation, disruption of which would undermine nuclear forces response actions" and "aggression against the Russian Federation with the use of conventional weapons when the very existence of the state is in jeopardy."[30]

As with previous official statements, this document does not call for the preemptive use of nuclear weapons during conventional conflicts. But it does not completely resolve the question of whether Russia would escalate to nuclear use if it were losing a conventional war. It notes that, "in the event of a military conflict, this Policy provides for the prevention of an escalation of military actions and their termination on conditions that are acceptable for the Russian Federation and/or its allies." Analysts have assessed that this means Russia might *threaten* to escalate to nuclear use as a way to deter a conflict that would threaten the existence of the state.[31]

Security Concerns

Analysts have identified several factors that contributed to Russia's increasing reliance on nuclear weapons during the 1990s. First, with the demise of the Soviet Union and Russia's subsequent economic collapse, Russia no longer had the means to support large and effective conventional forces. Conflicts in the Russian region of Chechnya and, in 2008, neighboring Georgia also highlighted seeming weaknesses in Russia's conventional military forces. In addition, Russian analysts saw emerging threats in other neighboring post-Soviet states; many analysts believed that by even implicitly threatening that it might resort to nuclear weapons, Russia hoped it could enhance its ability to deter the start of, or NATO interference in, such regional conflicts.

Russia's sense of vulnerability, and its view that its security was increasingly threatened, also stemmed from NATO enlargement.[32] Russia has long feared that an expanding alliance would create a new challenge to Russia's security, particularly if NATO were to move nuclear weapons closer to Russia's borders. These concerns contributed to the statement in the 1997 doctrine that Russia might use nuclear weapons if its national survival was threatened.[33]

For many in Russia, NATO's air campaign in Kosovo in 1999 underlined Russia's growing weakness and NATO's increasing willingness to threaten Russian interests.[34] Russia's 2000 National Security Concept noted that the level and scope of the military threat to Russia was growing. It cited, specifically, "the desire of some states and international associations to diminish the role of existing mechanisms for ensuring international security." It also noted that "a vital task of the Russian Federation is to exercise deterrence to prevent aggression on any scale, nuclear or otherwise, against Russia and its allies." Consequently, it concluded, Russia "must have nuclear

[30] Ibid. Para 19.

[31] Nikolai Sokov, *Russia Clarifies Its Nuclear Deterrence Policy*, Vienna Center for Disarmament and Non-Proliferation, Vienna, Austria, June 3, 2020, https://vcdnp.org/russia-clarifies-its-nuclear-deterrence-policy/.

[32] In 1995, NATO completed a Study on NATO Enlargement that concluded that "the end of the Cold War provided a unique opportunity to build improved security in the entire Euro-Atlantic area and that NATO enlargement would contribute to enhanced stability and security for all." Its membership has since expanded from 16 to 29 nations, adding many nations that were a part of the Soviet Union and Warsaw Pact prior to 1991. For information, see North Atlantic Treaty Organization, *Member Countries*, https://www.nato.int/cps/en/natohq/topics_52044.htm.

[33] For information on the evolution of Russia's external threat perception and its views on nuclear weapons, see Stephen Blank, editor, *Russian Nuclear Weapons: Past, Present, Future* (U.S. Army War College, 2011).

[34] Alexei Arbatov, "The Transformation of Russian Military Doctrine: Lessons Learned from Kosovo and Chechnya," The Marshall Center Papers, No. 2, 2000, https://apps.dtic.mil/dtic/tr/fulltext/u2/a478927.pdf.

forces capable of delivering specified damage to any aggressor state or a coalition of states in any situation."[35]

The potential threat from NATO remained a concern for Russia in its 2010 and 2014 military doctrines.[36] The 2010 doctrine stated that the main external military dangers to Russia were "the desire to endow the force potential of the North Atlantic Treaty Organization (NATO) with global functions carried out in violation of the norms of international law and to move the military infrastructure of NATO member countries closer to the borders of the Russian Federation, including by expanding the bloc." It also noted that Russia was threatened by "the deployment of troop contingents of foreign states (groups of states) on the territories of states contiguous with the Russian Federation and its allies and also in adjacent waters" (a reference to the fact that NATO now included states that had been part of the Warsaw Pact). Russian concerns also extended to U.S. missile defense deployed on land in Poland and Romania and at sea near Russian territory as a part of the European Phased Adaptive Approach (EPAA).

Russia's possession of a large arsenal of nonstrategic nuclear weapons and dual-capable systems, combined with recent statements designed to remind others of the strength of Russia's nuclear deterrent, have led some to argue that Russia has increased the role of nuclear weapons in its military strategy and military planning.[37] Before Russia's invasion of Ukraine in 2014, some analysts argued that Russia's nonstrategic nuclear weapons had "no defined mission and no deterrence framework [had] been elaborated for them."[38] However, subsequent Russian statements, coupled with military exercises that appeared to simulate the use of nuclear weapons against NATO members, have led many to believe that Russia might threaten to use its shorter-range, nonstrategic nuclear weapons to coerce or intimidate its neighbors. Such a nuclear threat could occur before or during a conflict if Russia believed that a threat to use nuclear weapons could lead its adversaries, including the United States and its allies, to back down.[39]

Consequently, several analysts have argued that Russia has adopted an "escalate to de-escalate" nuclear doctrine. They contend that when faced with the likelihood of defeat in a military conflict with NATO, Russia might threaten to use nuclear weapons in an effort to coerce NATO members to withdraw from the battlefield.[40] Officials in the Trump Administration advanced this view, and it informed decisions made during the 2018 Nuclear Posture Review. However, Russia does not

[35] "2000 Russian National Security Concept"; see text at https://fas.org/nuke/guide/russia/doctrine/gazeta012400.htm.

[36] See text of the 2010 Russian Military Doctrine, February 5, 2010, at https://carnegieendowment.org/files/2010russia_military_doctrine.pdf. See, also, Dmitri Trenin, "2014: Russia's New Military Doctrine Tells All," Carnegie Moscow Center, Moscow, December 29, 2014, https://carnegie.ru/commentary/57607.

[37] Robin Emmott, "Risk of Nuclear War in Europe Growing, warns Russian Ex-Minister," Reuters, March 21, 2016. See, also, Yasmin Tadjdeh, "State Dept. Official: Russian Nuclear Disarmament Must Continue," National Defense, March 23, 2016.

[38] Dmitry Adamsky, "Nuclear Incoherence: Deterrence Theory and Non-Strategic Nuclear Weapons in Russia," *Journal of Strategic Studies*, 37/2014, pp. 91-134, https://www.tandfonline.com/doi/full/10.1080/01402390.2013.798583.

[39] For a detailed description of Russia's strategy, see Nikolai N. Sokov, "Why Russia calls a limited nuclear strike 'deescalation,'" *Bulletin of the Atomic Scientists*, March 2014, http://thebulletin.org/why-russia-calls-limited-nuclearstrike-de-escalation.

[40] John R. Harvey, Franklin C. Miller, Keith B. Payne, and Bradley H. Roberts, "Continuity and Change in U.S. Nuclear Policy," RealClear Defense, February 7, 2018, https://www.realcleardefense.com/articles/2018/02/07/continuity_and_change_in_us_nuclear_policy_113025.html.

use the phrase "escalate to de-escalate" in any versions of its military doctrine, and debate exists about whether this is an accurate characterization of Russian thinking about nuclear weapons.[41]

Conflicting statements from Russia have contributed to disagreements among U.S. analysts over the circumstances under which Russia would use nuclear weapons. During a March 2018 speech to the Federal Assembly, President Putin seemed to affirm the broad role for nuclear weapons that Russia's military doctrine assigns:

> I should note that our military doctrine says Russia reserves the right to use nuclear weapons solely in response to a nuclear attack, or an attack with other weapons of mass destruction against the country or its allies, or an act of aggression against us with the use of conventional weapons that threaten the very existence of the state. This all is very clear and specific. As such, I see it is my duty to announce the following. Any use of nuclear weapons against Russia or its allies, weapons of short, medium or any range at all, will be considered as a nuclear attack on this country. Retaliation will be immediate, with all the attendant consequences. There should be no doubt about this whatsoever.[42]

This statement is consistent with the conditions outlined in the 2020 document on The Basic Principles of State Policy of the Russian Federation on Nuclear Deterrence.

Putin and other Russian officials have extensively used what some Western analysts have described as "nuclear messaging" in the wake of Russia's annexation of Crimea and instigation of conflict in eastern Ukraine. Their references to Russia's nuclear capabilities have seemed like an effort to signal that Russia's stakes are higher than those of the West and that Russia is willing to go to great lengths to protect its interests.[43]

At times, however, President Putin has offered a more restrained view of the role of nuclear weapons. In 2016, Putin stated that "brandishing nuclear weapons is the last thing to do. This is harmful rhetoric, and I do not welcome it." He also dismissed suggestions that Russia would consider using nuclear weapons offensively, stating that "nuclear weapons are a deterrent and a factor of ensuring peace and security worldwide. They should not be considered as a factor in any potential aggression, because it is impossible, and it would probably mean the end of our civilization."[44]

In October 2018, President Putin made a statement that some analysts interpreted as potentially moving toward a "sole purpose" doctrine, by which Russia would use nuclear weapons only in response to others' use of nuclear weapons.[45] Putin declared

> There is no provision for a preventive strike in our nuclear weapons doctrine. Our concept is based on a retaliatory reciprocal counter strike. This means that we are prepared and will use nuclear weapons only when we know for certain that some potential aggressor is attacking Russia, our territory [with nuclear weapons]…. Only when we know for certain—and this takes a few seconds to understand—that Russia is being attacked will we deliver a counterstrike…. Of course, this amounts to a global catastrophe, but I would like

[41] This debate is addressed in more detail below.

[42] "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018, http://en.kremlin.ru/events/president/news/56957.

[43] Jacek Durkalec, "Nuclear-Backed 'Little Green Men:' Nuclear Messaging in the Ukraine Crisis," July 14, 2015, https://www.pism.pl/files/?id_plik=20165.

[44] "Meeting of the Valdai International Discussion Club," President of Russia, October 27, 2016, http://en.kremlin.ru/events/president/news/53151.

[45] Michael Krepon, "Weapons of Last Resort," Arms Control Wonk, October 29, 2018, https://www.armscontrolwonk.com/archive/1206119/weapons-of-last-resort/.

> to repeat that we cannot be the initiators of such a catastrophe because we have no provision for a preventive strike.[46]

However, as noted above, the 2020 document on Basic Principles … on Nuclear Deterrence contains a broader range of circumstances, including attacks on nuclear command and control and attacks with other weapons of mass destruction that might result in a Russian nuclear response.

Soviet Nuclear Forces

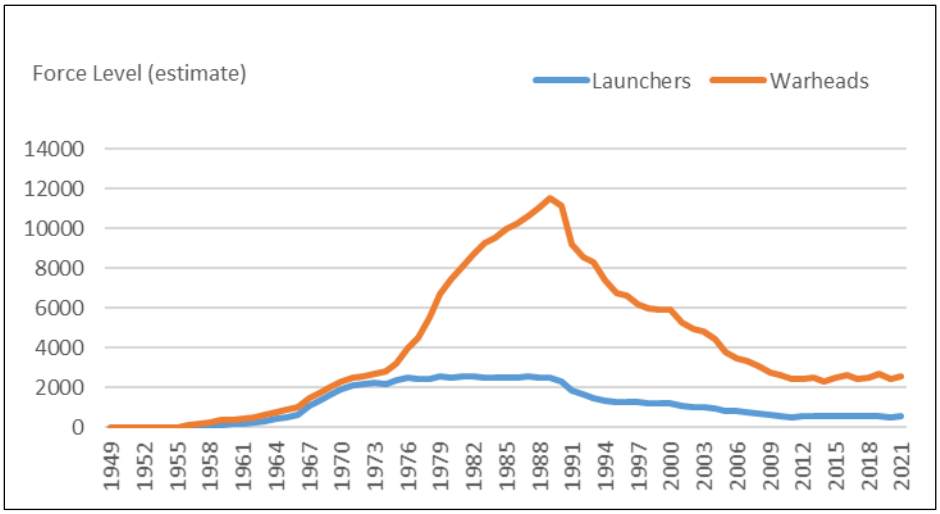
The Soviet Union conducted its first explosive test of a nuclear device on August 29, 1949, four years after the United States employed nuclear weapons against Japan at the end of World War II. After this test, the Soviet Union initiated the serial production of nuclear devices and work on thermonuclear weapons, and it began to explore delivery methods for its nascent nuclear arsenal. The Soviet Union tested its first version of a thermonuclear bomb in 1953, two years after the United States crossed that threshold. The Soviet stockpile of nuclear warheads grew rapidly through the 1960s and 1970s, peaking at more than 40,000 warheads in 1986, according to unclassified estimates (see **Figure 1**). Within this total, around 10,700 warheads were carried by long-range delivery systems, the strategic forces that could reach targets in the United States in the mid-1980s.

By the 1960s, the Soviet Union, like the United States, had developed a triad of nuclear forces: land-based intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and heavy bombers equipped with nuclear weapons.[47] In 1951, the Soviet Union conducted its first air drop test of a nuclear bomb and began to deploy nuclear weapons with its Long-Range Aviation forces soon thereafter. Bomber aircraft included the M-4 Bison, which barely had the range needed to attack the United States and then return home. The Tu-95 Bear strategic bomber, which had a longer range, entered service in 1956. Later modifications of the Bear bomber have since been the mainstay of the Soviet/Russian nuclear triad's air leg.

[46] Transcript of the meeting of the Valdai International Discussion Club, October 18, 2018, http://kremlin.ru/events/president/news/58848.

[47] Unless explicitly cited, this section draws on Pavel Podvig, ed., *Russian Strategic Nuclear Forces* (MIT Press, 2001) and Steven J. Zaloga, *The Kremlin's Nuclear Sword: The Rise and Fall of Russia's Strategic Nuclear Forces, 1945-2002* (Smithsonian Institution Press, 2002).

Figure 1. Estimates of Soviet/Russian Strategic Forces



Source: Natural Resources Defense Council, Archive of Nuclear Data and *Bulletin of the Atomic Scientists*, Nuclear Notebook.

In 1956, the Soviet Union tested and deployed its first ballistic missile with a nuclear warhead, the SS-3, a shorter-range, or theater, missile. It tested and deployed the SS-4, a theater ballistic missile that would be at the heart of the 1962 Cuban Missile Crisis, by 1959. Soviet missile ranges were further extended with the deployment of an intermediate-range ballistic missile, the SS-5. The 1957 launch of the Sputnik satellite on a modified SS-6 long-range missile heralded the Soviet Union's development of ICBMs. By the end of the decade, the Soviet Union had launched an SS-N-1 SLBM from a Zulu-class attack submarine of the Soviet Navy. The undersea leg of the triad would steadily progress over the following decade with the deployment of SLBMs on the Golf class attack submarine and then the Hotel and Yankee class nuclear-powered submarines.

Manned since 1959 by a separate military service called the Strategic Rocket Forces, the ICBM leg came to dominate the Soviet nuclear triad. During the 1960s, the Soviet Union rapidly augmented its force of fixed land-based ICBMs, expanding from around 10 launchers and two types of missiles in 1961 to just over 1,500 launchers with eight different types of missiles in 1971.[48] Because these missiles were initially based on soft launch pads or in vertical silos that could not withstand an attack from U.S. nuclear warheads, many concluded that the Soviet Union likely planned to use them in a first strike attack against U.S. missile forces and U.S. territory.

Moreover, the United States believed that the design of Soviet ICBMs provided the Soviet Union with the ability to contemplate, and possibly execute, a successful disarming first strike against U.S. land-based forces. Half of the ICBM missile types were different variants of the largest missile, the SS-9 ICBM. The United States referred to this as a "heavy" ICBM due to its significant throwweight, which allowed it to carry a higher-yield warhead, estimated at around 20 megatons.[49] The United States believed, possibly inaccurately,[50] that the missile's combination of

[48] The United States expanded its force from about 12 launchers in 1960 to a peak of 1,054 launchers at the end of the decade.

[49] See the table in Pavel Podvig, "The Window of Vulnerability That Wasn't: Soviet Military Buildup in the 1970s." Throwweight is a measure of the lifting power, or maximum payload, that a ballistic missile could deliver to a target. Missiles with greater throwweight could carry and deliver larger warheads and a larger number of warheads against an adversary.

[50] Pavel Podvig, "The Window of Vulnerability That Wasn't: Soviet Military Buildup in the 1970s—A Research Note," International Security, vol. 33, no. 1 (summer 2008), pp. 118-138.

improved accuracy and high yield posed a unique threat to U.S. land-based missiles. Concerns about Soviet heavy ICBMs persisted throughout the Cold War, affecting both U.S. force structure decisions and U.S. proposals for arms control negotiations.

Although smaller and less capable than its land-based forces, the sea-based leg of the Soviet triad was built up during the 1960s, with the deployment of SLBMs on Golf-, Hotel-, and Yankee-class submarines. These submarines carried intermediate-range (rather than intercontinental-range) missiles, but their mobility allowed the Soviet Union to threaten targets throughout Europe and, to a lesser extent, in the United States. The Soviet Union began the decade with 30 missile launchers on 10 submarines and ended it with 228 launchers on 31 submarines.[51]

By the end of the 1960s, the United States and the Soviet Union had initiated negotiations to limit the numbers of launchers for long-range missiles.[52] The emerging parity in numbers of deployed nuclear-armed missiles, coupled with several nuclear crises, had paved the way for a recognition of their mutual deterrence relationship and arms control talks.[53] As noted below, the Interim Agreement on Offensive Arms—negotiated as part of the Strategic Arms Limitation Talks (SALT I) and signed in 1972—capped the construction and size of ICBM silo launchers (in an effort to limit the number of heavy ICBMs in the Soviet force) and limited the number of launchers for SLBMs. It did not, however, limit the nuclear warheads that could be carried by ICBMs or SLBMs.

The Offense/Defense Relationship Part I

Analysts have recognized the connection between offensive nuclear weapons and ballistic missile defenses since the 1960s. While missile defenses might have been able protect critical assets and, possibly, cities from missile attack, some believed they also could spur an arms race in offensive missiles. According to this view, both the United States and Soviet Union would be better able to launch a successful attack if they had enough offensive missiles to saturate a fixed number of defensive interceptors. And neither would be willing to limit the size of its offensive forces if the other could deploy an unlimited number of defensive interceptors. The 1972 SALT agreements sought to address this concern. The Interim Agreement on Offensive Arms limited the number of land-based and submarine-based missile launchers, while the Anti-ballistic Missile (ABM) Treaty limited the number of missile defense sites and missile defense interceptors in each country. Together, the two agreements sought to ensure that each side had the ability to launch a successful second strike, thereby discouraging either from launching a first strike. While many believed that this balance was necessary to maintain stability and security in the nuclear age, others argued that U.S. security would be better served by developing and deploying extensive defensive systems that could protect the United States and its allies from missile attack. The debate over these two perspectives persisted throughout the Cold War and continues today.

As a result, the Soviet Union continued to modernize and expand its nuclear forces in the 1970s. During this time, the Soviet Union

- commissioned numerous Delta-class strategic missile submarines, armed with the single-warhead, intercontinental-range SS-N-8 SLBM;
- developed the Tu-22M Backfire intermediate-range bomber aircraft;

[51] The Soviet ballistic missile submarine force continued to grow during the 1970s, peaking at 993 launchers on 86 submarines in 1979. The United States deployed 41 ballistic missile submarines by 1969; these carried 656 launchers.

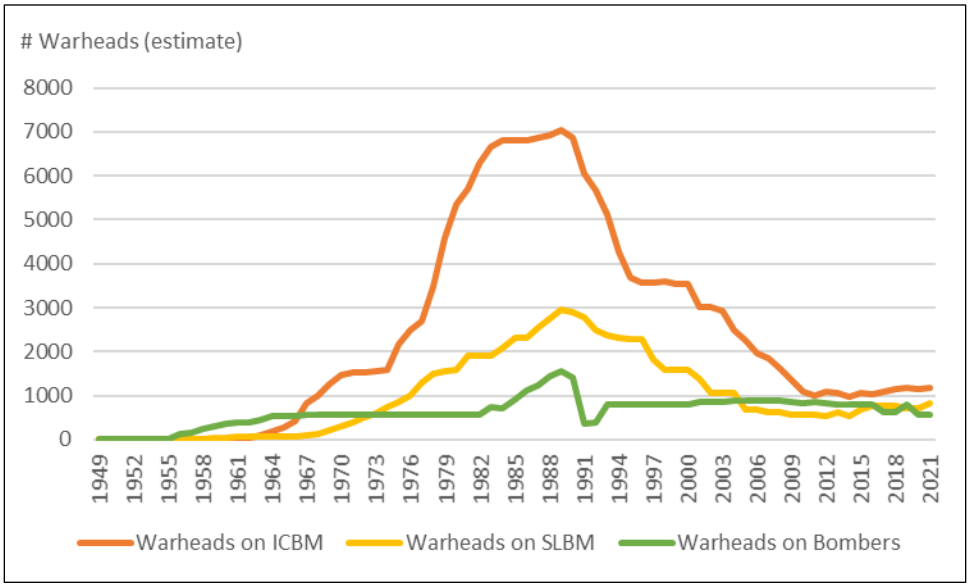
[52] A more detailed discussion of the role that arms control has played in shaping and reducing Soviet and Russian nuclear forces appears on page 25, below.

[53] Russian analysts argue that the 1962 Cuban Missile Crisis, which did not result in a nuclear attack on the Soviet Union, despite U.S. nuclear superiority, signaled the beginning of the mutual deterrence relationship. A.A. Kokoshin, V.A. Veselov, A. V. Liss, *Sderzhivaniye vo vtorom yadernom veke* [Deterrence in the second nuclear century] (Russian Academy of Sciences, 2001), pp. 9-17.

- began to develop a new supersonic strategic heavy bomber (eventually the Tu-160 Blackjack); and
- began to deploy the SS-20 intermediate-range ballistic missile in 1976, which, along with other missiles of its class, would be eliminated under the 1987 INF Treaty.

The Soviet Union also pursued an extensive expansion of its land-based ICBM force. It not only developed a number of new types of ICBMs, but, in 1974, it began to deploy these missiles with multiple warheads (known as MIRVs, or multiple independent reentry vehicles).[54] During this time frame the Soviet Union developed, tested, and deployed the 4-warhead SS-17 ICBM, 10-warhead SS-18 ICBM (a new heavy ICBM that replaced the SS-9), and 6-warhead SS-19 ICBM. Because each of these missiles could carry multiple warheads, the SALT I limit on ICBM launchers did not constrain the number of warheads on the Soviet missile force. Moreover, the ICBM force began to dominate the Soviet triad during this time (see **Figure 2**).

Figure 2. Estimates of Warheads on Soviet/Russian Strategic Nuclear Forces



Source: Natural Resources Defense Council, Archive of Nuclear Data and *Bulletin of the Atomic Scientists*, Nuclear Notebook.

U.S. analysts and officials expressed particular concern about the heavy SS-18 ICBM and its subsequent modifications. The Soviet Union deployed 308 of these missiles, each with the ability to carry up to 10 warheads and numerous decoys and penetration aides designed to confuse missile defense radars. These concerns contributed to a debate in the U.S. defense community about a "window of vulnerability" in the U.S.-Soviet nuclear balance due to a Soviet advantage in cumulative ballistic missile throwweight. Some asserted that the Soviets' throwweight advantage could translate into an edge in the number of warheads deployed on land-based missiles. They postulated that the Soviet Union could attack all U.S. land-based missiles with just a portion of the Soviet land-based force, leaving it with enough warheads after an initial nuclear attack to dominate and possibly coerce the United States into surrendering without any retaliation. Others

[54] During this time, the United States also deployed multiple warheads on its ICBMs and SLBMs, leading to a rapid increase in the number of deployed warheads on each nation's strategic forces.

disputed this theory, noting that the United States maintained a majority of its nuclear warheads on sea-based systems that could survive a Soviet first strike and that the synergy of U.S. land-based, sea-based, and air-delivered weapons would complicate, and therefore deter, a Soviet first strike.[55]

Recent research examining the records of Soviet planners and officials suggests that Soviet missile developments during the 1970s did not seek to achieve, and did not have the capabilities needed for, a first-strike advantage or a warfighting posture. Instead, the Soviet Union began to harden its missile silos so they could survive attack and to develop an early warning system, thus moving toward a second-strike capability.[56]

Moreover, the 1980s saw Soviet planners worrying about maintaining their second-strike capability in light of U.S. strategic offense and missile defense programs.[57] The United States was modernizing its land-based ICBMs, ballistic missile submarines and SLBMs, and heavy bombers. Each of the new U.S. missiles would carry multiple warheads, and the Soviets believed all would have the accuracy to target and destroy Soviet land-based missiles. In March 1983, President Reagan announced the Strategic Defense Initiative, a missile defense program that he pledged would make ballistic missiles "impotent and obsolete."[58] The SS-18 ICBM, with its capacity to carry 10 warheads and penetration aids, provided a counter to these U.S. capabilities.

The Offense/Defense Relationship Part II

Although the United States long insisted that its nuclear forces served as a deterrent by providing the United States with the ability to retaliate *after* a Soviet first strike, the Soviet Union believed the United States was pursuing a first-strike capability during the 1980s. Specifically, the combination of new U.S. offensive and defensive capabilities raised concerns about a situation known as the "ragged second strike" problem. In this concept, a U.S. first strike against Soviet missiles would deplete the Soviet force. U.S. missile defenses, even if they were too limited to intercept the full arsenal of Soviet land-based missiles, might then "mop up" the remaining, retaliating warheads. If, during an extreme crisis, the Soviet Union believed it was about to fall victim to this attack, it might choose to strike first, while it still had enough missiles and warheads to penetrate the U.S. defenses. This pressure to launch first in a crisis, which experts refer to as *crisis instability*, led to proposals to limit the numbers and capabilities of ballistic missile defenses and to reduce the numbers of warheads on vulnerable land-based missiles, which would make them less lucrative as targets in a first strike. This proposal was captured by the 1993 START II Treaty (described below).

Although SDI never produced an expansive missile defense system, the United States withdrew from the ABM Treaty in 2002. Consequently, Russia still sees U.S. missile defense programs as a threat to its retaliatory capability, and it continues to seek technologies and weapons systems that will provide it with the ability to retaliate after a U.S. first strike and in the face of expansive U.S. missile defenses.

[55] Leslie H. Gelb, "Vulnerability Assumes the Soviets Will Strike First," *New York Times*, October 4, 1981, https://www.nytimes.com/1981/10/04/weekinreview/vulnerability-assumes-the-soviets-will-strike-first.html. See, also, Michael R. Gordon, "The Summit: Reagan's Missile-Cut Offer Throws Open 'Window of Vulnerability' Debate," December 7, 1987. For a detailed review of this theory, see *The Report of the President's Commission on Strategic Forces* (The Scowcroft Commission Report), April 1983, http://web.mit.edu/chemistry/deutch/policy/1983-ReportPresCommStrategic.pdf.

[56] Pavel Podvig, "The Window of Vulnerability That Wasn't: Soviet Military Buildup in the 1970s-A Research Note," *International Security*, Summer 2008, https://www.mitpressjournals.org/doi/pdf/10.1162/isec.2008.33.1.118.

[57] Brendan R. Green and Austin Long, "The MAD Who Wasn't There: Soviet Reactions to the Late Cold War Nuclear Balance," *Security Studies*, 26/2017, https://www.tandfonline.com/doi/full/10.1080/09636412.2017.1331639.

[58] Ronald Reagan, *Address to the Nation of National Security*, University of Virginia, Miller Center, Presidential Speeches, March 23, 1983, https://millercenter.org/the-presidency/presidential-speeches/march-23-1983-address-nation-national-security.

During the 1980s, development continued across all three legs of the Soviet nuclear triad. The Typhoon-class strategic submarine and the Tu-160 Blackjack bomber entered into service. Anti-ship cruise missiles were joined by modern AS-15 land-attack cruise missiles. The Soviet Union continued to improve the accuracy of its fixed, silo-based missiles and began to deploy mobile ICBMs, adding both the road-mobile, single warhead SS-25 missile and the rail-mobile, 10-warhead SS-24 missile.

By the end of the 1980s, prior to the signing of the 1991 Strategic Arms Reduction Treaty (START), the Soviet Union had completed the backbone of what was to become the Russian nuclear triad of the 1990s. Its air leg consisted of Bear, Backfire, and Blackjack bombers. Its undersea leg consisted of Delta- and Typhoon-class submarines with MIRV SLBMs. Its ICBM leg consisted of the SS-18, SS-19, and SS-25 missiles.[59]

During the Cold War, the Soviet Union produced and deployed a wide range of delivery vehicles for nonstrategic nuclear weapons. At different times during the period, it deployed devices small enough to fit into a suitcase-sized container; nuclear mines; shells for artillery; short-, medium-, and intermediate-range ballistic missiles; short-range, air-delivered missiles; and gravity bombs. The Soviet Union deployed these weapons at nearly 600 bases, with some located in Warsaw Pact countries in Eastern Europe, some in the Soviet Union's non-Russian republics along its western and southern perimeter, and others throughout the Soviet Union. Estimates vary, but many analysts believe that by 1991 the Soviet Union had more than 20,000 of these weapons. Before the collapse of the Warsaw Pact in 1989, the numbers may have been higher, in the range of 25,000 weapons.[60]

Russian Nuclear Forces

Like the Soviet Union, the Russia Federation maintains a triad of nuclear forces consisting of ICBMs, SLBMs, and heavy bombers. The total number of warheads in the Soviet and Russian arsenal and the number deployed on Soviet and Russian strategic forces began to decline in the late 1980s (see **Figure 1** and **Figure 2** above). These reductions were primarily driven by the limits in the 1991 START I Treaty, the 2002 Strategic Offensive Reductions Treaty, and the 2010 New START Treaty. The reductions also reflect the retirement of many older Soviet-era missiles and their replacement with new missiles that carry fewer warheads, as well as the effects of the fiscal crisis in the late 1990s, which slowed the deployment of the next generation of Russian missiles and submarines. Moreover, under the Nunn-Lugar Cooperative Threat Reduction program, the United States helped Russia, Ukraine, Belarus, and Kazakhstan move Soviet-era nuclear weapons back to Russian territory and to dismantle portions of the Soviet Union's nuclear arsenal.

Russia deploys its strategic nuclear forces at more than a dozen bases across its territory. These bases are shown on **Figure 4**, below.

Russia is currently modernizing most of the components of its nuclear triad. The current phase of modernization essentially began in 1998. The Soviet Union replaced its land-based missiles frequently, with new systems entering the force every 10-15 years and modifications appearing every few years. Russia has not kept up this pace. When it began the most recent modernization

[59] See **Appendix A** for a timeline of the development and deployment of Soviet/Russian nuclear-capable delivery systems active since 1989.

[60] Joshua Handler, "The 1991-1992 PNIs and the Elimination, Storage and Security of Tactical Nuclear Weapons," in Alexander, Brian and Alistair Millar, editors, Tactical Nuclear Weapons (Washington, DC: Brassey's Inc., 2003), p. 31.

cycle, it was in the midst of a financial crisis. The crisis not only reduced the number of new missiles entering the force each year, but slowed the process. As a result, some of the systems that have had been under development since the late 1990s and early 2000s began to enter the force in the late 2000s, but others will not do so until the 2020s. In December 2020, Russia's President Vladimir Putin reported that about 86% of Russia's strategic nuclear force was made up of modern weapons, a number he expected to rise to 88% in 2021.[61]

Figure 3. Bases for Russian Strategic Forces

Source: Compiled by CRS.

Active Forces

Intercontinental Ballistic Missiles

As was the case during the Soviet era, Russia's Strategic Rocket Forces (SRF) are a separate branch of the Russian armed forces. These forces are still the mainstay of Russia's nuclear triad. Today, the SRF includes three missile armies, which, in turn, comprise 11 missile divisions (see **Figure 3**).[62] These divisions are spread across Russia's territory, from Vypolzovo in the west to the Irkutsk region in eastern Siberia. The Strategic Rocket Forces are estimated to have approximately 60,000 personnel.[63]

[61] "Defence Ministry Board Meeting," December 24, 2019, http://en.kremlin.ru/events/president/news/62401, cited in Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true.

[62] Pavel Podvig, "Strategic Rocket Forces," Russian strategic nuclear forces, June 2017, http://russianforces.org/missiles/.

[63] Defense Intelligence Agency (DIA), *Russia Military Power: Building a Military to Support Great Power*

According to official and unofficial sources, Russia's ICBM force currently comprises 310 missiles that can carry up to 1,189 warheads, although only about 800 warheads are deployed and available for use.[64] Over half of these missiles are MIRVed, carrying multiple warheads.

Russia is modernizing its ICBM force, replacing the last missiles remaining from the Soviet era with new single warhead and multiple warhead missiles. According to U.S. estimates, Russia is likely to complete this modernization around 2022.[65] It is anticipated that, after modernization, Russia's ICBM force will come to rely primarily on two missiles: the single-warhead SS-27 Mod 1 (Topol-M) and the SS-27 Mod 2 (Yars), which can carry up to 4 MIRV warheads.

As discussed below, Russia is developing a new heavy ICBM, known as the Sarmat (SS-X-30), which is expected to deploy with 10 or more warheads on each missile. It may also carry the new Avangard hypersonic glide vehicle, also described below. According to unclassified reports, Russia has pursued other projects, including an intermediate-range version of the SS-27 Mod 2 (known as the RS-26) and a rail-mobile ICBM called Barguzin, but their future is unclear.[66]

Table 1. Russian ICBM Systems

In service and under development

ICBM System	Launchers	Warheads	Notes
SS-18 (R-36M2)	46	10	Retiring, to be replaced by Sarmat
SS-19 (UR-100NUTTH)	0	0	Retired, replaced by Yars
SS-19 with Avangard HGV	4	1 HGV	Deployment of 2 planned in 2019 and 12 planned by 2027
SS-25 (Topol)	27	1	Retiring, being replaced by Yars
SS-27 Mod 1 (Topol-M) silo	60	1	Currently deployed
SS-27 Mod 2 (Topol-M) mobile	18	1	Currently Deployed
SS-27 Mod 2/RS-24 (Yars) mobile	135	4	Currently Deployed
SS-27 Mod 2/RS-24 (Yars) silo	20	4	Currently Deployed
SS-X-30 (Sarmat) silo		10 +	Expected in 2022

Sources: Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true., and Pavel Podvig, Russian Strategic Nuclear Forces blog.

Aspirations, Washington, DC, 2016, p. 47, https://www.dia.mil/portals/27/documents/news/military%20power%20publications/russia%20military%20power%20report%202017.pdf.

[64] Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true. The Defense Intelligence Agency reported that about 1,200 warheads were retained for Russia's ICBMs in 2016, before Russia met New START limits. DIA, "Russia Military Power," 2016, p. 47, https://www.dia.mil/portals/27/documents/news/military%20power%20publications/russia%20military%20power%20report%202017.pdf.

[65] DIA, "Russia Military Power," 2016, p. 76.

[66] Kristensen and Korda, "Russian nuclear forces, 2019."

Submarine-Launched Ballistic Missiles

Russia's Strategic Naval Forces are a part of the Russian Navy. Ballistic missile submarines are deployed with the Northern Fleet, headquartered in Severomorsk in the Murmansk region, and the Pacific Fleet, headquartered in Vladivostok.[67]

The Strategic Naval Forces have 10 strategic submarines of three different types: Delta, Typhoon, and Borei class. Some of these are no longer operational. The last submarine of the Typhoon class is used as a testbed for launches of the Bulava missile, which is deployed on the Borei-class submarines. The Delta and Borei-class submarines can each carry 16 SLBMs, with multiple warheads on a missile, "for a combined maximum loading of more than 700 warheads."[68] However, because Russia may have reduced the number of warheads on some of the missiles to comply with limitations set by the 2010 New START Treaty, the submarine fleet may carry around 624 warheads.[69]

Table 2. Russian Ballistic Missile Submarines and Missiles

Strategic Submarine	Number of SSBN	Type of SLBM	Number of Missiles	Warheads per Missile	Notes
Delta III (Project 667BDR)	1	SS-N-18 (R-29R)	16	3	Being withdrawn from service, with two decommissioned in 2018
Delta IV (Project 667BDRM)	6	SS-N-23 (R-29RM)	96	4	4-5 of each operational at any given time
Typhoon (Project 941)					Test bed for Bulava missiles
Borei (Project 955)	4	SS-N-32 (Bulava R-30)	64	6	Planned deployment of 10 submarines

Sources: Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true.

Pavel Podvig, Russian Strategic Nuclear Forces blog.

Most of the submarines in Russia's fleet are the older Delta class, including one Delta III submarine and 6 Delta IV submarines. The last of these was built in 1992; they are based with Russia's Northern Fleet. Although older Delta submarines were deployed with three-warhead SS-N-18 missiles, the Delta IV submarines carry the four-warhead SS-N-23 missile. An upgraded version of this missile, known as the Sineva system, entered into service in 2007. Another modification, known as the Liner (or Layner), could reportedly carry up to 10 warheads.[70]

Russia began constructing the lead ship in its Borei class of ballistic missile submarines (SSBN) in 1996. After numerous delays, the lead ship joined the Northern Fleet in 2013. According to public reports, Russia will eventually deploy 10 Borei-class submarines, with 5 in the Pacific Fleet and 5 in the Northern Fleet. Four submarines are currently in service, all in the Northern

[67] Pavel Podvig, "Strategic fleet," Russian strategic nuclear forces, June 2017, http://russianforces.org/navy/.

[68] Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true.

[69] Ibid.

[70] Pavel Podvig, "Strategic fleet," Russian strategic nuclear forces, June 2017, http://russianforces.org/navy/.

Fleet, and four more are in "various stages of construction."[71] One of the operational submarines and the four under construction are an improved version, known as the Borei-A/II. Russia plans to complete the first eight ships by 2023 and to finish the last two by 2027. Borei-class submarines can carry 16 of the SS-N-32 Bulava missiles; each missile can carry six warheads. The Bulava missile began development in the late 1990s. It experienced numerous test failures before it entered service in 2018.[72]

Heavy Bombers

Russia's strategic aviation units are part of the Russian Aerospace Forces' Long-Range Aviation Command. This command includes two divisions of Tu-160 (Blackjack) and Tu-95MS (Bear H) aircraft, which are the current mainstay of Russia's strategic bomber fleet. These are located in the Saratov region, in southwestern Russia, and the Amurskaya region, in Russia's Far East.[73]

Unclassified sources estimate that Russia has 60 to 70 bombers in its inventory—50 of them count under the New START Treaty.[74] Around 55 of these are Tu-95MS Bear bombers; the rest are Tu-160 Blackjack bombers. The former can carry up to 16 AS-15 (Kh-55) nuclear-armed cruise missiles, while the latter can carry up to 12 AS-15 nuclear-armed cruise missiles. Both bombers can also carry nuclear gravity bombs, though experts contend that the bombers would be vulnerable to U.S. or allied air defenses in such a delivery mission.

Russia has recently modernized both of its bombers, fitting them with a new cruise missile system, the conventional AS-23A (Kh-101) and the nuclear AS-23B (Kh-102). A newer version of the Tu-160, which is expected to include improved stealth characteristics and a longer range, is set to begin production in the mid-2020s. Experts believe the fleet will then include around 50-60 aircraft, with the eventual development of a new stealth bomber, known as the PAK-DA, as a part of Russia's long-term plans.[75]

Nonstrategic Nuclear Weapons

Russia has a variety of delivery systems that can carry nuclear warheads to shorter and intermediate ranges. These systems are generally referred to as nonstrategic nuclear weapons, and they do not fall under the limits in U.S.-Soviet or U.S.-Russian arms control treaties.[76] According to unclassified reports, Russia has a number of nuclear weapons available for use by its "naval, tactical air, air- and missile defense forces, as well as on short-range ballistic missiles."[77] It is reportedly engaged in a modernization effort focused on "phasing out Soviet-era weapons and replacing them with newer versions." Unclassified estimates place the number of warheads assigned to nonstrategic nuclear weapons at 1,912.[78]

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[71] Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true.

[72] Pavel Podvig, "Bulava is finally accepted for service," Russian Strategic Nuclear Forces blog, June 29, 2018, http://russianforces.org/blog/2018/06/bulava_is_finally_accepted_for.shtml.

[73] Pavel Podvig, "Strategic aviation," Russian strategic nuclear forces, June 20, 2017, http://russianforces.org/aviation/.

[74] Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true.

[75] Ibid.

[76] For details, see CRS Report RL32572, *Nonstrategic Nuclear Weapons*, by Amy F. Woolf.

[77] Hans Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, 2021, vol. 77, no. 2, p. 91, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2021.1885869?needAccess=true.

[78] Ibid.

Recent analyses indicate that Russia is both modernizing existing types of short-range delivery systems that can carry nuclear warheads and introducing new versions of weapons that have not been a part of the Soviet/Russian arsenal since the latter years of the Cold War. In May 2019, Lt. Gen. Robert P. Ashley of the Defense Intelligence Agency (DIA) raised this point in a public speech. He stated that Russia has 2,000 nonstrategic nuclear warheads and that its stockpile "is likely to grow significantly over the next decade." He also stated that

> Russia is adding new military capabilities to its existing stockpile of nonstrategic nuclear weapons, including those employable by ships, aircraft, and ground forces. These nuclear warheads include theater- and tactical-range systems that Russia relies on to deter and defeat NATO or China in a conflict. Russia's stockpile of non-strategic nuclear weapons [is] already large and diverse and is being modernized with an eye towards greater accuracy, longer ranges, and lower yields to suit their potential warfighting role. We assess Russia to have dozens of these systems already deployed or in development. They include, but are not limited to: short- and close-range ballistic missiles, ground-launched cruise missiles, including the 9M729 missile, which the U.S. Government determined violates the Intermediate-Range Nuclear Forces or INF Treaty, as well as antiship and antisubmarine missiles, torpedoes, and depth charges.[79]

It is not clear from General Ashley's comments, or from many of the other assessments of Russia's nonstrategic nuclear forces, whether Russia will deploy these new delivery systems with nuclear warheads. Many of Russia's medium- and intermediate-range missile systems, including the Kalibr sea-launched cruise missile and the Iskander ballistic and cruise missiles, are dual-capable and can carry either nuclear or conventional warheads. This is also likely true of the new 9M729 land-based, ground-launched cruise missile, the missile that the United States has identified as a violation of the 1987 INF Treaty.[80]

It unclear why Russia retains, and may expand, its stockpile of nonstrategic nuclear weapons. Some argue that these weapons serve to bolster Russia's less capable conventional military forces and assert that as Russia develops more capable advanced conventional weapons, it may limit its nonstrategic modernization program and retire more of these weapons than it acquires. Others, however, see Russia's modernization of its nonstrategic nuclear weapons as complementary to an "escalate to de-escalate" nuclear doctrine and argue that Russia will expand its nonstrategic nuclear forces as it raises the profile of such weapons in its doctrine and warfighting plans.

Key Infrastructure

Early Warning

Russia deploys an extensive early warning system. Operated by its Aerospace Forces, the system consists of a network of early warning satellites that transmit to two command centers: one in the East, in the Khabarovsk region, and one in the West, in the Kaluga region. The data are then transmitted to a command center in the Moscow region. Russia also operates an extensive network of ground-based radars across Russia, as well as in neighboring Kazakhstan and Belarus, that are used for early warning of missile launches and to monitor objects at low-earth orbits.

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[79] See Lt. Gen. Robert P. Ashley Jr., "Russian and Chinese Nuclear Modernization Trends," Remarks at the Hudson Institute, May 29, 2019, https://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/1859890/russian-and-chinese-nuclear-modernization-trends/.

[80] For details, see CRS Report R43832, *Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty: Background and Issues for Congress*, by Amy F. Woolf.

Russia uses the Okno observation station, located in Tajikistan, to monitor of objects that orbit at higher altitudes.[81]

Command and Control

The Russian President is the Supreme Commander in Chief of the Russian Armed Forces, and he has the authority to direct the use of nuclear weapons. According to a 2016 DIA report, "The General Staff monitors the status of the weapons of the nuclear triad and will send the direct command to the launch crews following the president's decision to use nuclear weapons. The Russians send this command over multiple C2 systems, which creates a redundant dissemination process to guarantee that they can launch their nuclear weapons."[82] According to DIA, Russia "also maintains the Perimetr system, which is designed to ensure that a retaliatory launch can be ordered when Russia is under nuclear attack."[83] It is unknown whether the order to transfer warheads from central storage and release them to the forces is part of the launch authorization.[84]

Production, Testing, and Storage

Russia has an extensive infrastructure of facilities for the production of nuclear weapons and missiles,[85] although it has consolidated and reduced the size of this infrastructure since the end of the Cold War. Moreover, Russia has improved the security of its nuclear weapons facilities through U.S.-Russian cooperation under the Nunn-Lugar CTR program.

Russia has about a dozen research institutes and facilities that participate in the design and manufacture of nuclear and nonnuclear components for its nuclear weapons, provide stockpile support, and engage in civilian nuclear and other research.[86] Russia, which has a significant stockpile of weapons-usable materials, no longer produces highly enriched uranium or plutonium for use in nuclear weapons.[87]

Russia's nuclear weapons are stored at approximately 12 national central storage sites. According to analysts, Russia also maintains 34 base-level storage facilities (see **Appendix B**). A special unit, the 12th Main Directorate (GUMO), is responsible for security, transportation, and handling of the warheads. In a period immediately preceding a conflict, it is anticipated that nuclear warheads could be transferred from the national central storage sites to the base-level facilities.[88]

Russia ratified the Comprehensive Test Ban Treaty (CTBT) in 2000. Although this treaty has yet to enter into force, Russia claims it has refrained from explosive nuclear testing in accordance with the treaty's requirements. Russia conducts hydrodynamic tests, which do not produce a nuclear yield, at a site located on Novaya Zemlya, an archipelago located in the Arctic Ocean. In

[81] Pavel Podvig, "Early Warning," Russian Strategic Nuclear Forces, September 29, 2018, http://russianforces.org/sprn/. Also see Anatoly Zak, "Russian Military and Dual-Purpose Spacecraft: Latest Status and Operational Overview," Center For Naval Analyses, June 2019, pp. 14-16, https://www.cna.org/CNA_files/PDF/IOP-2019-U-020191-Final.pdf.

[82] DIA, "Russia Military Power," 2016, pp. 25-27.

[83] DIA, "Russia Military Power," 2016, pp. 25-27.

[84] Jeffrey G. Lewis and Bruno Tetrais, "The Finger on the Button," CNS Occasional Paper, February 2019, https://www.nonproliferation.org/wp-content/uploads/2019/02/Finger-on-the-Nuclear-Button.pdf.

[85] For a map of Russian nuclear facilities, see https://gmap.nti.org/nuclear_russia.html.

[86] For more information, see https://www.nti.org/learn/countries/russia/facilities/.

[87] IPFM, "Fissile Materials: Russia," February 12, 2018, http://fissilematerials.org/countries/russia.html.

[88] Pavel Podvig and Javier Serratt, "Lock Them Up: Zero-deployed Non-strategic Nuclear Weapons in Europe," UNIDIR, 2017, pp. 14-19.

his May 2019 speech, DIA Director General Ashley stated that "the United States believes that Russia probably is not adhering to its nuclear testing moratorium in a manner consistent with the 'zero-yield' standard."[89] However, when questioned about this assertion, he said that the U.S. intelligence community does not have "specific evidence that Russia had conducted low-yield nuclear tests" but that the DIA thinks Russia has "the capability to do that."[90]

Key Modernization Programs

Table 3. Russian Nuclear Delivery System Modernization Programs

System	Warheads	Notes
Avangard HGV	One per vehicle, nuclear	Can be delivered by SS-19 and potentially the Sarmat ICBMs; intended to overcome missile defense
RS-28 (Sarmat) silo ICBM	10+, nuclear	Deployment expected around 2022; intended to overcome missile defense
Poseidon Autonomous Underwater Vehicle	Conventional or nuclear	Carried by special-purpose submarines; intended as a second-strike, retaliatory weapon
Burevestnik Nuclear Powered Cruise Missile	Nuclear	"Unlimited" range, owing to its nuclear reactor; intended to overcome missile defense
Kinzhal Air-Launched Ballistic Missile	Conventional or nuclear	Intended to target naval vessels
Tsirkon Hypersonic Cruise Missile	Conventional or nuclear	Intended to attack ships and ground targets
Barguzin Rail-Mobile ICBM	up to 4? Nuclear	Program reportedly postponed in 2017
RS-26 Rubezh ICBM	up to 4? Nuclear	Program reportedly postponed in 2018

Source: Compiled by CRS.

Note: While the text used both Russian designations (RS-X) and U.S./NATO designations (SS-X) to identify deployed Russian weapons systems, this table displays the Russian only the Russian designation (RS-X) because a NATO designation has not yet been assigned.

In addition to replacing aging Soviet-era ICBMs, SLBMs, and ballistic missile submarines, Russia is developing several kinds of nuclear delivery vehicles. Some of these, like the Sarmat ICBM, may replicate capabilities that already exist; others could expand the force with new types of delivery systems not previously deployed with nuclear warheads. President Putin unveiled most of these systems during his March 1, 2018, annual State of the Nation address to the Federal Assembly, when he presented a range of weapons systems currently under development in Russia.[91] His speech also featured videos and animations of new weapons systems.

[89] Lt. General Robert P. Ashley Jr., *Russian and Chinese Nuclear Modernization Trends*, Director, Defense Intelligence Agency, Remarks at the Hudson Institute, Washington, DC, May 29, 2019, pp. 2-3, https://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/1859890/russian-and-chinese-nuclear-modernization-trends/.

[90] Paul Sonne, "Top U.S. military intelligence official says Russia 'probably' not adhering to nuclear test ban," *Washington Post*, May 29, 2019, https://www.washingtonpost.com/world/national-security/top-us-military-intelligence-official-says-russiaprobably-not-adhering-to-nuclear-test-ban/2019/05/29/815a1a36-8234-11e9-9a67-a687ca99fb3d_story.html?utm_term=.bdc536a94f9e.

[91] "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018, http://en.kremlin.ru/events/president/news/56957.

During his speech, President Putin explicitly linked Russia's new strategic weapons programs to the U.S. withdrawal from the ABM Treaty in 2002. He said

> We did our best to dissuade the Americans from withdrawing from the treaty. All in vain. The US pulled out of the treaty in 2002. Even after that we tried to develop constructive dialogue with the Americans. We proposed working together in this area to ease concerns and maintain the atmosphere of trust. At one point, I thought that a compromise was possible, but this was not to be. All our proposals, absolutely all of them, were rejected. *And then we said that we would have to improve our modern strike systems to protect our security*. [Emphasis added] In reply, the US said that it is not creating a global BMD system against Russia, which is free to do as it pleases, and that the US will presume that our actions are not spearheaded against the US….
>
> … the US, is permitting constant, uncontrolled growth of the number of anti-ballistic missiles, improving their quality, and creating new missile launching areas. If we do not do something, eventually this will result in the complete devaluation of Russia's nuclear potential. Meaning that all of our missiles could simply be intercepted.
>
> Let me recall that the United States is creating a global missile defence system primarily for countering strategic arms that follow ballistic trajectories. These weapons form the backbone of our nuclear deterrence forces, just as of other members of the nuclear club. As such, Russia has developed, and works continuously to perfect, highly effective but modestly priced systems to overcome missile defence. They are installed on all of our intercontinental ballistic missile complexes.

These comments, and President Putin's repeated reference to U.S. ballistic missile defenses, provide a possible context for many of the ongoing modernization programs.

The Offense/Defense Relationship Part III

The United States has not developed or deployed ballistic missile defense systems with the capabilities needed to intercept Russia's strategic ballistic missiles or warheads. According to the Defense Department's 2019 Ballistic Missile Defense Review Report, the United States "relies on deterrence to protect against large and technically sophisticated Russian and Chinese intercontinental ballistic missile threats to the U.S. homeland." [92] Russia, however, continues to believe that the United States will develop and eventually deploy missile defense interceptors with the capabilities needed to counter Russian missiles and in numbers that can undermine Russia's strategic deterrent. Hence, although the United States cannot defend against the existing warheads on Russian ballistic missiles, Russia has emphasized that Avangard poses a new challenge to the United States because missile defenses cannot intercept a maneuvering hypersonic glide vehicle. Many U.S. analysts and observers have echoed this assertion, despite the fact that Avangard does not change the existing balance between Russian offensive and U.S. defensive forces.

Avangard Hypersonic Glide Vehicle

The Avangard hypersonic glide vehicle (HGV),[93] previously known as Project 4202, is a reentry body carried atop an existing ballistic missile that can maneuver to evade air defenses and ballistic missile defenses to deliver a nuclear warhead to targets in Europe and the United States. Russia views the Avangard system as a hedge to buttress its second-strike capability, ensuring that a retaliatory strike can penetrate U.S. ballistic missile defenses. In his March 2018 remarks, President Putin specifically stressed that Russia would pursue "a new hypersonic-speed, high-precision new weapons systems that can hit targets at

[92] Department of Defense, *Missile Defense Review*, Report, Washington, DC, September 2018, p. 8, https://media.defense.gov/2019/Jan/17/2002080666/-1/-1/1/2019-MISSILE-DEFENSE-REVIEW.PDF.

[93] For details on the technology and role of hypersonic glide vehicles in U.S. defense policy, see CRS Report R41464, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, by Amy F. Woolf. See, also, CRS Report R45811, *Hypersonic Weapons: Background and Issues for Congress*, by Kelley M. Sayler.

inter-continental distance and can adjust their altitude and course as they travel" in response to the U.S. withdrawal from the ABM Treaty. Some U.S. analysts, however, have noted that the Avangard could be used "as a first strike system to be used specifically against missile defenses, clearing the way for the rest of Russia's nuclear deterrent."[94] Others have stressed that the Avangard is likely to serve as a niche capability that adds little to Russia's existing nuclear force structure.[95]

The Soviet Union first experimented with HGV technology in the 1980s, partly in response to the expected deployment of U.S. ballistic missile defense systems under the SDI program. The current program has been under development since at least 2004 and has undergone numerous tests.[96] In a test on December 26, 2018, the glider was launched atop an SS-19 ICBM from the Dombarovskiy missile base in the Southern Urals toward a target on the Kamchatka Peninsula more than 3,500 miles away.[97] According to some sources, Russia might deploy the Avangard on the SS-19 and, potentially, on the new Sarmat ICBMs.[98] Experts continue to debate Avangard's true technical characteristics. However, President Putin has stated that the system is capable of "intensive maneuvering" and achieving "supersonic speeds in excess of Mach 20."[99]

After the December 2018 test, President Putin announced that the weapon would be added to Russia's nuclear arsenal in 2019. In January 2019, an official with Russia's Security Council confirmed that the Avangard had been integrated onto the SS-19 force.[100] According to the Commander of Russia's Strategic Rocket Forces, the Dombarovskiy Missile Division will stand up a "missile regiment comprising a modified command-and-control post and two silo-based launchers" in 2019.[101] On December 27, 2019, the Russian military announced that the Strategic Rocket Forces had activated two SS-19 missiles equipped with Avangard hypersonic glide vehicles. An additional two missiles equipped with Avangard were activated in late 2020.[102]

Although not specified in the Russian announcement, the missiles are likely deployed with the 13th regiment of the Dombarovskiy (Red Banner) missile division based in the Orenburg

[94] Michael Kofman, "Russia's Avangard hypersonic boost-glide system," Russia Military Analysis, January 11, 2019, https://russianmilitaryanalysis.wordpress.com/2019/01/11/russias-avangard-hypersonic-boost-glide-system/.

[95] See Pavel Podvig, "Avangard system is tested, said to be fully ready for deployment," Russian Strategic Nuclear Forces blog, December 26, 2018, http://russianforces.org/blog/2018/12/avangard_system_is_tested_said.shtml, and Michael Kofman, "Russia's Avangard hypersonic boost-glide system," Russia Military Analysis, January 11, 2019, https://russianmilitaryanalysis.wordpress.com/2019/01/11/russias-avangard-hypersonic-boost-glide-system/.

[96] See table of development in Pavel Podvig, "Avangard system is tested, said to be fully ready for deployment," Russian Strategic Nuclear Forces blog, December 26, 2018, http://russianforces.org/blog/2018/12/avangard_system_is_tested_said.shtml.

[97] Aristos Georgiou, "Russia Successfully Tests Weapon That Travels 27 Times Speed of Sound and Renders Missile Defense Systems 'Useless'—Officials," *Newsweek*, December 28, 2018, https://www.newsweek.com/russian-new-weapon-mach-27-avangard-hypersonic-glide-vehicle-intercontinental-1273729?utm_source=Twitter&utm_campaign=NewsweekTwitter&utm_medium=Socia.

[98] Nikolai Novichkov, "Russia announces successful flight test of Avangard hypersonic glide vehicle," Jane's Missiles & Rockets, January 3, 2019.

[99] "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018, en.kremlin.ru/events/president/news/56957.

[100] Nikolai Novichkov, "Russia announces successful flight test of Avangard hypersonic glide vehicle," Jane's Missiles & Rockets, January 3, 2019.

[101] Nikolai Novichkov, "Russia beefs up Strategic Missile Forces," Jane's Defense Weekly, December 20, 2018.

[102] "Two new 'Avanguards' can take up combat duty at the end of December," *Tass*, December 17, 2020, https://tass.ru/armiya-i-opk/10277813.

region.[103] According to earlier reports, the 13th regiment is expected to eventually receive two more SS-19 ICBMs fitted with Avangard warheads, for a total of six. Eventually, the Strategic Rocket Forces will have two missile regiments with six Avangard systems each, by 2027.[104]

Russian officials have indicated that these missiles will count under the New START Treaty. Consequently, Russians officials conducted an exhibition of the system for U.S. inspectors, as mandated by the New START Treaty, prior to deployment. The exhibition demonstrated that each missile will carry one Avangard HGV, but it is not clear whether or how Russia demonstrated that each HGV would carry only one warhead.[105]

Sarmat ICBM

The RS-28 Sarmat (SS-X-30) missile is a liquid-fueled heavy ICBM that Russia intends to eventually deploy as a replacement for the SS-18 heavy ICBM. Russia has been reducing the number of SS-18 missiles in its force since the 1990s, when the original START Treaty required a reduction from 308 to 154 missiles. Russia likely would have eliminated all of the missiles if the START II Treaty (described below) had entered into force, but it has retained 46 of them under New START, while awaiting the development of the Sarmat. Reports indicate that the Sarmat can carry 10, or according to some sources, 15 warheads, along with penetration aids, and potentially several Avangard hypersonic glide vehicles.[106] Putin stated in his March 2018 speech that Sarmat weighs over 200 tons, but details about the ICBM's true weight, and thus its payload, remain unclear.[107]

Russia began testing the Sarmat missile in 2016; reports indicate that it is likely to be deployed in the Uzhur Missile Division around 2022.[108] Russia also may deploy the missile at the Dombarovsky Missile Division, with an eventual total of seven Sarmat regiments with 46 missiles.[109] This number is equal to roughly the number of SS-18 ICBMs that Russia has retained under New START and, therefore, indicates that Russia could be planning to deploy the Sarmat in a manner consistent with the limits in the treaty. Some have speculated, however, that Russia

[103] Julian E. Barnes and David E. Sanger, "Russia Deploys Hypersonic Weapon, Potentially Renewing Arms Race," *New York Times*, December 27, 2019, https://www.nytimes.com/2019/12/27/us/politics/russia-hypersonic-weapon.html. See, also, Franz-Stefan Gady, "Russia's Avangard Hypersonic Warhead Officially Enters Service," *The Diplomat*, December 27, 2019, https://thediplomat.com/2019/12/russias-avangard-hypersonic-warhead-officially-enters-service/.

[104] Nikolai Novichkov, "Russia announces successful flight test of Avangard hypersonic glide vehicle," Jane's Missiles & Rockets, January 3, 2019.

[105] "Russia Shows Off Hypersonic Nuclear Missile to U.S. Inspectors," *The Moscow Times*, November 26, 2019, https://www.themoscowtimes.com/2019/11/26/russia-shows-off-hypersonic-nuclear-missile-to-us-inspectors-a68329. See, also, Pavel Podvig, "Russia shows Avangard system 'to maintain viability' of New START," Russian Strategic Nuclear Forces Blog, http://russianforces.org/blog/2019/11/russia_shows_avangard_system_t.shtml.

[106] "RS-28 Sarmat," Jane's Strategic Weapons Systems, November 19, 2018.

[107] See "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018, en.kremlin.ru/events/president/news/56957; Michael Kofman, "Emerging Russian Weapons: Welcome to the 2020s: Part 1," Russian military analysis, March 4, 2018, https://russianmilitaryanalysis.wordpress.com/2018/03/04/emerging-russian-weapons-welcome-to-the-2020s-part-1-kinzhal-sarmat-4202/ and "RS-28 Sarmat," Jane's Strategic Weapons Systems, November 19, 2018.

[108] "RS-28 Sarmat," Jane's Strategic Weapons Systems, November 19, 2018.

[109] Pavel Podvig, "Sarmat deployment is said to begin in 2021," Russian Strategic Nuclear Forces blog, http://russianforces.org/blog/2018/10/sarmat_deployment_is_said_to_b.shtml.

could exceed the limits in the treaty after its expiration by eventually expanding its deployment of Sarmat missiles or increasing the number of warheads on each missile.[110]

In his March 2018 speech, President Putin highlighted the Sarmat missile's ability to confound and evade ballistic missile defense systems. As was the case with the SS-18 missile, the large number of warheads and penetration aids are designed to increase the probability that the missile's warhead could penetrate defenses and reach its target. In addition, President Putin noted that Sarmat could attack targets by flying over both the North and South Poles, evading detection by radars seeking missiles flying in an expected trajectory over the North Pole. He also stated that the missile "has a short boost phase, which makes it more difficult to intercept for missile defense systems." He emphasized that Sarmat is a formidable missile and, owing to its characteristics, "is untroubled by even the most advanced missile defense systems."[111]

Poseidon Autonomous Underwater Vehicle

The existence of Poseidon, a nuclear-powered autonomous underwater vehicle (also known as Status 6 or Kanyon, its NATO designation), was first "leaked" to the press in November 2015, when a slide detailing it appeared in a Russian Ministry of Defense briefing.[112] According to that slide, the autonomous underwater vehicle, or drone, could reach a depth of 1,000 meters, go at a speed of 100 knots, and have a range of up to 10,000 km. The slide indicated that the system would be tested between 2019 and 2025. Press reports indicate, however, that Russia has been testing the system since at least 2016, with a recent test occurring in November 2018. However, the system may not be deployed until 2027.[113]

Russia may deploy the Poseidon drone on four submarines, two in the Northern Fleet and two in the Pacific Fleet. Each submarine would carry eight drones.[114] According to some reports, each drone would be armed with a two-megaton nuclear or conventional payload that could be detonated "thousands of feet" below the surface. Russia could release the drone from its submarine off the U.S. coast and detonate it in a way that would "generate a radioactive tsunami" that could destroy cities and other infrastructure along the U.S. coast.[115] According to Russia's President Putin, Russia might target Poseidon drones armed with conventional warheads against a broad range of targets, "including aircraft carrier groups, shore fortifications, and infrastructure."[116]

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[110] Lt. General Robert P. Ashley Jr., *Russian and Chinese Nuclear Modernization Trends*, Director, Defense Intelligence Agency, Remarks at the Hudson Institute, Washington, DC, May 29, 2019, p. 3, https://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/1859890/russian-and-chinese-nuclear-modernization-trends/.

[111] "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018, http://en.kremlin.ru/events/president/news/56957.

[112] Edward Moore Geist, "Would Russia's undersea 'doomsday drone' carry a cobalt bomb?" *Bulletin of the Atomic Scientists*, July 3, 2016, https://thebulletin.org/2016/07/would-russias-undersea-doomsday-drone-carry-a-cobalt-bomb/.

[113] Amanda Macias, "Russia's nuclear-armed underwater drone may be ready for war in eight years," *CNBC*, March 29, 2019, https://www.cnbc.com/2019/03/25/russias-nuclear-armed-underwater-drone-may-be-ready-for-war-in-2027.html.

[114] "Russian Navy to put over 30 Poseidon strategic underwater drones on combat duty - source," *Tass*, January 12, 2019, http://tass.com/defense/1039603. See, also, Michael Kofman, "Emerging Russian Weapons: Welcome to the 2020s: Part 2," Russian military analysis, March 4, 2018, https://russianmilitaryanalysis.wordpress.com/2018/03/06/emerging-russian-weapons-welcome-to-the-2020s-part-2-9m730-status-6-klavesin-2r/.

[115] Mark Episkopos, "Russian Navy Will Soon Deploy 32 'Poseidon' Nuclear Drones Across 4 Submarines," *The National Interest*, January 15, 2019, https://nationalinterest.org/blog/buzz/russian-navy-will-soon-deploy-32-poseidon-nuclear-drones-across-4-submarines-41617.

[116] "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018,

When Russia first revealed the existence of this new drone, some analysts questioned whether Russia was developing a new first-strike weapon that could evade U.S. defenses and devastate the U.S. coastline. Russia, however, views the nuclear version of this weapon as a second- or third-strike option that could ensure a retaliatory strike against U.S. cities. Like the Avangard and Sarmat, this system, according to Russian statements, would also serve as a Russian response to concerns about the U.S. withdrawal from the ABM Treaty and U.S. advances in ballistic missile defenses. As President Putin noted in his March 2018 speech, "we have developed unmanned submersible vehicles that can move at great depths (I would say extreme depths) intercontinentally, at a speed multiple times higher than the speed of submarines, cutting-edge torpedoes and all kinds of surface vessels…. They are quiet, highly manoeuvrable and have hardly any vulnerabilities for the enemy to exploit."[117]

Burevestnik Nuclear-Powered Cruise Missile

The Burevestnik (SSC-X-9 Skyfall) is a nuclear-powered cruise missile intended to have "unlimited" range, because it would be powered by a nuclear reactor. In his March 2018 speech, Putin stressed that the "low-flying stealth missile carrying a nuclear warhead, with almost an unlimited range, unpredictable trajectory and ability to bypass interception boundaries" would be "invincible against all existing and prospective missile defense and counter-air defense systems."[118]

According to reports, Russia began conducting tests with a prototype missile, and with an electric power source instead of a nuclear reactor, in 2016.[119] Russia reportedly conducted a successful test of the missile in January 2019.[120] However, a test using a nuclear-powered engine in August 2019 ended in failure when the missile crashed into the White Sea. During an effort to recover the engine, an explosion killed five Russian nuclear scientists and spread radiation in the area.[121] According to some reports, Russia is unlikely to deploy the cruise missile for at least another decade and, even then, the high cost could limit the number introduced into the Russian arsenal.[122] Nevertheless, according to unclassified analysis of satellite data, Russia seemed to be preparing for another test of the Burevestnik Cruise Missile in August 2021.[123]

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http://en.kremlin.ru/events/president/news/56957.

[117] Ibid.

[118] Ibid.

[119] Michael Kofman, "Emerging Russian Weapons: Welcome to the 2020s: Part 2" Russian military analysis, March 4, 2018, https://russianmilitaryanalysis.wordpress.com/2018/03/06/emerging-russian-weapons-welcome-to-the-2020s-part-2-9m730-status-6-klavesin-2r/.

[120] "Tests of Burevestnik nuclear powered cruise missile successfully completed, says source," Tass, February 16, 2019, https://tass.com/defense/1045012.

[121] David Sanger and Andrew Kramer, "U.S. Officials Suspect New Nuclear Missile in Explosion That Killed 7 Russians," *New York Times*, August 12, 2019, https://www.nytimes.com/2019/08/12/world/europe/russia-nuclear-accident-putin.html?nl=todaysheadlines&emc=edit_th_190812?campaign_id=2&instance_id=11410&segment_id=16070&user_id=7a8ed53b1fc5f7e04a00bb1610157848&regi_id=303468470812.

[122] Amanda Macias, "Vladimir Putin's so-called missile with unlimited range is too expensive for the Kremlin – and has yet to fly farther than 22 miles," *CNBC*, March 22, 2019, https://www.cnbc.com/2019/03/22/putins-missile-with-unlimited-range-is-too-expensive-and-hasnt-flown-more-than-22-miles.html.

[123] Zachary Cohen, "New satellite images show Russia may be preparing to test nuclear powered 'Skyfall' missile," *CNN*, August 18, 2021, https://www.cnn.com/2021/08/18/politics/russia-skyfall-missile-test-satellite-images/index.html.

Kinzhal Air-Launched Ballistic Missile

Russia has developed a nuclear-capable air-launched ballistic missile, known as the Kinzhal, that could be launched on MiG-31K interceptor aircraft or Tu-22M bombers. It has been deployed with a specially modified MIG-31 K interceptor since 2017, and was first tested from a Tu-22M in 2020. According to press reports, the Kinzhal is a variant of the Iskander short-range ballistic missile currently in service with the Russian Armed Forces. The air-launched version may be intended to be launched while the aircraft is at supersonic speeds, adding to the system's invulnerability to U.S. air and missile defenses.[124] President Putin noted this capability in his March 2018 speech, when he said that the missile "flying at a hypersonic speed, 10 times faster than the speed of sound, can also maneuver at all phases of its flight trajectory, which also allows it to overcome all existing and, I think, prospective anti-aircraft and anti-missile defense systems, delivering nuclear and conventional warheads in a range of over 2,000 kilometers."[125]

Unless Russian aircraft approach U.S. shores before releasing the missile, however, it will not have the range needed to target U.S. territory. Instead, experts believe the missile is intended primarily to target naval vessels. President Putin stated that the system entered service in the Southern Military District in December 2017. Russia's Minister of Defense stated in February 2019 that MiG-31 crews have taken the Kinzhal on air patrols over the Black and Caspian seas.[126]

Tsirkon Anti-Ship Hypersonic Cruise Missile

Russia has been developing the Tsirkon (3M-22, NATO designated SS-N-33), an anti-ship hypersonic cruise missile, since at least 2011. The missile is "designed for naval surface vessels and submarines, able to attack both ships and ground targets."[127] It is intended to replace the SS-N-19 cruise missile on the Kirov-class cruisers[128] and is expected to be test-launched from the new Yasen-class submarine in 2021.[129] Russia conducted several successful tests of the missile from the Admiral Groshkov frigate in 2020.[130]

In a February 2019 address to the Federal Assembly, Putin stated that Tsirkon is a "hypersonic missile that can reach speeds of approximately Mach 9 and strike a target more than 1,000 km away both under water and on the ground." He also stated that the missile could be launched from submarines.[131] In late 2019, President Putin also noted that Russia would develop a land-based version of this missile as a response to the U.S. withdrawal from the INF Treaty.

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[124] Michael Kofman, "Emerging Russian Weapons: Welcome to the 2020s: Part 1," Russian military analysis, March 4, 2018, https://russianmilitaryanalysis.wordpress.com/2018/03/04/emerging-russian-weapons-welcome-to-the-2020s-part-1-kinzhal-sarmat-4202/.

[125] "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018, http://en.kremlin.ru/events/president/news/56957.

[126] "New Russian weapons to guarantee security of the country without increasing costs and involvement in the arms race," Ministry of Defense of the Russian Federation, February 20, 2019, http://eng.mil.ru/en/news_page/country/more.htm?id=12218197@egNews.

[127] Roger McDermott, "Moscow Prepares Tests for Hypersonic Cruise Missile," Eurasia Daily Monitor, March 20, 2019, https://jamestown.org/program/moscow-prepares-tests-for-hypersonic-cruise-missiles/.

[128] "3M-22 Tsirkon," Jane's Weapons: Naval, February 15, 2018.

[129] Roger McDermott, "Moscow Prepares Tests for Hypersonic Cruise Missile," Eurasia Daily Monitor, March 20, 2019, https://jamestown.org/program/moscow-prepares-tests-for-hypersonic-cruise-missiles/.

[130] "Russia reports successful test launch of hypersonic missile," *Associated Press*, October 7, 2020, https://www.defensenews.com/global/europe/2020/10/07/russia-reports-successful-test-launch-of-hypersonic-missile/.

[131] "Presidential Address to the Federal Assembly," President of Russia, February 20, 2019, http://en.kremlin.ru/events/

Barguzin Rail-Mobile ICBM

Russia had been developing a rail-mobile ICBM system to replace the SS-24 Mod 3 Scalpel since 2013. An ejection test of the missile appears to have been conducted. However, Russia may have canceled the program in 2017.[132]

RS-26 Rubezh ICBM

Russia had been developing a version of its three-stage RS-24 Yars ICBM with only two stages. According to unclassified reports, Russia conducted four flight tests of this missile in the early part of this decade. Two of these flight tests—one that failed in September 2011 and one that succeeded in May 2012—flew from Plesetsk to Kura, a distance of approximately 5,800 kilometers (3,600 miles). The second two tests—in October 2012 and June 2013—were both successful. In both cases, the missile flew from Kapustin Yar to Sary-Shagan, a distance of 2,050 kilometers (1,270 miles).[133] These tests raised questions about whether the missile was designed to violate, or circumvent, the limits in the 1987 INF Treaty, as that treaty banned the testing and deployment of missiles with a range between 500 and 5,500 kilometers. Russia appears to have cancelled this missile program in 2018,[134] but some analysts believe it might reappear now that the INF Treaty has lapsed.[135]

The Effect of Arms Control on Russia's Nuclear Forces

The number of warheads on Soviet strategic nuclear delivery vehicles reached its peak in the mid-1980s and began to decline sharply by the early 1990s (see **Figure 2**). This decline continued, with a few pauses, through the 1990s and 2000s. While a number of factors likely contributed to this decline, most experts agree that these reductions were shaped by the limits in bilateral arms control agreements.

The SALT Era (1972-1979)

The United States and the Soviet Union signed their first formal agreements limiting nuclear offensive and defensive weapons in May 1972. The Strategic Arms Limitation Talks (SALT) produced two agreements: the Interim Agreement on Certain Measures with Respect to the Limitation of Strategic Offensive Arms (Interim Agreement) and the Treaty on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty). The parties paired these two agreements, in part, to forestall an offense-defense arms race, where increases in the number of missile defense

president/news/59863.

[132] Pavel Podvig, "Barguzin rail-mobile ICBM is cancelled (again)," Russian Strategic Nuclear Forces, December 4, 2017, http://russianforces.org/blog/2017/12/barguzin_rail-mobile_icbm_is_c.shtml.

[133] Hans Kristensen, "Russian Missile Test Creates Confusion and Opposition in Washington," FAS Strategic Security blog, July 3, 2013, http://blogs.fas.org/security/2013/07/yars-m/.

[134] Pavel Podvig, "By cancelling RS-26 Russia keeps its options open," Russian Strategic Nuclear Forces, April 2, 2018, http://russianforces.org/blog/2018/04/by_cancelling_rs-26_russia_kee.shtml.

[135] The United States first determined that Russia had violated the INF Treaty in 2014, and withdrew from the treaty in early 2019 after Russia refused to acknowledge its violation or return to compliance. The treaty lapsed on August 2, 2019. For more information, see CRS Report R43832, *Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty: Background and Issues for Congress*, by Amy F. Woolf.

interceptors on one side would encourage the other to increase the number of missiles needed to saturate those defenses. The United States also sought to limit the number of large ICBMs in the Soviet offensive force, an area where the Soviet Union had an advantage over the United States. As a result, the Interim Agreement imposed a freeze on the number of launchers for ICBMs that the United States and the Soviet Union could deploy. (At the time the United States had 1,054 ICBM launchers and the Soviet Union had 1,618 ICBM launchers.) The two countries also agreed to freeze their number of SLBM launchers and modern ballistic missile submarines, though they could add SLBM launchers if they retired old ICBM launchers.[136]

Although the Interim Agreement limited the number of Soviet ICBM and SLBM launchers, it did not restrain the growth in the number of warheads carried on the missiles deployed in those launchers. After signing the agreement, both nations expanded the number of warheads on their missiles by deploying missiles with multiple warheads (MIRVs). The Soviet deployment of MIRVs led to a sharp increase—from around 2,000 to more than 6,100—in the number of warheads on ICBMs and SLBMs between 1972 and 1979. The second Strategic Arms Limitation Treaty (SALT II) sought to curb this growth by limiting the number of missiles that could carry multiple warheads. The treaty would have capped all strategic nuclear delivery systems at 2,400 and limited each side to 1,320 MIRVed ICBMs, MIRVed SLBMs, and heavy bombers equipped to carry nuclear-armed, air-launched cruise missiles (ALCMs). The treaty would not have limited the total number of warheads that could be carried on these delivery vehicles, even though the parties agreed that they would not deploy MIRVed ICBMs with more than 10 warheads each and MIRVed SLBMs with more than 14 warheads each.

SALT II proved to be highly controversial. Some analysts argued that it would fail to reduce nuclear warheads or curb the arms race, while others argued that the treaty would allow the Soviet Union to maintain strategic superiority over the United States with its force of large, heavily MIRVed land-based ballistic missiles. Shortly after the Soviet Union invaded Afghanistan in December 1979, President Carter withdrew the treaty from the Senate's consideration. The Soviet Union continued to increase the number of warheads on its ICBMs and SLBMs, reaching around 10,000 warheads in 1989.

INF and START (1982-1993)

President Reagan entered office in 1981 planning to expand U.S. nuclear forces and capabilities in an effort to counter the perceived Soviet advantages in nuclear weapons. Initially, at least, he rejected the use of arms control agreements, but after Congress and many analysts pressed for more diplomatic initiatives, the Reagan Administration outlined negotiating positions to address intermediate-range missiles, long-range strategic weapons, and ballistic missile defenses. These negotiations began to bear fruit in the latter half of President Reagan's second term, with the signing of the Intermediate-Range Nuclear Forces (INF) Treaty in 1987. In the INF Treaty, the United States and Soviet Union agreed to destroy all intermediate-range and shorter-range ground-launched ballistic missiles and ground-launched cruise missiles with ranges between 500 and 5,500 kilometers (between 300 and 3,400 miles). The Soviet Union destroyed 1,846 missiles, including 654 SS-20 missiles that carried three warheads apiece, resulting in a reduction of more than 3,100 deployed warheads.[137] The INF Treaty was seen as a significant milestone in arms

[136] The Interim Agreement was to remain in force for five years, unless the parties replaced it with a more comprehensive agreement limiting strategic offensive weapons. In 1977, both nations agreed to observe the agreement until they completed the SALT II Treaty, which was then under negotiation.

[137] The United States destroyed 846 single-warhead Pershing II ballistic missiles and Gryphon cruise missiles.

control because it established an intrusive verification regime and eliminated entire classes of weapons that both sides regarded as modern and effective.[138]

The United States and the Soviet Union began negotiations on the Strategic Arms Reduction Treaty (START) in 1982, although the talks stopped between 1983 and 1985 after a Soviet walkout in response to the U.S. deployment of intermediate-range missiles in Europe. The Soviet Union viewed START as a continuation of the SALT process and initially proposed limits on the same categories of weapons defined in the SALT II Treaty: total delivery vehicles, MIRVed ballistic missiles, and heavy bombers equipped to carry nuclear-armed ALCMs. The United States, however, sought to change the units of account from launchers to missiles and warheads, and proposed deep reductions rather than marginal changes from the SALT II level. The United States specifically sought sublimits on heavy ICBMs (the Soviet SS-18) and heavily MIRVed ICBMs (at the time, the Soviet SS-19), but it did not include any limits on heavy bombers.[139]

The nations adjusted their positions in 1985 and 1986 and saw the beginnings of a convergence after the October 1986 summit in Reykjavik, Iceland. However, they were unable to reach agreement by the end of the Reagan Administration. President George H. W. Bush continued the negotiations during his term, and the United States and the Soviet Union signed START in July 1991. The countries agreed that each side could deploy up to 6,000 attributed warheads on 1,600 ballistic missiles and bombers, with up to 4,900 warheads on ICBMs and SLBMs (see **Table 4**).[140] START also limited each side to 1,540 warheads on "heavy" ICBMs, which represented a 50% reduction in the number of warheads deployed on the SS-18 ICBMs. The United States placed a high priority on reductions in Soviet heavy ICBMs during the negotiations (as it had during the SALT negotiations) and seemed to succeed, with this provision, in reducing the Soviet advantage in this category of weapons.

When the Soviet Union collapsed at the end of 1991, about 70% of the strategic nuclear weapons covered by START were deployed at bases in Russia, and the other 30% were deployed in Ukraine, Belarus, and Kazakhstan. In May 1992, the four newly independent countries and the United States signed a protocol that made all four post-Soviet states parties to the treaty, and Ukraine, Belarus, and Kazakhstan agreed to eliminate all of the nuclear weapons on their territory. The collapse of the Soviet Union also led to calls for deeper reductions in strategic offensive arms. As a result, the United States and Russia signed a second treaty, known as START II, in January 1993, weeks before the end of the Bush Administration. START II would have limited each side to between 3,000 and 3,500 warheads; reductions initially were to occur by the year 2003, but that deadline would have been extended until 2007 if the nations had approved a new protocol. In addition, START II would have banned all MIRVed ICBMs. As a result, it would

[138] In 2014, the United States determined that Russia had violated the INF Treaty by developing and testing a new ground-launched cruise missile of INF range. After years of seeking to convince Russia to return to compliance, the United States announced that it would withdraw from the treaty on August 2, 2019. For details, see CRS Report R43832, *Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty: Background and Issues for Congress*, by Amy F. Woolf.

[139] Before the talks broke down in 1983, the United States had added a limit of 400 heavy bombers to its proposal, in response to criticism that the U.S. position was far too one-sided with its focus on limiting MIRVed ICBMs.

[140] While START contained a limit on the number of permitted warheads, the two sides did not actually count the warheads on each missile. They listed the number of warheads attributed to each type of missile in a database and calculated the number that counted under the treaty. The parties could not deploy missiles with more than the attributed number of warheads, and, with some exceptions, the calculation would count the attributed number of warheads even if the parties reduced the number on some missiles. Moreover, some weapons carried on bombers did not count against the treaty's limits, so each side could deploy 8,000 or 9,000 actual weapons while remaining within the limit of 6,000 total weapons.

have accomplished the long-standing U.S. objective of eliminating the Soviet SS-18 heavy ICBMs.

Although START II was signed in early January 1993, its full consideration was delayed until START entered into force at the end of 1994, during a dispute over the future of the Arms Control and Disarmament Agency. The U.S. Senate eventually consented to its ratification on January 26, 1996. The Russian Duma also delayed its consideration of START II as members addressed concerns about some of the limits. Russia also objected to the economic costs it would bear when implementing the treaty, because, with many Soviet-era systems nearing the end of their service lives, Russia would have to invest in new systems to maintain forces at START levels. This proved difficult as Russia endured a financial crisis in the latter half of the 1990s. The treaty's future clouded again after the United States sought to negotiate amendments to the 1972 ABM Treaty. With these delays and disputes, START II never entered into force, although Russian nuclear forces continued to decline as Russia retired its older systems.

The Moscow Treaty and New START

Although the START Treaty was due to remain in force through December 2009, the United States and Russia signed the Strategic Offensive Reductions Treaty, known as the Moscow Treaty, in May 2002. The United States had not expected to negotiate a new treaty. During a summit meeting with Russian President Putin, President Bush stated that the United States would reduce its "operationally deployed" strategic nuclear warheads to between 1,700 and 2,200 warheads during the next decade. President Putin indicated that Russia wanted to use the formal arms control process to reach a "reliable and verifiable agreement" in the form of a legally binding treaty that would provide "predictability and transparency" and ensure the "irreversibility of the reduction of nuclear forces."[141] The United States preferred a less formal process—such as an exchange of letters and, possibly, new transparency measures—that would allow the United States to maintain the flexibility to size and structure its nuclear forces in response to its own needs. The resulting treaty satisfied these objectives; it codified the planned reductions to 1,700-2,200 warheads, but it contained no definitions, counting rules, or schedules to guide implementation. Each party would simply declare the number of operationally deployed warheads (a term that remained undefined) in its forces at the implementation deadline of December 31, 2012. The treaty would then expire, allowing both parties to restore forces or remain at the limit. The treaty also lacked monitoring and verification provisions, but because the original START Treaty remained in force, its verification provisions continued to provide insights into Russian forces.

Knowing that the verification provisions in START were due to expire in late 2009, the United States and Russia began to discuss options for arms control after START in mid-2006, but they were unable to agree on a path forward. The United States initially did not want to negotiate a new treaty, but it would have been willing to informally extend some of START's monitoring provisions. Russia wanted to replace START with a new treaty that would further reduce deployed forces while using many of the same definitions and counting rules in START. In December 2008, the two sides agreed that they wanted to replace START before it expired, but acknowledged that this task would have to be left to negotiations between Russia and the Obama Administration. These talks began in early 2009; the United States and Russia signed the new Strategic Arms Reduction Treaty (New START) in April 2010.

[141] Comments of General Yuri Baluyevskiy. U.S. Department of Defense. Under Secretary Feith Joint Media Availability with Russian First Deputy Chief. News Transcript. Washington, January 16, 2002.

The New START Treaty limits each side to no more than 800 deployed and nondeployed ICBM and SLBM launchers and deployed and nondeployed heavy bombers equipped to carry nuclear armaments. Within that total, it limits each side to no more than 700 deployed ICBMs, SLBMs, and heavy bombers equipped to carry nuclear armaments. The treaty also limits each side to no more than 1,550 deployed warheads; this limit counts the actual number of warheads carried by deployed ICBMs and SLBMs, and one warhead for each deployed heavy bomber equipped for nuclear armaments. New START also contains a monitoring regime, similar to the regime in START, that requires extensive data exchanges, exhibitions, and on-site inspections to verify compliance with the treaty.

The limits in New START differ from those in the original START Treaty in a number of ways. First, START contained sublimits on warheads attributed to different types of strategic weapons, in part because the United States wanted the treaty to impose specific limits on elements of the Soviet force that were deemed to be destabilizing. New START, in contrast, contains only a single limit on the aggregate number of deployed warheads, thereby providing each nation with the freedom to mix their forces as they see fit. Second, under START, to determine the number of warheads that counted against the treaty limits, the United States and Russia tallied the number of deployed launchers, assuming that each launcher contained a missile carrying the number of warheads "attributed" to that type of missile. Under New START, the United States and Russia also count the number of deployed launchers, but instead of calculating an attributed number of warheads, they simply declare the total number of warheads deployed across their force.

Table 4 summarizes the limits in START, the Moscow Treaty, and New START. **Figure 4** shows how the numbers of warheads and launchers in Russia's strategic nuclear forces have declined over the last 20 years. Because the definitions and counting rules differ, it is difficult to compare the force sizes across treaties. Moreover, Russia's fiscal crisis in the late 1990s and subsequent delays in some of its modernization programs may have produced similar reductions even in the absence of arms control. Nevertheless, while the numbers of warheads on Soviet strategic nuclear forces peaked in the late 1980s, the numbers have declined since the two sides began implementing the reductions mandated by these treaties.

Table 4. Limits in START, Moscow Treaty, and New START

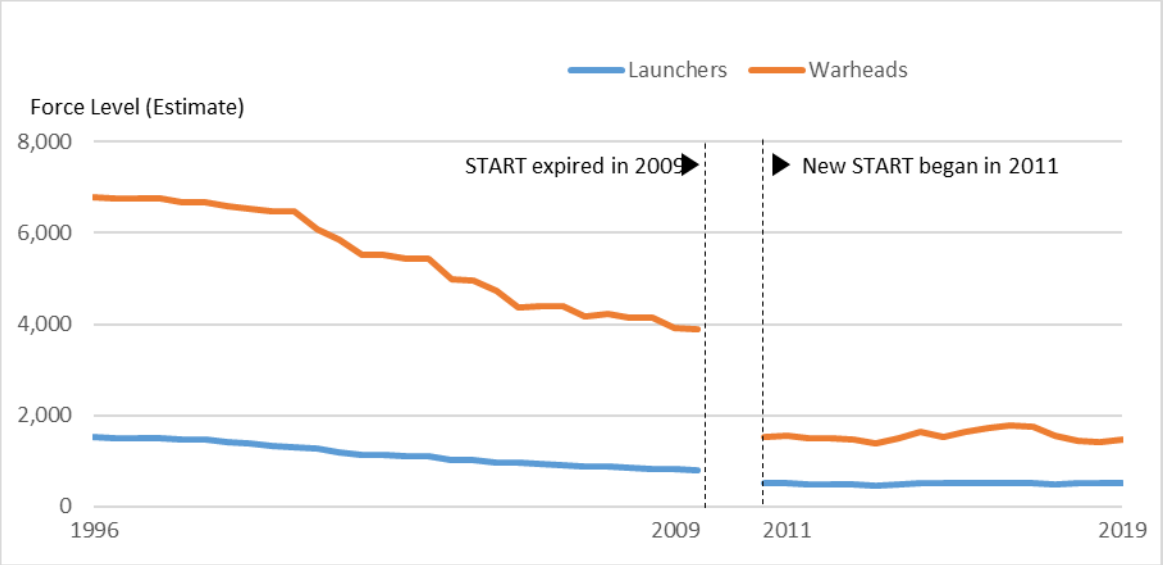
Treaty	START (1991)	Moscow Treaty (2002)	New START (2010)
Limits on Delivery Vehicles	1,600 strategic nuclear delivery vehicles	No limits	800 deployed and nondeployed ICBM launchers, SLBM launchers, and heavy bombers equipped to carry nuclear weapons Within the 800 limit, 700 deployed ICBMs, SLBMs, and heavy bombers equipped to carry nuclear weapons

Treaty	START (1991)	Moscow Treaty (2002)	New START (2010)
Limits on Warheads	6,000 warheads attributed to ICBMs, SLBMs, and heavy bombers 4,900 warheads attributed to ICBMs and SLBMs 1,100 warheads attributed to mobile ICBMs 1,540 warheads attributed to heavy ICBMs	1,700-2,200 deployed strategic warheads No sublimits	1,550 deployed warheads No sublimits
Limits on Throwweight	3,600 metric tons	No limit	No limit

Source: State Department fact sheets.

Figure 4. Russian Strategic Forces and Arms Control

START: 1994-2009, New START: 2011-2019



Source: State Department Fact Sheets.

Notes: The break in the graph between 2009 and 2011 reflects the fact that START expired in 2009 and New START entered into force in 2011. Although the Moscow Treaty remained in force during that time, the two parties did not exchange data under that treaty.

Issues for Congress

Congress has held several hearings in recent years where it has sought information about Russian nuclear weapons and raised concerns about the pace and direction of Russia's nuclear modernization programs. Specifically, some Members have questioned whether Russia and the United States are approaching a new arms race as both modernize their forces; they have addressed concerns about the future size and structure of Russia's nuclear forces after the New START Treaty lapses, and they have sought to understand the content of and debate about Russia's nuclear doctrine. This section reviews some of the key issues discussed in these hearings.

Arms Race Dynamics

The United States and Russia are both pursuing modernization programs to rebuild and recapitalize their nuclear forces. Each began this process to replace existing systems that have been in service since the Cold War and are reaching the end of their service lives. In many cases, both nations have extended the life of these aging systems. Russia retains some ballistic missiles that the Soviet Union first fielded in the 1980s (and, therefore, were expected to be replaced by the early 2000s); it may retire many of these over the next 10 years as it completes its current modernization programs. The United States extended the life of its Ohio-class submarines from 30 to 42 years by refueling their reactor cores, and it extended the lives of both land-based and submarine-based missiles by replacing the propellant in existing motors and replacing guidance systems. The United States plans to begin fielding new systems in the late 2020s.[142]

Many analysts and observers have identified an arms race dynamic in these parallel modernization programs. Some believe that Russia is at fault—that the United States is falling behind because Russia began to deploy new missiles and submarines in the early 2000s, while the United States will not field similar systems until the late 2020s, and because Russia is developing new and more exotic systems, as described above. David Trachtenberg, the Principal Deputy Under Secretary of Defense for Policy, raised this point in April 2018, when he noted that "it takes two to race." He stated that the United States is "not interested in matching the Russians system for system. The Russians have been developing an incredible amount of new nuclear weapons systems, including the novel, nuclear systems that President Putin unveiled to great fanfare a number of months ago."[143] Franklin Miller, a former Pentagon and National Security Council official, made a similar point during a Senate Armed Services Committee hearing in early 2019 when he noted that "the [U.S.] program is not creating a nuclear arms race. Russia and China began modernizing and expanding their nuclear forces in the 2008-2010 timeframe and since then have been placing large numbers of new strategic nuclear systems in the field. The United States has not deployed a new nuclear delivery system in this century and the first products of our nuclear modernization program will not be deployed until the mid to late 2020s."[144]

Others argue that the United States is spurring the arms race, in that the expansive U.S. modernization program might heighten the mistrust between the two nations and provide Russia with an incentive to expand its programs beyond what was needed to replace aging Soviet-era systems.[145] Former Secretary of Defense William Perry raised this point in an interview in 2015, when the Obama Administration offered its support to the full scope of U.S. nuclear modernization programs. He noted that "we're now at the precipice, maybe I should say the brink, of a new nuclear arms race" that "will be at least as expensive as the arms race we had during the Cold War, which is a lot of money."[146]

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[142] For details on U.S. life extension and modernization programs, see CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf.

[143] David Trachtenberg, *The Future of U.S. Extended Deterrence*, Brookings Institution, April 24 2018.

[144] U.S. Congress, Senate Committee on Armed Services, *Nuclear Policy and Posture*, 116th Cong., 1st sess., February 28, 2019.

[145] Scott Paltrow, "Special Report: In modernizing nuclear arsenal, U.S. stokes new arms race," *Reuters*, November 21, 2017, https://www.reuters.com/article/us-usa-nuclear-modernize-specialreport/special-report-in-modernizing-nuclear-arsenal-u-s-stokes-new-arms-race-idUSKBN1DL1AH. See, also, Richard Sokolosky and Gordon Adams, "Obama Is About To Launch A New Nuclear Arms Race. There's a Better Way.," Defense One, January 18, 2016, https://www.defenseone.com/ideas/2016/01/obama-about-launch-new-nuclear-arms-race-theres-better-way/125174/.

[146] Aaron Mehta, "Former SecDef Perry: US on 'Brink' of New Nuclear Arms Race," *Defense News*, December 3,

Some have disputed the notion that the modernization programs are either evidence of an arms race or an incentive to pursue one. Both nations are modernizing their forces because existing systems are aging out; neither is pursuing these programs because the other is modernizing its forces, and neither would likely cancel its programs if the other refrained from its efforts. As former Secretary of Defense Ashton Carter noted in 2016, "In the end, though, this is about maintaining the bedrock of our security and after too many years of not investing enough, it's an investment that we, as a nation, have to make because it's critical to sustaining nuclear deterrence in the 21st century."[147] Russia seems to be in a similar position; it delayed a planned modernization cycle in the late 1990s and has been pursuing a number of programs at a relatively slow pace since that time. Moreover, the new types of strategic offensive arms introduced recently seem to be more of a response to concerns about U.S. missile defense programs than a response to U.S. offensive modernization programs.

The Future of Arms Control

In 2018 and 2019, Trump Administration officials indicated that they were reviewing New START and assessing whether it continued to serve U.S. national security interests before deciding whether the United States would propose or accept a five-year extension.[148] In April 2019, President Trump directed his staff to develop proposals for expanded arms control efforts, instead of pursuing an extension of New START, that would include China as a party and that would capture all of Russia's nuclear weapons, including several of the new types of systems described in this report.[149] Nevertheless, the Trump Administration held several meetings with Russia in 2020 to discuss the possible extension of the treaty.[150]

While these talks continued through October 2020, the two sides were unable to reach an agreement. The United States eventually agreed, in principle, to extend New START for one year in exchange for Russia's agreement on a one-year freeze on the size of nuclear stockpile.[151] The parties did not, however, agree on the precise definitions needed to implement the warhead freeze or the necessary verification procedures needed to monitor it.[152] The United States and Russia did not resolve their differences before the end of the Trump Administration. The Biden

2015, https://dod.defense.gov/News/Transcripts/Transcript-View/Article/956079/remarks-by-secretary-carter-to-troops-at-minot-air-force-base-north-dakota/s://; www.defensenews.com/pentagon/2015/12/03/former-secdef-perry-us-on-brink-of-new-nuclear-arms-race/.

[147] U.S. Department of Defense, *Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota*, Transcript, Washington, DC, September 26, 2016, https://dod.defense.gov/News/Transcripts/Transcript-View/Article/956079/remarks-by-secretary-carter-to-troops-at-minot-air-force-base-north-dakota/.

[148] U.S. Congress, Senate Committee on Foreign Relations, *Status of U.S.-Russia Arms Control Efforts*, Hearing, 115th Cong., 2nd sess., September 18, 2018. See the prepared statement of Honorable David Trachtenberg, Deputy Under Secretary of Defense for Policy, https://www.foreign.senate.gov/imo/media/doc/091818_Trachtenberg_Testimony.pdf.

[149] Paul Sonne and John Hudson, "Trump orders staff to prepare arms-control push with Russia and China," *Washington Post*, April 25, 2019, https://www.washingtonpost.com/world/national-security/trump-orders-staff-to-prepare-arms-control-push-with-russia-and-china/2019/04/25/c7f05e04-6076-11e9-9412-daf3d2e67c6d_story.html?utm_term=.3e294ce0a8e9.

[150] For a detailed description of these negotiations, see CRS Report R41219, *The New START Treaty: Central Limits and Key Provisions*, by Amy F. Woolf, pp. 46-50.

[151] Michael R. Gordon, "U.S., Russia Move Toward Outline of Nuclear Deal, Administration Says," *Wall Street Journal*, October 5, 2020, https://www.wsj.com/articles/u-s-russia-move-toward-outline-of-nuclear-deal-administration-official-says-11601933654.

[152] David Lawler, "Trump aiming for nuclear arms deal with Russia before Election Day," *Axios*, October 9, 2020, https://www.axios.com/trump-russia-nuclear-arms-agreement-new-start-4fe42c37-83e0-4088-aa26-b37f8a07bf7f.html.

Administration endorsed a five-year extension of New START on January 21, 2021; the United States and Russia exchanged diplomatic notes that achieved this goal on February 3, 2021.[153]

Russia's nuclear modernization programs, in general, and its development of new kinds of strategic offensive arms were one of the key issues that raised concerns in discussions about New START extension. For example, General John Hyten, while serving as the commander of U.S. Strategic Command (STRATCOM), stated that he believed New START serves U.S. national security interests because its monitoring regime provides transparency and visibility into Russian nuclear forces, and because its limits provide predictability about the future size and structure of those forces. However, in testimony before the Senate Armed Services Committee in February 2019, General Hyten expressed concern about Russia's new nuclear delivery systems—the Poseidon underwater drone, the Burevestnik nuclear-powered cruise missile, the Kinzhal air-launched ballistic missile, and the Tsirkon hypersonic cruise missile—which would not count under New START's limits. He noted that these weapons could eventually pose a threat to the United States and that he believed the United States and Russia should expand New START so they would count them under the treaty.[154]

Some analysts have questioned whether this approach made sense because Russia is not likely to deploy these systems until later in the 2020s. Even then, the numbers are likely to be relatively small. On the other hand, Russia began to deploy the Avangard hypersonic glide vehicle in late December 2019 and may deploy the Sarmat heavy ballistic missile in 2022. Both will count under New START. However, if New START had expired, Russia would no longer be bound by any numerical limits on the number of long-range missiles and heavy bombers it can deploy, or the number of nuclear warheads that could be deployed on those missiles and bombers. Because Russia is already producing new missiles like the Yars, it could possibly accelerate production to increase the number of warheads added to the force. Russia could also possibly add to the number of warheads deployed on some of these missiles, increasing them from four warheads to six to eight warheads per missile. In addition, Russia will likely have to limit the deployment of the Sarmat missile and retire old SS-18 missiles to remain under New START limits, but it could have deployed hundreds of new warheads on the Sarmat between 2022 and 2026 if the treaty were not in place. According to some analyses, if Russia had expanded its forces with these changes, it could possibly add more than 1,000 warheads to its force without increasing the number of deployed missiles between 2021 and 2026.[155]

The Debate Over Russia's Nuclear Doctrine

The 2018 Nuclear Posture Review (NPR) adheres to the view that Russia has adopted an "escalate to de-escalate" strategy and asserts that Russia "mistakenly assesses that the threat of

[153] Antony J. Blinken, U.S. Secretary of State, On the Extension of the New START Treaty with the Russian Federation, U.S. Department of State, press statement, Washington, DC, February 3, 2021, https://www.state.gov/on-the-extension-of-the-new-start-treaty-with-the-russian-federation/. See, also, Statement by the Ministry of Foreign Affairs of the Russian Federation on the extension of the Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms, February 3, 2021, https://www.mid.ru/foreign_policy/news/-/asset_publisher/cKNonkJE02Bw/content/id/4551078.

[154] Joe Gould, "US nuclear general worries over Russia's weapons outside New START," *Defense News*, February 26, 2019, https://www.defensenews.com/smr/nuclear-arsenal/2019/02/26/us-nuclear-general-worries-over-russias-weapons-outside-new-start/.

[155] For a detailed discussion on these implications, see Vince Manzo, *Nuclear Arms Control Without a Treaty? Risks and Options after New START*, Center for Naval Analysis, Arlington, VA, March 2019, p, 53. https://www.cna.org/CNA_files/PDF/IRM-2019-U-019494.pdf.

nuclear escalation or actual first use of nuclear weapons would serve to 'de-escalate' a conflict on terms favorable to Russia."[156] The NPR's primary concern is with a scenario where Russia executes a land-grab on a NATO ally's territory and then presents U.S. and NATO forces with a fait accompli by threatening to use nuclear weapons. The NPR thus recommends that the United States develop new low-yield nonstrategic weapons that, it argues, would provide the United States with a credible response, thereby "ensuring that the Russian leadership does not miscalculate regarding the consequences of limited nuclear first use."[157]

While some experts outside government agree with the assessment of Russian nuclear doctrine described in the Nuclear Posture Review,[158] others argue that it overstates or is inconsistent with Russian statements and actions. Some have argued that the NPR's "evidence of a dropped threshold for Russian nuclear employment is weak." They note that, although some Russian authors and analysts advocated such an approach, was not evident in the government documents published in 2010 and 2014. As a result, they argue that the advocates for this type of strategy may have lost the bureaucratic debates.[159] Others have reviewed reports on Russian military exercises and have disputed the conclusion that there is evidence that Russia simulated nuclear use against NATO in large conventional exercises.[160]

One analyst has postulated that Russia may actually raise its nuclear threshold as it bolsters its conventional forces. According to this analyst, "It is difficult to understand why Russia would want to pursue military adventurism that would risk all-out confrontation with a technologically advanced and nuclear-armed adversary like NATO. While opportunistic, and possibly even reckless, the Putin regime does not appear to be suicidal."[161] As a study from the RAND Corporation noted, Russia has "invested considerable sums in developing and fielding long-range conventional strike weapons since the mid-2000s to provide Russian leadership with a buffer against reaching the nuclear threshold—a set of conventional escalatory options that can achieve strategic effects without resorting to nuclear weapons."[162] Others note, however, that Russia has integrated these "conventional precision weapons and nuclear weapons into a single strategic weapon set," lending credence to the view that Russia may be prepared to employ, or threaten to employ, nuclear weapons during a regional conflict.[163]

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[156] Department of Defense, Nuclear Posture Review, Washington, DC, February 2, 2018, p. 8, https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINALREPORT.PDF.

[157] Ibid., p. 30.

[158] Matthew Kroenig, "The Case for U.S. Tactical Nukes," *Wall Street Journal*, January 24, 2018, https://www.wsj.com/articles/the-case-for-tactical-u-s-nukes-1516836395. See also Elbridge Colby, "Countering Russian Nuclear Strategy In Central Europe," *Center for New American Security*, November 11, 2015, https://www.cnas.org/publications/commentary/countering-russian-nuclear-strategy-in-central-europe.

[159] Olga Oliker and Andrey Baklitsky, "The Nuclear Posture Review and Russian 'De-Escalation:' a Dangerous Solution to a Nonexistent Problem," War on the Rocks, February 20, 2018, https://warontherocks.com/2018/02/nuclear-posture-review-russian-de-escalation-dangerous-solution-nonexistent-problem/.

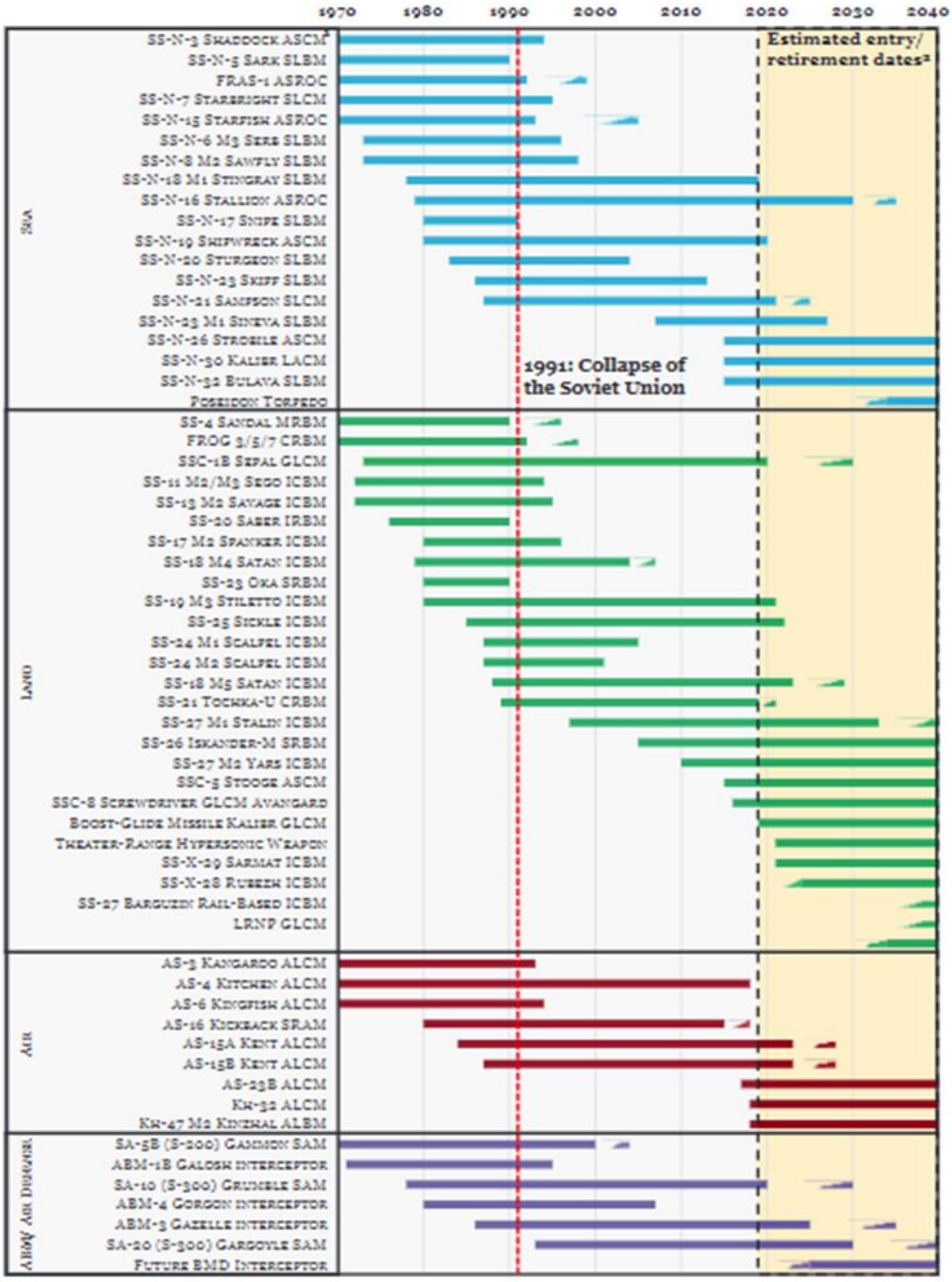
[160] Bruno Tetrais, "Does Russia really include limited nuclear strikes in its large-scale military exercises?," *Survival*, February 15, 2018, https://www.iiss.org/blogs/survival-blog/2018/02/russia-nuclear.

[161] Kristin Ven Bruusgaard, "The Myth of Russia's Lowered Nuclear Threshold," War on the Rocks, September 22, 2017, https://warontherocks.com/2017/09/the-myth-of-russias-lowered-nuclear-threshold/.

[162] Scott Boston and Dara Massicot, "The Russian Way of Warfare," RAND Perspective, 2017, https://www.rand.org/pubs/perspectives/PE231.html.

[163] Dave Johnson, "Russia's Conventional Precision Strike Capabilities, Regional Crises, and Nuclear Thresholds," LLNL paper, February 2018, https://cgsr.llnl.gov/content/assets/docs/Precision-Strike-Capabilities-report-v3-7.pdf.

Appendix A. Russian Nuclear-Capable Delivery Systems



Source: Center for Strategic and Budgetary Assessments, *Assessing the Arsenals: Past, Present, and Future Capabilities*, March 15, 2019, https://csbaonline.org/research/publications/Assessing_the_Arsenals_Past_Present_and_Future_Capabilities/publication.

Appendix B. Russian Nuclear Storage Facilities

Source: United Nations Institute for Disarmament Research (UNIDIR), Lock them Up: Zero-deployed Non-strategic Nuclear Weapons in Europe, 2017, http://www.unidir.org/files/publications/pdfs/lock-them-up-zero-deployed-non-strategic-nuclear-weapons-in-europe-en-675.pdf.

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