ANALYSIS

ESTIMATING THE NUMBER AND CHARACTERISTICS OF RUSSIA'S STRATEGIC NUCLEAR WEAPONS

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Russian strategic nuclear modernization programs are the most extensive in the world, despite the fact that China is increasingly a competitor for this distinction. The sheer number of Russian nuclear programs is almost at the Soviet level, although the annual procurement rate is much more limited due to resource limitation and Western sanctions—resulting in a much slower pace of modernization than in the Soviet period. In January 2017, Russian Defense Minister General of the Army Sergei Shoigu stated that the development of the strategic nuclear forces was Russia's top priority, and that Russia will "…continue a massive program of nuclear rearmament, deploying modern ICBMs on land and sea, [and] modernizing the strategic bomber force."[1] Pavel Felgenhauer elaborated, "By 2020, Russia may have more than ten types of land-based deployed ICBMs and up to five different sea-based ballistic missiles, while the US has only two deployed long-range ballistic missiles—the vintage land-based Minuteman and the sea-based Trident."[2] Indeed, Russia has multiple systems for every leg of its nuclear Triad and is moving forward with novel systems with long-range capabilities that fall outside the traditional definition of a strategic Triad.[3]

Russia has announced more than 20 new or modernized strategic delivery systems since the end of the Cold War, most of which are being developed from post-Cold War designs.[4] In

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[1] Pavel Felgenhauer, "Kremlin Learning to Navigate Washington's New Unpredictability," *Eurasia Daily Monitor*, Vol. 14, No. 3 (January 19, 2017), available at https://jamestown.org /program/kremlin-learning-navigate-washingtons-new-unpredictability/.

[2] Loc. cit.

[3] Mary Beth D. Nikitin, *Russia's Nuclear Weapons: Doctrine, Forces, and Modernization* (Washington, D.C.: Congressional Research Service, April 21, 2022), p. 37, available at https://crsreports.congress.gov/product/pdf/R/R45861/16; and, Mark B. Schneider, "Russian Nuclear Weapons Policy," *Real Clear Defense*, April 28, 2017, available at https://www.realcleardefense.com/articles/2017/04/28/russian_nuclear_weapons_policy_111261.html.

[4] Ibid. See also, *Section II. Minimum Deterrence: Fragile Hope of a Constant and Benign Threat Environment* (Fairfax, VA: National Institute for Public Policy, September 2014), pp. 15-26, available at https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Litigation_Release/Litigation%20Release%20-%20Section%20II%20Minimum%20Deterrence%20Fragile%20Hope.pdf; "Russia developing new 'Osina' Yars missile variant," *BBC Monitoring Former Soviet Union*, June 16, 2021, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/183279F7D59204B8; Isabel Van Brugen, "Russia Creating Unstoppable Submarine Nuclear Missiles—Report," *Newsweek*, May 15, 2023, available at https://www.newsweek.com/russia-new-unstoppable-intercontinental-ballistic-missile-submarine-navy-1800313; Mark B. Schneider, "The Russian Nuclear Buildup and the Biden Administration Nuclear Posture Review," *Real Clear Defense*, September 21, 2021, available at https://www.realcleardefense.com/articles/2021/09/29/the_russian_nuclear_buildup_and

addition, Moscow is likely developing other strategic systems that have not been publicly announced. Indeed, the U.S. Department of Defense usually does not reveal anything about Russia's nuclear missiles that Moscow has not already made public. Russia's announced programs are in various stages of development, testing, or deployment.[5] However, Russia sometimes has more than one name for a missile system, which creates confusion. (Note that the current Yars-M ICBM is different from the RS-24 Rubezh ICBM, which was also called the Yars-M.)[6] The Russian government sometimes does not announce when a program is suspended. However, such information is usually disclosed in Russian media reports.

This analysis uses a broad range of open sources, governmental and nongovernmental, to estimate the size and characteristics of Russian strategic nuclear forces. Doing so can help inform an understanding of the nature of the Russian threat.

Regardless of whether President Putin remains in power, a large percentage of these programs is expected to go forward. Russia sees strategic forces as the core of its "great power" status; its modernization programs are extensive and reflect this perspective. Given Russian modernization cycles, it is anticipated that every system will be replaced by either an improved version or a new type. Despite Western sanctions, a weakened economy and its war against Ukraine, Russia has continued with the expansion and modernization of its nuclear arsenal.

Russian Strategic Nuclear Capabilities

According to the Russian government, its strategic nuclear forces on September 1, 2022 were composed of: 1) 540 deployed ICBMs, SLBMs and heavy bombers; 2) 1,549 nuclear warheads deployed on ICBMs, SLBMs and one counted for each heavy bomber; and, 3) 759 deployed and non-deployed ICBM launchers, SLBM launchers and heavy bombers.[7] At entry into force of the New START Treaty (February 2011), the declared Russian numbers were 527, 1,537 and 865, respectively. Thus, according to official Russian data, there has been a small increase in the number of its deployed warheads and delivery vehicles since the New START Treaty took effect.[8] However, the warhead number did not take into consideration the impact of Russian bomber modernization, which has enhanced the Russian bomber delivery

_the_biden_administration_nuclear_posture_review_796621.html; and, Mark B. Schneider, "Russian Strategic and Hypersonic Naval Nuclear Weapons," *Real Clear Defense*, November 21, 2020, available at https://www.realcleardefense.com/articles/2020/11/18/russian_strategic_and_hypersonic_naval_nuclear_weapons_650130.html.

[5] John A. Tirpak, "The Great Hypersonic Race," *Air Force Magazine*, June 27, 2018, available at https://www.airandspaceforces.com/article/the-great-hypersonic-race/.

[6] Pavel Podvig, "Too Many Missiles - Rubezh, Avangard, and Yars-M," *RussianForces.org*, July 6, 2013, available at https://russianforces.org/blog/2013/07/too_many_missiles_-_rubezh_ava.shtml.

[7] U.S. Department of State "New START Treaty Aggregate Numbers of Strategic Offensive Arms," *State.gov*, September 1, 2022, available at https://www.state.gov/new-start-treaty-aggregate-numbers-of-strategic-offensive-arms-4/.

[8] U.S. Department of State, *New START Treaty Aggregate Numbers of Strategic Offensive Arms* (Washington, D.C.: Department of State, October 25, 2011), p. 1, available at https://2009-2017.state.gov/documents/organization/176308.pdf.

New Russian Strategic Nuclear Delivery Vehicles

ICBMs:

- The new road-mobile and silo-based single warhead SS-27 Mod 1/Topol-M Variant 2 ICBM, which is operational and fully deployed;
- The new SS-27 Mod 2/RS-24/Yars MIRVed ICBM, which is operational and whose deployment is continuing;
- The improved Yars-S, which is operational and the deployment of which is continuing;
- The Yars-M, a novel missile design, which is under development;
- The Avangard hypersonic glider launched on the SS-19 ICBM, which is operational and the deployment of which is continuing;
- The Sarmat highly-MIRVed heavy ICBM, which is in testing with deployment announced for 2023;
- The new RS-26 Rubezh missile, called an "ICBM" by Russia, but in reality an intermediate-range missile, with deployment suspended pending a 2027 decision;
- The Barguzin rail-mobile ICBM, with deployment suspended pending a 2027 decision;
- The Osina-RV ICBM, perhaps a new road-mobile ICBM, which is under development; and,
- The Kedr ICBM, a reported replacement for the Yars, the development of which is probably about to start.

SLBMs and SSBNs:

- The new Borei and Borei A ballistic missile submarines;
- The new Bulava-30 missiles with new MIRV warheads which are operational, and deployment of which is continuing on new Borei submarines;
- An improved Bulava-30 SLBM, which is in development;
- A recently announced follow-on missile to replace the Bulava-30, the characteristics and status of which are unknown;
- The improved versions of the Soviet legacy SS-N-23 SLBM called the Sineva and the Layner/Liner, both of which are operational and the deployments which have been completed; and,
- The new Husky 5th generation ballistic missile submarine and a new liquid-fueled ballistic missile; the development of both probably is suspended.

Bombers:

- Repeated modernizations of the Blackjack (Tu-160) and the Bear (Tu-95) heavy bombers;
- A program to deploy at least 50 new Tu-160M2 bombers, the production of which is now underway;
- New nuclear cruise missiles including 1) the new Kh-102 stealthy long-range strategic cruise missile, which is operational; 2) the nuclear-capable Kh-101 long-range cruise missile, which is operational; and, 3) reported deployment of the Kinzhal hypersonic missile on the Tu-160; and,
- The development of a new stealthy heavy bomber, the Pak DA, which reportedly will carry cruise and hypersonic missiles.

Novel Systems:

- The Poseidon (previously called the Status-6) nuclear-powered, nuclear-armed drone carried by the large new Belgorod-class nuclear submarines, which is nearly operational; and,
- The Burevestnik nuclear-armed, nuclear-powered cruise missile, which is under development.

capability considerably. The reduction in Russian non-deployed delivery vehicles appears to be the result of scrapping systems that were no longer functional, such as the Typhoon ballistic missile submarines, which reportedly were no longer operational even in 2011. (The main problem with the Typhoons was the lack of missiles**,** as many were eliminated by 2012 under the Cooperative Threat Reduction program.)[9]

Alexei Arbatov, former Deputy Chairman of the Duma Defense Committee, turned out to be correct in 2010 when he said that New START was a Treaty that would only limit U.S. strategic forces, which were reduced in all three New START categories by hundreds of weapons and delivery systems.[10] Indeed, during the 2010 Russian New START ratification hearings, then Defense Minister Anatoly Serdyukov said, "The parameters laid down in the treaty will in no way reduce the potential of our strategic forces."[11] Furthermore, he said that Russia intended to *increase* its forces up to the New START Treaty limits of 700 deployed strategic delivery vehicles, 1,550 deployed warheads, and 800 total deployed and non-deployed delivery systems.[12]

The following chart was released by the Department of State in March 2022.[13] It does not include the increase in Russian force levels reported in the last Russian New START Treaty data notification provided to the United States on September 1, 2022.

[9] Pavel Podvig, "Elimination of R-39/SS-N-20 Missiles," *RussianForces.org*, September 18, 2012, available at https://russianforces.org/blog/2012/09/elimination_of_r-39ss-n-20_mis.shtml.

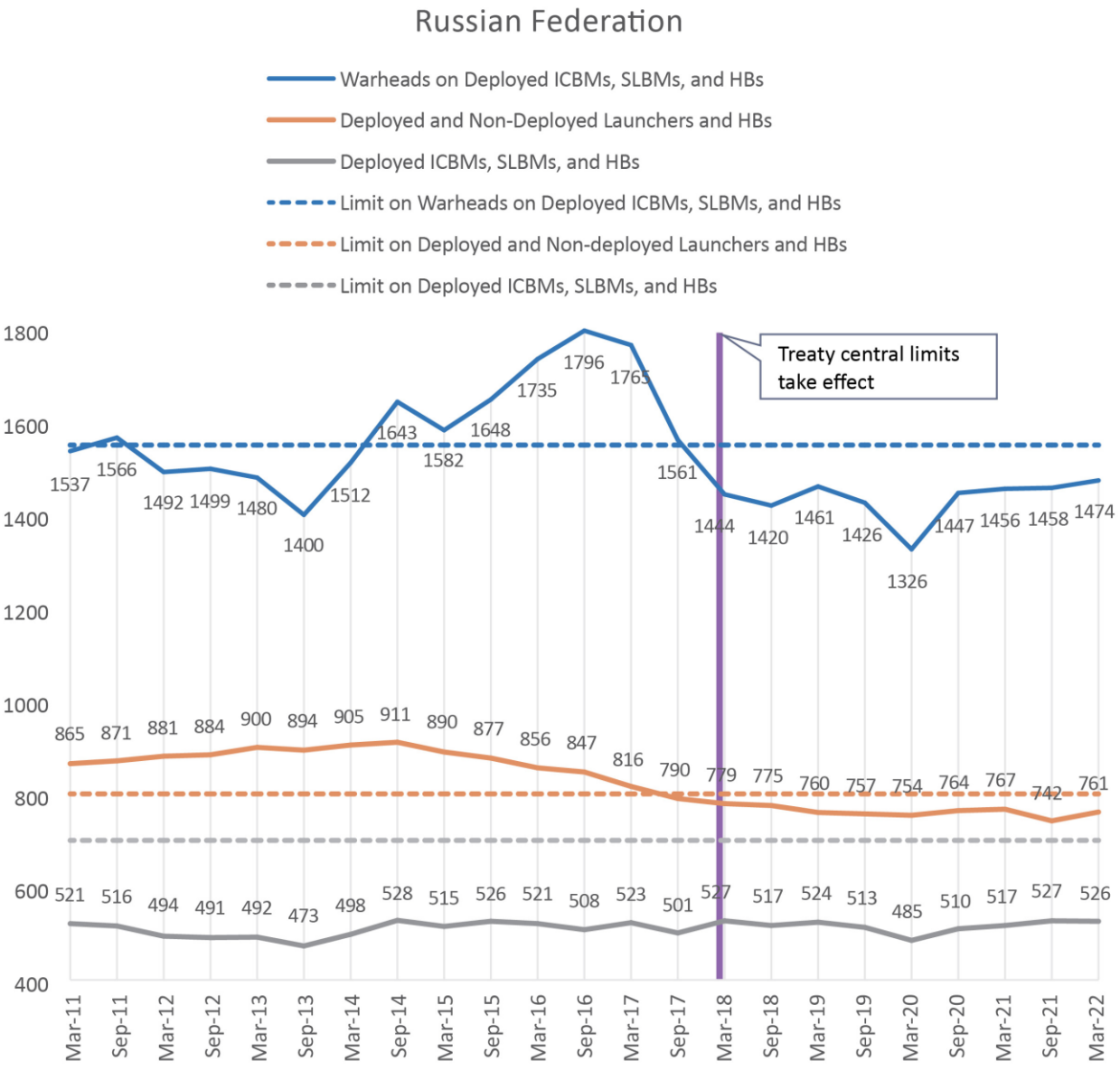
[10] Quoted in Mark B. Schneider, *New START: The Anatomy of a Failed Negotiation* (Fairfax, VA: National Institute Press, July 2012), p. iii, available at http://www.nipp.org/wp-content/uploads/2014/12/New-start.pdf; and, U.S. Department of State, "New START Treaty Aggregate Numbers of Strategic Offensive Arms," September 1, 2022, op. cit.

[11] Keith B. Payne, "Postscript on New START **-** The Senate was Misinformed about the Nuclear Treaty," *National Review*, January 18, 2011, available at http://www.nationalreview.com/articles/257329/postscript-new-start-keith-bpayne; "Defence Minister Outlines Benefits of New START Treaty to Russia," *BBC Monitoring Former Soviet Union*, December 24, 2010, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/134578172F18FDD8; and, "Nuclear Treaty Goes Easy on Russia: Analysts," *Dawn.com,* December 27, 2010, available at https://www.dawn.com/news/593943/nuclear-treaty-goes-easy-on-russia-analysts.

[12] Ibid.

[13] U.S. Department of State, "New START Treaty Aggregate Numbers of Strategic Offensive Arms of the United States and the Russian Federation, February 2011 – March 2022," *State.gov*, March 1, 2022, available at https://www.state.gov/new-start-treaty-aggregate-numbers-of-strategic-offensive-arms-of-the-united-states-and-the-russian-federation-february-2011-march-2022/.

Russian Nuclear Weapons and Treaty Limits



Source: U.S. Department of State

The Number of Russian Strategic Nuclear Weapons

As noted previously, then Principal Deputy Under Secretary of Defense for Policy Dr. James Miller's 2011 numbers on Russia's nuclear inventory[14] suggested it had up to 2,500 strategic nuclear weapons. This number appears to be the then-declared Russian number of deployed strategic nuclear warheads under the New START Treaty plus the well-documented delivery capability of Russian strategic nuclear bombers, which is generally reported at about 800. Dr. Miller's numbers with regard to the total Russian nuclear weapons inventory (4,000-6,500)[15] have never been publicly updated by the Defense Department.

The official Russian position, repeatedly stated at the Nuclear Non-Proliferation Treaty (NPT) review conferences, is that Russia has reduced its strategic nuclear forces by 85 percent since the Cold War.[16] However, this appears to be misleading, as Russia is comparing the New START Treaty accountability number (which grossly undercounts Russian bomber weapons) to the original (1990) START Treaty accountability number (10,271),[17] which used different counting rules.

Despite this apples-to-oranges comparison, in December 2018, General Karakayev stated that, "…the nuclear potentials of the sides have [been] reduced more than 66 percent since the signing of START I."[18] The difference between an 85 percent reduction and a 66 percent reduction is almost 2,000 strategic nuclear warheads, which suggests Russia, at that time, had about 3,300 strategic nuclear weapons, well above the New START Treaty-allowed level of 1,550. It is not possible to get this high a number by just adding about 800 bomber-delivered weapons unaccountable under the New START Treaty.[19] Instead, it is likely that at least part of the difference is made up by additional cruise missiles, nuclear gravity bombs, and possibly short-range nuclear missiles.[20] Significant numbers of nuclear gravity bombs

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[14] James Miller, as quoted in, U.S. House of Representatives, *The Current Status and Future Direction for U.S. Nuclear Weapons Policy and Posture* (Washington, D.C.: Armed Services Committee, Subcommittee on Strategic Forces, November 2, 2011), available at https://www.govinfo.gov/content/pkg/CHRG-112hhrg71527/html/CHRG-112hhrg71527.htm.

[15] Loc. cit.

[16] *Statement by Mr. Dmitry Polyanskiy, First Deputy Permanent Representative of the Russian Federation to the UN, during General Debate at the UN Disarmament Commission 2018*, Permanent Mission of the Russian Federation to the United Nations, April 2, 2018, available at http://russiaun.ru/en/news/desarm0204.

[17] *START Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms Signed in Moscow July 31, 1991*, op. cit., p. 122.

[18] "U.S. to seek ways of leveling capacities of Russian strategic nuclear forces - Gen. Karakayev," *Interfax*, December 17, 2018, available at https://interfax.com/; and, "US to look for new ways of neutralizing Russian strategic nuclear forces." *TASS*, December 16, 2018, available at https://tass.com/defense/1036341.

[19] U.S. Department of State, "New START Treaty Aggregate Numbers of Strategic Offensive Arms," *State.gov*, October 2, 2017, available at https://2017-2021.state.gov/new-start-treaty-aggregate-numbers-of-strategic-offensive-arms-5/index.html.

[20] "Winged Snipers: Best of the Best of Russia's Ballistic and Cruise Missiles," *Sputnik*, December 23, 2017, available at https://sputnikglobe.com/20171223/russian-air-launched-ballistic-cruise-missiles-1060272064.html; and, Hans M. Kristensen and Matt Korda, "Russian Nuclear Weapons, 2022," *Bulletin of the Atomic Scientists*, Vol. 78, No. 2 (2022), p. 99.

and short-range missiles could be included in the count of actual Russian bomber weapons. These could explain, in part, Karakayev's 3,300 overall number.

In addition, these systems could be augmented by undeclared SS-27 Mod 2/RS-24 Yars mobile ICBMs. If so, then the total number of deployed strategic nuclear weapons could easily reach 3,300. The Soviet Union established a precedent for covert deployment of mobile ICBMs; therefore, such a possibility today should not be summarily dismissed. Indeed, the Reagan Administration's first Soviet arms control non-compliance report in January 1984 concluded that the SS-16 ICBM was deployed at Plesetsk in "probable violation" of the SALT II Treaty prohibition on its deployment.[21] Many years later, when SALT II was apparently forgotten, Russian generals and the chief designer of the SS-16 acknowledged its deployment by the Soviet Union, which was a violation of the SALT II prohibition.[22]

If Russia had 3,300 deployed strategic nuclear weapons in 2018, the potential covert upload capability due to continued modernization, the end of on-site inspections in 2020**,** and Russia's New START Treaty "suspension" could have allowed Russia to add even more weapons to the 3,300 number. Indeed, well-known Russian expert Sergei Rogov reportedly stated that the "…overall number of [Russian] strategic nuclear weapons, including those in storage, could be as high as around 6,000."[23]

In a 2014 article, Colonel (ret.) Houston T. Hawkins of the Los Alamos National Laboratory, wrote that, "Today, estimates are that Russia has about 4,500 strategic weapons in its inventory. But how accurate are these new estimates?"[24] He noted that the primary driver for Cold War-era estimates of Soviet strategic nuclear weapons was the assessed amount of Soviet Highly Enriched Uranium (HEU), which the United States underestimated by at least 100 percent.[25] Today, it appears that the Russian stockpile of fissile material is vastly in excess of what Russia could possibly need for any of the currently estimated nuclear warhead numbers. The information in Hawkins's article was subjected to a security review and it is unlikely that a U.S. National Laboratory would have published an article on such an important subject that lacked credibility. A Russian strategic nuclear stockpile of 4,500 weapons in 2014 would have indicated a significant upload capability, allowing Russia to achieve a rapid breakout from the New START Treaty. In the current context of no on-site inspections for more than three years, such a hedge force could support large-scale cheating.

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[21] Ronald Reagan, *Message to the Congress Transmitting a Report and a Fact Sheet on Soviet Noncompliance With Arms Control Agreements*, ReaganLibrary.gov, January 23, 1984, available at https://www.reaganlibrary.gov/archives/speech/message-congress-transmitting-report-and-fact-sheet-soviet-noncompliance-arms.

[22] Schneider, *New START: The Anatomy of a Failed Negotiation*, op. cit., pp. 36-37.

[23] Pavel Felgenhauer, "Kremlin Overrules Own Defense and Foreign Policy Establishment on Arms Control," *Eurasia Daily Monitor*, Vol. 17, Iss. 149 (October 22, 2020), available at https://jamestown.org/program/kremlin-overrules-own-defense-and-foreign-policy-establishment-on-arms-control/.

[24] Houston T. Hawkins, *Rethinking the Unthinkable* (Los Alamos, NM: Los Alamos National Laboratory, July 23, 2014), LA-UR-14-25647, p. 10, available at https://www.osti.gov/biblio/1148302.

[25] Ibid.

There is other evidence of Russian expansion of its nuclear force. In 2019, the Director of the Defense Intelligence Agency (DIA) Lt. General Robert P. Ashley, Jr., in a speech delivered at the Hudson Institute, stated that "…during the past decade, Russia has improved and expanded its [nuclear weapons] production complex, which has the capacity to process thousands of warheads annually."[26] Russia does not have money to waste even on its highest priority programs, strategic nuclear forces. Russia does not need a capability to produce and/or dismantle "thousands" of weapons a year to sustain a roughly 6,000-warhead stockpile as assessed by the Federal of American Scientists (FAS) in its February 2022 and May 2023 reports. This suggests that Russia desires to increase its nuclear weapons capability massively. The question is: Why?

In December 2017, American journalist Bill Gertz reported, "Russia is aggressively building up its nuclear forces and is expected to deploy a total force of 8,000 warheads by 2026 along with modernizing deep underground bunkers, according to Pentagon officials. The 8,000 warheads will include both large strategic warheads and thousands of new low-yield and very low-yield warheads to circumvent arms treaty limits and support Moscow's new doctrine of using nuclear arms early in any conflict."[27] In August 2019, then Deputy Assistant Secretary of Defense for Nuclear Matters Rear Admiral (ret.) Peter Fanta, speaking at the Crane Naval Submarine Warfare Center Symposium on Strategic Nuclear Weapons Modernization and Hypersonics, confirmed the Gertz report stating that, "The Russians are going to 8,000 plus warheads."[28]

An incisive 2015 study by James R. Howe concluded that Russia had the potential to deploy 2,664-5,890 nuclear warheads on its then-planned strategic ballistic missile force.[29] In another analysis, published in September 2019, he said Russia would have between "2,976 WHs [warheads], and a maximum of 6,670 WHs" (depending on warhead loading) plus over 800 bomber weapons.[30] He noted that "the 2022 [Russian] strategic nuclear force's (SNFs) warhead (WH) levels will likely significantly exceed New START levels based on planned WH loadings."[31] Indeed, as a result of the lack of on-site inspections for more than three years, some of this nuclear force growth may have already happened. Much of it depends on the scale of the Sarmat heavy ICBM deployment since it is a 20-warhead system (see below).

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[26] Ashley, Jr., "Russian and Chinese Nuclear Modernization Trends," op. cit.

[27] Bill Gertz, "Russia Sharply Expanding Nuclear Arsenal, Upgrading Underground Facilities," *Washington Free Beacon*, December 13, 2017, available at http://freebeacon.com/national-security/russia-sharply-expanding-nuclear-arsenal-upgrading-underground-facilities/.

[28] Peter Fanta, Deputy Assistant Secretary of Defense for Nuclear Matters, speaking at the NWSC Crane Triad Symposium, August 23, 2019.

[29] James R. Howe, "Exploring the Dichotomy Between New START Treaty Obligations and Russian Actions and Rhetoric," *Vision Centric, Inc.*, October 2015, mimeo, slide 4.

[30] James R. Howe, "Future Russian Strategic Nuclear and Non-Nuclear Forces: 2022," in Stephen J. Blank ed., *The Russian Military in Contemporary Perspective* (Carlisle, PA.: U.S. Army War College, Strategic Studies Institute, September 2019), p. 358, available at https://press.armywarcollege.edu/monographs/907/.

[31] Ibid., p. 341.

The Potential for Covert Upload of Russian Strategic Ballistic Missiles

After nine years of the degraded New START Treaty verification regime (2011-2020), which included no on-site monitoring of Russian mobile ICBM production, followed by more than three years of no on-site inspections, it is highly unlikely that the United States can rely on the accuracy of Russian data declarations (the last one occurred in September 2022). Moreover, on March 15, 2023, the U.S. Department of State announced that, "Russia has stopped providing its [New START] treaty-mandated notifications."[32] As discussed above, more than three years without on-site inspections means the treaty is essentially unverifiable. This stands Ronald Reagan's maxim, "Trust, but verify," on its head. As a result, Russia can deploy any number of strategic nuclear weapons it desires, up to the theoretical capability of its delivery systems, with potentially little risk of detection and, given past history, little risk of a robust and serious U.S. response. Russia also can produce large numbers of ICBMs and SLBMs and put them in storage, and they are not accountable under the New START Treaty.

The November 2022 FAS New START Treaty advocacy article stated that, without New START, Russia could increase its deployed strategic nuclear weapons to 2,425, an increase of 837 nuclear warheads over what the FAS estimated the Russians had deployed at that time.[33] However, the authors appear to have significantly underestimated Russian missile upload potential. They included 400 bomber weapons in the 837 number.[34] The authors said they were counting nuclear weapons in bomber base weapons storage areas.[35] Yet, the number of nuclear weapons that are available at bomber bases is not limited in any way under the New START Treaty. Indeed, in December 2019, Rose Gottemoeller cautioned that the United States may lose nuclear parity because, if freed from the New START warhead limit, "…without deploying a single additional missile,"[36] Russia, "could readily add several hundred—by some accounts, one thousand—more warheads, to their ICBMs…"[37] Both of these estimates likely understate Russian upload potential by a considerable amount.

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[32] U.S. Department of State, "Russian Noncompliance with and Invalid Suspension of the New START Treaty," *State.gov*, March 15, 2023, available at https://www.state.gov/russian-noncompliance-with-and-invalid-suspension-of-the-new-start-treaty.

[33] Jessica Rogers, Matt Korda, Hans M. Kristensen, "Nuclear Notebook: The Long View—Strategic Arms Control after the New START Treaty," *Bulletin of the Atomic Scientists*, November 9, 2022, available at https://thebulletin.org/premium/2022-11/nuclear-notebook-the-long-view-strategic-arms-control-after-the-new-start-treaty/.

[34] Ibid.

[35] Kristensen and Korda, "Russian Nuclear Weapons, 2022," op. cit., pp. 98, 100, 110.

[36] Rose Gottemoeller, as quoted in, U.S. Congress, House of Representatives, *The Importance of the New START Treaty* (Washington, D.C.: Committee on Foreign Affairs, December 4, 2019), p. 61, available at https://www.congress.gov/116/meeting/house/110302/documents/CHRG-116hhrg38543.pdf.

[37] Rose Gottemoeller, *The Importance of the New START Treaty* (Washington, D.C.: House of Representatives, Committee on Foreign Affairs, December 4, 2019), p. 2, available at https://www.congress.gov/116/meeting/house/110302/witnesses/HMTG-116-FA00-Wstate-GottemoellerR-20191204.pdf.

While the United States has a good understanding of the maximum Russian warhead upload potential for existing missile types (thanks largely to the original START Treaty that gave the United States a significant amount of data plus 15 years of unencrypted telemetry), open source information is inadequate to assess how much upload has actually taken place since the end of on-site inspections and, in particular, since Putin's 2022 expanded invasion of Ukraine. The assessed upload potential in the February 2022 and the May 2023 FAS reports and the November 2022 FAS arms control advocacy article appears to have been significantly understated. The FAS reports did not reveal the assumed warhead loadings that make up its estimate of 1,388 deployed ballistic missile warheads in the February 2022 report or its May 2023 estimate of 1,474.[38]

The 2018 *Nuclear Posture Review* report stated that, "Russia is developing and deploying new nuclear warheads…"[39]—which Russia has acknowledged since 2005.[40] Russia's ability to break out of the New START Treaty by uploading warheads on the new strategic missiles deployed mainly over the last decade depends on the size and weight of the warheads themselves. A number of Russian press reports indicate that Russia has developed a new warhead with a weight of 100-kg and a yield of 100-kt.[41] (This may be the same as the "small" power warhead that is sometimes reported as 150-kt.) In general, evaluating open source assessments of Russian upload warhead numbers is done by taking half the throw-weight of the missile and dividing it by the weight of the warhead to get a plausible maximum number of warheads for that missile type.

The biggest uncertainty the United States faces in assessing Russian upload potential is whether or not the Russians have developed and deployed the 10-warhead package of "super-lightweight" warheads on the SS-27 Mod 2/RS-24 Yars ICBMs and the Bulava-30 SLBM.[42] In a technical sense, it is possible for Russia to create a "super-lightweight" warhead. Indeed, in the *late 1960s*, the United States reportedly developed and deployed a similar warhead on the Poseidon missile. The warhead was so small and light that 14 of them could have been deployed on it.[43] However, it was apparently never actually deployed with that number of warheads and, under the START Treaty, the U.S. Poseidon SLBM was limited to 10 warheads.[44] This illustrates the fact that there is always a tradeoff between missile range and

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[38] Kristensen and Korda, "Russian Nuclear Weapons, 2022," op. cit., p. 98; and, Kristensen, Korda and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 175.

[39] U.S. Department of Defense, *Nuclear Posture Review* (Washington, D.C.: U.S. Department of Defense, 2018), p. 9, available at https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF.

[40] Mark B. Schneider, "The Future of the U.S. Nuclear Deterrent," *Comparative Strategy*, Vol. 27, No. 4 (2008), p. 347.

[41] *Section II: Minimum Deterrence: Fragile Hope of a Constant and Benign Threat Environment*, op. cit., p. 21.

[42] Schneider, *New START: The Anatomy of a Failed Negotiation*, op. cit., p. 29.

[43] "Poseidon C-3 Missile," Smithsonian National Air and Space Museum, no date, available at https://airandspace.si.edu/collection-objects/missile-submarine-launched-poseidon-c-3/nasm_A19731668000; and, "United States of America Poseidon C-3," *Navweaps.com*, no date, available at http://www.navweaps.com/Weapons/WMUS_Poseidon.php.

[44] *START Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms Signed in Moscow July 31, 1991*, op. cit., p. 120.

warhead numbers and weight. Since Russia increased its accountable nuclear warheads to 1,796 under the New START Treaty in September 2016[45] (before the limit of 1,550 came into legal effect), it apparently saw a benefit in deploying a larger number of nuclear warheads than legally permitted under the New START limit.

This does not necessarily mean that the Russians will field the largest warhead load that is technically feasible on their missiles. Warhead numbers and technical characteristics relate to targeting objectives and Russia will clearly try to maximize its capabilities in this arena consistent with its overall strategic objectives. The yield of a "super-lightweight" warhead would have to be lower than the reported yields of the Russian "small," "medium" and "high" power warheads and Russian targeting objectives would be a consideration in determining the number they would deploy. It is likely they would deploy 10- and 12-warhead packages on their Bulava-30 and their Sineva and Layner/Liner SLBMs, respectively, because of the reported targets for these systems. In a September 13, 2007 interview in *Moskovskiy Komsomolets*, Colonel General (ret.) Viktor Yesin described Russian Navy strategic nuclear targeting, stating, "The sailors…largely hit targets that do not have any serious protection, such as cities and enterprises, and therefore they don't require a very high degree of accuracy."[46]

The recent FAS estimates placed Russian total upload capability at only about 500 warheads, which appears to be much too low. The number of additional warheads Russia could deploy by uploading depends upon: 1) the number of missiles deployed; 2) the number of warheads they now carry; and, 3) the maximum number of warheads they could carry. Available information on the maximum number of warheads Russian missiles are capable of carrying is summarized in the following chart as assembled by this author based on publicly available sources:[47]

[45] U.S. Department of State, "New START Treaty Aggregate Numbers of Strategic Offensive Arms," *State.gov*, January 1, 2017, available at https://2009-2017.state.gov/t/avc/rls/2016/266384.htm.

[46] Mark B. Schneider, "Russian Nuclear Targeting," *Real Clear Defense*, October 4, 2022, available at https://www.realcleardefense.com/articles/2022/10/04/russian_nuclear_targeting_857030.html.

[47] START Treaty accountability numbers did not necessarily represent the maximum possible warhead load. There were deployment limits and counting rules that allowed National Technical Means (NTM) to be used, in conjunction with on-site inspections, to verify Treaty limits. Information contained in the 1990 START Treaty Memorandum of Understanding, later updated in the case of the SS-27 Mod 1/Topol M Variant 2 and Bulava-30, is still useful in evaluating the credibility of Russian reports on the warhead capability and yield of the new Russian missiles. Available open source data on the characteristics of U.S. nuclear missile warheads, some dating back to the 1960s, provide a sanity check on the Russian press reporting. There is simply no doubt that Russia can duplicate the U.S. capabilities achieved 30-50 years ago.

Russian Nuclear Warhead Upload Potential

	Russian Missile Type	START Treaty Accountable[a]	FAS Estimates	Upload Potential[b]
ICBMs	SS-18	10	10	14
	Sarmat	N/A[c]	10	20
	SS-19	6	6[d]	6
	SS-25	1	1	1[e]
	SS-27 Mod 1/Topol M V2	1	1	4-7
	SS-27 Mod 2/RS-24 Yars	N/A[f]	4	6-10
	RS-24 Yars S	N/A[g]	N/A[h]	3-4
	Yars-M	N/A	N/A[i]	4 (?)
SLBMs	Bulava-30	6	6	6-10
	SS-N-23 Sineva/Layner[j]	4	4	8-12
	SS-N-18	3	3	7[k]

a START Treaty accountable warheads are not necessarily the largest number that can be deployed on the missile even without reducing the size and weight of the warheads.
b Based largely on Russian sources.
c The Sarmat did not exist during the START Treaty duration. It was originally planned to be a 100-ton missile but evolved into a 200-ton missile. Supposedly, it will become operational in 2023.
d The FAS includes an entry for the SS-19 ICBM on its forces chart; but oddly does not include SS-19 ICBMs in the count of Russian warheads.
e An upload for the SS-25 is theoretically possible but unlikely due to the age of the missile and its on-going phase out.
f The SS-27 Mod 2/RS-24 Yars was never declared under the START Treaty probably because of the compliance issue involving MIRVing a single warhead missile (the SS-27 Mod 1 ICBM).
g The RS-24 Yars S post-dates the end of the START Treaty in 2009.
h The RS-24 Yars is not mentioned in the FAS study. It reportedly carries medium yield warheads.
i The Yars-M is mentioned in the 2023 FAS report but not included in its main table of Russian nuclear forces.
j The Sineva and Layner/Liner SLBMs are upgraded versions of the SS-N-23 SLBM. Warhead upload was prohibited by the START Treaty.
k The FAS includes an entry for the SS-N-18 on its forces chart but does not include SS-N-18 missiles in the count of Russian warheads.

To highlight problems with the FAS analyses, their estimate of the maximum number of warheads that can be uploaded on Russian ICBMs and SLBMs will be compared with the upload potential of these missiles reported in a wide variety of Western and Russian sources.[48]

The FAS May 2023 article on Russian nuclear forces stated, without citing any sources, that, "It is estimated that the SS-18 heavy ICBMs now carry only five warheads each to meet the New START limit for deployed strategic warheads," and can be uploaded to 10.[49] (The

[48] James R. Howe, "Exploring the Dichotomy Between New START Treaty Obligations and Russian Actions and Rhetoric," *Vision Centric, Inc.*, October 2015, mimeo.

[49] Kristensen, Korda, and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 175.

SS-18 is inaccurately referred to as "M6" [Mod 6] when it is the Mod 5. The Mod 6 was reportedly a single warhead 20-megaton yield version of the missile.)[50] There is now open source proof that the SS-18 Mod 5 has a maximum upload capability of up to 14 high-yield warheads.[51] By contrast, the FAS February 2022 report said it was "possible" that the SS-18 was downloaded to five warheads.[52] However, there appears to be no open source data that supports this assessment.

The May 2023 FAS report, again without sourcing, reduced its estimate of the number of operational SS-18 launchers from 46 in 2021 and 40 in February 2022 to only 34 in May 2023.[53] It also said, "It is also possible that a fourth regiment at Dombarovsky is operational."[54] The June 2020 joint report by the Defense Intelligence Agency (DIA) and the National Air and Space Intelligence Center (NASIC) said the number of SS-18 Mod 5s was "about 50."[55] While this was before the Sarmat conversion began, there appears to be no press reports indicating that Russian Sarmat conversion is as fast and on such a large scale as the FAS now assesses. The FAS has nine silos being converted to Sarmat and 14 off line.[56] If the FAS is correct about the scope of current Russian conversion from SS-18 to Sarmat activities, the increase in the potential number of Russian strategic nuclear weapons could be rapid and substantial since the Sarmat is able to carry many more warheads than the SS-18.

Even setting aside the conversion to Sarmat ICBMs, with 34 operational SS-18 launchers, the upload potential would be 136 warheads more than the FAS assesses. If there are 40 operational SS-18 launchers as assessed in the February 2022 FAS report, the upload number would be 160 extra warheads.

The SS-27 Mod 2/RS-24 Yars mobile ICBM likely is the quickest and easiest Russian missile to upload *covertly* in the protracted no on-site inspection environment because upload would likely be done within covered buildings on bases. If the Russians have covertly uploaded this missile, it likely could be deployed with a six- or even a 10-warhead package. The first version of the Yars is the most likely to be uploaded. The upload capability of both

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[50] Defense Intelligence Ballistic Missile and Analysis Committee (DIBMAC), *Ballistic and Cruise Missile Threat* (Wright-Patterson AFB, OH: NASIC, 2020), p. 29, available at https://media.defense.gov/2021/Jan/11/2002563190/-1/-1/1/2020%20%20BALLISTIC%20AND%20CRUISE%20MISSILE%20THREAT_FINAL_2OCT_REDUCEDFILE.PDF; U.S. Department of Defense, *Soviet Military Power: Prospects for Change 1989* (Washington, D.C.: U.S Department of Defense, 1989), p. 45, available at https://apps.dtic.mil/sti/pdfs/ADA212860.pdf; and, Steven J. Zaloga, *The Kremlin's Nuclear Sword: The Rise and Fall of Russia's Strategic Nuclear Forces: 1945-2000* (Washington, D.C.: Smithsonian Books, 2002), p. 237.

[51] Kristensen and Korda, "Russian Nuclear Weapons, 2022," op. cit., pp. 99-100; and, Joseph Trevithick, "Russia Releases Incredibly Detailed Views Of Its Massive 'Satan' Missile," *The War Zone*, November 21, 2022, available at https://www.thedrive.com/the-war-zone/russia-releases-incredibly-detailed-views-of-its-massive-satan-missile.

[52] Kristensen and Korda, "Russian Nuclear Weapons, 2022," op. cit., p. 100.

[53] Loc. cit.; Kristensen and Korda, "Russian Nuclear Weapons, 2022," op. cit., p. 100; and, Hans M. Kristensen and Matt Korda, "Russian Nuclear Weapons, 2021," *Bulletin of the Atomic Scientists*, Vol. 77, No. 2 (2021), p. 91.

[54] Kristensen, Korda, and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 175. This type of ICBM regiment typically includes six boosters.

[55] DIBMAC, *Ballistic and Cruise Missile Threat*, 2020, op. cit., p. 29.

[56] Kristensen, Korda, and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 175.

the SS-27 Mod 2/RS-24 Yars ICBM and the Bulava-30 SLBM appears to be at least six warheads and possibly 10.

The May 2023 FAS study credited the SS-27 Mod 2/RS-24 Yars with a maximum of four warheads but stated, "It is estimated that the SS-27 Mod 2s now carry only three warheads each to meet the New START limit on deployed strategic warheads."[57] Here again, the assumption of Russian New START compliance is increasingly dubious. Moreover, the February 2022 edition of the report said only that, "It is *possible* that the SS-27 Mod 2s now carry only three warheads each to meet the New START limit on deployed strategic warheads."[58] This continues the pattern of less nuanced assessments by the FAS, without apparent evidence to back them.

If the SS-27 Mod 2/RS-24 Yars is uploaded to six warheads, which is clearly possible as it has more throw-weight than the six-warhead Bulava-30, it could deliver up to 386 more warheads than the FAS May 2023 estimate. A problem in making a confident estimate of the number of Russian warheads is that the number of Yars-S missiles and the number of warheads that missile carries is unknown from open sources. If there is a 10-warhead option, the upload potential could be, in theory, 1,158 warheads above the FAS estimate. Again, the problem is that it is unknown how many of the deployed missiles are the Yars-S. It is unlikely that Moscow would deploy the maximum theoretical number of the 10-warhead packages, as a 10-warhead package would require individual warheads with lower yields and less capability to destroy hard targets in a counterforce strike. "Low-yield" likely is not five kilotons or fewer, but significantly lower than the reported 100-150-kt yield of the original SS-27 Mod 2/RS-24 Yars warheads. The Yars-S would likely be uploaded to four of the medium-yield warheads, as the "medium" yield warheads would give the Yars-S more capability against hard targets. It is unlikely Russia would sacrifice this military capability just to have more warheads. Since the Yars-S was not deployed until several years ago, most Yars are probably the first version with the more numerous smaller yield warheads and greater upload potential.

Russia reportedly has 78 SS-27 Mod 1/Topol M variant 2 ICBMs which are presumed to be single warhead ICBMs but, according to Howe, the missile "…has been tested with multiple RVs [reentry vehicles], and there are reports it may be upgraded to carry 4 to 7 RVs, and stay in service until 2027."[59] Even at four warheads (or RVs), this adds up to 234 more warheads than the FAS assessed. At seven warheads each it would add an additional 468.

The February 2022 and the May 2023 FAS reports assume no operational SS-19 ICBMs other than those converted for use with Avangard hypersonic boost glide vehicles, despite the fact that the authors acknowledge that "activities continue at some former regiments," and, it "is possible that one or two SS-19 regiments are active."[60] The assumption of no operational SS-19s appears inconsistent with available evidence. In April 2021, *TASS*

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[57] Loc. cit.

[58] Kristensen and Korda, "Russian Nuclear Weapons, 2022," op. cit., p. 99. (Emphasis added.)

[59] Howe, "Future Russian Strategic Nuclear and Non-Nuclear Forces: 2022," op. cit., p. 359.

[60] Loc. cit.; and, Kristensen, Korda, and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 175.

reported that there were "currently 50" SS-19s deployed.[61] The June 2020 DIA/NASIC report said "about 50."[62] In April 2021, Alexander Leonov, identified as the "CEO and Chief Designer of the Research and Production Association of Machine-Building," the manufacturer of the SS-19, said that, "We will keep this missile [the SS-19] on combat duty as long as necessary. Now we are going to extend its service life by three years."[63] He also said the SS-19s "…are being replaced by advanced Yars ICBMs…"[64] According to Howe, some SS-19s can be deployed until the late 2020s, using the 22 SS-19s Russia received from Ukraine that were never fueled.[65] Also, in December 2020, General Karakayev listed the SS-19 "Stilet" (possibly also known as the "Stiletto") as being operational.[66] There is open source evidence that the SS-27 Mod 2/RS-24 Yars ICBMs are still being deployed in SS-19 silos. This includes two missiles deployed in December 2022,[67] and a missile deployed in November 2021.[68] The May 2023 FAS report said Russia had deployed 22 Yars in silos, which would certainly be former SS-19 silos.[69] The 2020 edition of the FAS Russia nuclear weapons report said Russia had 11 silo-based SS-27 Mod 2/RS-24 Yars.[70] If the 11 added SS-27 silos are subtracted from the 50 reported deployed SS-19s in 2020, this leaves 39 SS-19s. Both the 2020 and 2021 FAS reports counted the deployed number of SS-19s at zero, despite the fact that the 2020 DIA/NASIC report credited Russia with about 50 deployed SS-19s.[71]

Unfortunately, there is no information on how many SS-19s have been downloaded and, if so, to what extent. However, it seems probable that the SS-19's contribution to the apparent FAS underestimate of Russian upload potential is 234 nuclear warheads.

As discussed above, and according to a statement by its manufacturer, the Sineva and the Layner/Liner SLBMs are reportedly capable of carrying eight-to-12 of the smaller Russian warheads developed for the SS-27 Mod 2/RS-24 Yars and the Bulava-30. Moreover, modifying these missiles to carry the new warheads makes sense. Upload of the Sineva and Layner/Liner to eight-to-12 warheads does *not* require the "super-lightweight" warhead associated with the Bulava-30's 10-warhead reports but merely the relatively light warhead originally deployed on the Bulava-30. In both the February 2022 and May 2023 FAS reports,

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[61] "Russia may Extend Service Life of SS-19 Stiletto ICBMs by Three Years," *TASS*, April 2, 2021, available at https://tass.com/defense/1273521.

[62] DIBMAC, *Ballistic and Cruise Missile Threat*, 2020, op. cit., p. 29.

[63] "Russia may Extend Service Life of SS-19 Stiletto ICBMs by Three Years," op .cit..

[64] Loc. cit.

[65] Howe, "Future Russian Strategic Nuclear and Non-Nuclear Forces: 2022," op. cit., p. 364.

[66] "Development of new Missiles for Russia's Strategic Forces to Begin Soon — Commander," *TASS*, December 15, 2020, available at https://tass.com/defense/1235501.

[67] "Next Yars ICBM Placed into Silo in Strategic Missile Formation in Central Russia," *TASS*, December 15, 2022, available at https://tass.com/defense/1550895.

[68] "Russia's Top Brass Uploads Video of Yars ICBM 'Being Loaded into Silo,'" *TASS*, November 29, 2021, available at https://tass.com/defense/1367663.

[69] Kristensen, Korda, and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 175.

[70] Hans M. Kristensen and Matt Korda, "Russian Nuclear Weapons, 2020," *Bulletin of the Atomic Scientists*, Vol. 76, No. 2 (2020), p. 103.

[71] Loc. cit.; Hans M. Kristensen and Matt Korda, "Russian Nuclear Weapons, 2021," op. cit., p. 91; and, DIBMAC, *Ballistic and Cruise Missile Threat*, 2020, op. cit., p. 29.

the Bulava-30 was credited with a maximum potential of six warheads accountable under the original START Treaty. If the maximum Bulava-30 warhead upload is six warheads, the FAS assessment of its upload potential would be correct. If the Bulava-30 can carry 10 warheads, however, the current Russian SLBM force could carry 224 more warheads than assessed by the FAS.

Russian Strategic Low-Yield Nuclear Warheads

The "small," "medium," and "high power" warheads reported for the *new* Russian missiles apparently correspond to a series of yield numbers that appear routinely in the Russian and non-Russian press: these are the maximum yields of 100-150-kt, 300-350-kt and 800-kt.[72] A December 2022 *Sputnik News* report listed a 500-kiloton warhead option for the Sineva and Layner/Liner SLBMs.[73] Reports from Pavel Felgenhauer indicated that these new Russian warheads are variable yield and have very low, minimum yields – *tens to hundreds of tons*.[74] General John Hyten stated that Russia had "thousands of low-yield nuclear and tactical nuclear weapons" and suggested that the new Russian ballistic missile weapons have variable yields.[75] Ten to 15 years ago, there were reports in Russian state and non-state media of Russian *deployment* of ultra-low-yield (50-200 tons yield) strategic nuclear warheads on its SLBMs.[76] In 2006, then Defense Minister Sergei Ivanov stated, "…the country's land and sea ballistic missiles will carry the same type of new warhead."[77] Thus, if

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[72] "New Nuclear Triad: A Look Into the Future of Russia's Strategic Defenses," *Sputnik*, July 27, 2018, available at https://sputnikglobe.com/20180727/russian-strategic-arsenal-upgrades-analysis-1066749013.html; Nikolai Litovkin, "What Major Weapons will Russia's Military get in 2018," *Russia Beyond the Headlines*, January 19, 2018, available at https://www.rbth.com/science-and-tech/327300-what-major-weapons-russian-military-get-in-2018; "Sarmat ICBM: 8 Megatons at Hypersonic Speeds, Arriving 2 Years Ahead of Schedule," *Sputnik*, January 19, 2018, available at https://sputnikglobe.com/20160907/sarmat-ahead-of-schedule-analysis-1045062797.html; Schneider, "The Future of the U.S. Nuclear Deterrent," op. cit., p. 347; "Doomsday Weapon: Russia's New Missile Shocks and Dazzles US, China," *Sputnik*, March 9, 2016, available at https://sputnikglobe.com/20160309/russia-missile-shocker-1036002714.html; "RS-24 Yars Intercontinental ballistic missile," *MilitaryToday.com*, no date, available at http://www.military-today.com/missiles/yars.htm; and, "Russia test-launches Topol-M ballistic missile," *Xinhua News Agency*, October 1, 2019, available at http://www.xinhuanet.com/english/2019-10/01/c_138437734.htm.

[73] Ilya Tsukanov, "How Many Nuclear Submarines Does Russia Have?," *Sputnik*, December 19, 2022, available at https://sputnikglobe.com/20221205/how-many-nuclear-submarines-does-russia-have-1105034535.html.

[74] Pavel Felgenhauer, "Bomber Makers Trade Union," *The Moscow Times*, March 14, 2002, available at http://www.themoscowtimes.com/opinion/article/bomb-makers-trade-union/247805html.

[75] "General Notes Value, Limitations of New START Treaty," *Defense.gov*, February 26, 2021, available at https://www.defense.gov/News/News-Stories/Article/Article/2517670/general-notes-value-limitations-of-new-start-treaty/.

[76] Ilya Kramnik, "Nevsky and Novomoskovsk: Two Submarines for Putin," *Sputnik*, December 12, 2010, available at https://sputnikglobe.com/20101215/161784522.html; and, *Section II: Minimum Deterrence: Fragile Hope of a Constant and Benign Threat Environment*, op. cit., p. 22.

[77] "Russia to use Same Warheads on Land, Sea," *UPI*, April 24, 2006, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/11D655C0E0E31CF8; see also, "Russia: Ivanov Says New Warhead Test To Ensure Security To 2030," *ITAR-TASS*, April 26, 2006, available at https://wnc-eastview-com.mutex.gmu.edu/wnc/article?id=31129705.

the Bulava-30 has a low-yield option, it is likely the Yars does as well. The costs involved in developing a new type of nuclear warhead suggest that the "small" yield warhead for the Sarmat is probably the same warhead as that of the Bulava-30 and the SS-27 Mod 2/RS-24 Yars.

Russian ICBM Modernization

According to Professor Dmitry Adamsky, "A popular Russian rock singer, close to the Kremlin and sanctioned by Ukraine, produced a hymn to Sarmat—the country's newest class of intercontinental ballistic missiles." It included a background of music provided by "the military orchestra of the Strategic Nuclear Missile Forces" and declared that "God and Sarmat are with us."[78] The new Sarmat heavy ICBM is the most important of Russia's strategic nuclear modernization programs because of its potential to increase vastly the number and capabilities of Russian strategic nuclear weapons. The Sarmat reportedly is the first Russian ICBM with satellite-aided guidance.[79] This will increase Russian capabilities to target U.S. ICBM silos with greater precision and the flexibility to launch very low-yield (e.g., tens to hundreds of tons) nuclear strikes against the United States and its allies. According to the Russian Ministry of Defense, the "…Sarmat will be able to carry up to 20 warheads of small, medium, high power classes."[80] In light of the apparent potential for the Soviet SS-18 Mod 4 and Mod 5 to carry 14 powerful warheads and the references to a 100-ton version of the Sarmat that could carry 10-15 warheads,[81] the possibility that the 200-ton Sarmat missile that was actually built might carry 20 warheads appears credible.

The announced throw-weight of the Sarmat is 10,000-kilograms.[82] The 10-warhead Soviet SS-24 ICBM/RT-23 (*not* the RS-24/Yars) was declared under the START Treaty as a

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[78] Dmitry Adamsky, "Russia's New Nuclear Normal How the Country Has Grown Dangerously Comfortable Brandishing Its Arsenal," *Foreign Affairs*, May 19, 2023, available at https://www.foreignaffairs.com/russian-federation/russias-new-nuclear-normal.

[79] "RS-28 Sarmat Satan 2 SS-X-30 ICBM," *ArmyRecognition.com*, December 8, 2022, available at https://www.armyrecognition.com/russia_russian_missile_system_vehicle_uk/rs-28_sarmat_satan_ii_ss-x-30_icbm_silo-based_intercontinental_ballistic_missile_data.html; and, Ilya Tsukanov, "Russia's Sarmat ICBM Can Correct Trajectory Even If Hit by Enemy Missile Defense, Designer Says," *Sputnik,* September 22, 2022, available at https://sputnikglobe.com/20220922/russias-sarmat-icbm-can-correct-trajectory-even-if-hit-by-enemy-missile-defense-designer-says-1101087476.html.

[80] "Guaranteed Defeat of Enemy Infrastructure: how the Sarmat Ballistic Missile will Enhance the Combat Potential of the Strategic Missile Forces," *RT*, December 16, 2019, available at https://russian.rt.com/russia/article/698699-sarmat-raketa-rvsn-perevooruzhenie.

[81] Viktor Litovkin, "New Russian 'Sarmat' ICBM will be like 'Son of Satan,'" *Russia Beyond the Headlines*, September 21, 2016, available at https://www.rbth.com/economics/defence/2016/09/21/new-russian-sarmat-icbm-will-be-like-son-of-satan_631869.

[82] "Formidable Sarmat: Satan's Successor that can Pierce any Defense," *TASS*, October 25, 2016, available at https://tass.com/defense/908575; "Guaranteed Defeat of Enemy Infrastructure," op. cit.; and, "Russia Completes pop-up Tests of most Advanced Sarmat ICBM," *TASS*, July 19, 2018, available at https://tass.com/defense/1014008.

10-warhead missile with a throw-weight of 4,050-kg,[83] or about 40 percent of the Sarmat. According to the FAS, its warheads ranged from 300- to 550-kt,[84] or roughly what the Russians are now apparently calling "medium" yield warheads. The SS-18 Mod 4 reportedly had a throw-weight of 7,300 kilograms and could carry 14 "high" yield warheads.[85] The increase in throw-weight from the SS-18 Mod 4 to the Sarmat seems consistent with the latter being able to carry up to 20 "high" yield warheads.

According to Colonel General (ret.) Viktor Yesin, Sarmat silos will be given:

> …a fundamentally new level of fortification protecting new ICBM silos, their technological and other renovation, operational, engineering and other means of camouflage, wide use of electronic jamming with the creation of a continuous field of impenetrable noise, measures to organize, alongside the passive defense of the silos their active defense, as well [as] through the deployment of long-range S-400 ABM systems and high-altitude S-500 systems capable of destroying on a par with space and air weapons the warheads of ICBMs and the enemy's precision weapons, including missiles and aircraft bombs and cruise missiles.[86]

In December 2019, Russia revealed that it intended to complete the modernization of its strategic nuclear forces by 2024 and President Putin was briefed on a plan involving the deployment of 20 regiments of the Sarmat by 2027.[87] This would result in the ability to carry at least 2,400 warheads. Twenty regiments of Sarmat ICBMs, with a minimum of six missiles per regiment, is an impractical allocation of resources, however, if Moscow has any intent to comply with the force ceilings of New START.

This report on the number of Sarmat regiments was surprising. Previously, the Russian press reported only 46 deployed Sarmat missiles and, in 2022, then Russian Space Agency Director Dmitry Rogozin also mentioned procuring 46 missiles.[88] It may be that Russia plans

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[83] *START Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms Signed in Moscow July 31, 1991* (Washington, D.C.: U.S. Department of State, October 1991), Supplement No. 5, p. 121.

[84] "RT-23 / SS-24 SCALPEL," *Federation of American Scientists*, July 29, 2000, available at https://nuke.fas.org/guide/russia/icbm/rt-23.htm.

[85] Schneider, *New START: The Anatomy of a Failed Negotiation*, op. cit., p. 65; and, "Most Powerful Strategic RS-20 to Remain In Inventory - Kommersant Moscow," *Kommersant.com*, July 29, 2008, available at http://www.kommersant.com/p-12927/r_527/RS-20_inventory/. An anonymous FAS report credits it with 7,200-kg of throw-weight and notes, "According to some Western estimates, evidence suggested that the Mod 4 may be capable of carrying as many as 14 RVs…" See "R-36M / SS-18 SATAN Overview," *Federation of American Scientists*, no date, available at https://programs.fas.org/ssp/nukes/nuclearweapons/russia_nukescurrent/ss18.html .

[86] "Russia to have new Heavy ICBM 2018 – Missile Force Commander Adviser," *ITAR-TASS*, April 12, 2011 (No longer available on the internet). See also, "Yesin: Russia Will Have RS-20 Missile Replacement in 2018," *ITAR-TASS*, April 12, 2011, available at https://wnc-eastview-com.mutex.gmu.edu/wnc/article?id=31220894.

[87] "Testing of Sarmat Intercontinental Missile to be over in 2021 - Russian Defense Management Center," *ITAR-TASS Daily*, December 24, 2019, available at https://on-demand-eastview-com.mutex.gmu.edu/browse/doc/56709629. State-run *Ria Novosti* also reported 20 planned regiments of the Sarmat. "Highlights of Russia's Arms Procurement Programme for 2018-2027," *BBC Monitoring Former Soviet Union*, December 30, 2019, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/17828B4D147ABCA0.

[88] Pavel Podvig, "Sarmat deployment plans," *RussianForces.org*, December 27, 2014, available at https://russianforces.org/blog/2014/12/sarmat_deployment_plans.shtml; and, "Russia Planning to Test Sarmat ICBMs

an open-ended procurement of the Sarmat at perhaps a regiment or two per year. Russia likely will be hard-pressed to deploy 46 Sarmats by 2027, much less another 20 regiments.

Russia says the Sarmat can attack the United States over the South Pole,[89] apparently to exploit limitations in U.S. early warning radar coverage. Russia has also indicated that the Sarmat is an orbital bombardment system; General Cotton, Commander of U.S. Strategic Command, has confirmed this, even hinting it might go beyond a "partial" orbital capability.[90] As part of the first Sarmat launch announcement, Colonel General Karakayev stated that the Sarmat can carry several Avangard hypersonic glide vehicles.[91] The heavy Avangard glider likely reduces the number of weapons that can be carried on each missile (the original SS-19 was a six-warhead missile) but dramatically increases the threat potential of the system against highly time-urgent targets such as the U.S. National Command Authority.[92]

The Avangard nuclear-armed hypersonic boost-glide vehicle became operational in December 2019. Formerly called Project 4202, it reportedly now uses the Soviet legacy SS-19/UR-100NUTTH ICBM, a large ballistic missile, to boost the large hypersonic glider.[93] The reported speed of the Avangard is 24,000-km per hour.[94] It is extremely large with a reported weight of 2,000-kg.[95] *TASS* stated that the Avangard carries a two-megaton nuclear warhead.[96] *Sputnik News* said it is between "0.8 and 2 megatons."[97] This apparently will be the equivalent of a "silver bullet" force because the Russians reportedly plan to deploy only

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Throughout 2022: Rogozin," *Asian News International / Sputnik*, May 21, 2022, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/18A23494827A4700. See also, "Russia's Sarmat ICBM Can Change Trajectory, Will Make Interception Hardly Possible in Coming Decades," *Sputnik*, May 22, 2022, available at https://sputnikglobe.com/20220522/russias-sarmat-icbm-can-change-trajectory-interception-hardly-possible-in-coming-decades-1095694819.html.

[89] "Russia's Sarmat ICBM Can Change Trajectory," op. cit.

[90] Anthony J. Cotton, *Statement of Anthony J. Cotton, Commander, United States Strategic Command* (Washington, D.C.: House Armed Services Committee, Subcommittee on Strategic Forces, March 8, 2023), p. 8, available at https://www.stratcom.mil/portals/8/Documents/2023%20USSTRATCOM%20Congressional%20Posture%20Statement.pdf?ver=bFFdbYI2D5Tju5nPNsebbw%3D%3D.

[91] "Russian Officer: Missile to Carry Several Hypersonic Weapons," *Associated Press*, April 24, 2022, available at https://apnews.com/article/russia-ukraine-putin-business-europe-moscow-e577969b24c19398cc7fd025ba3327a6.

[92] Mark B. Schneider, "Russia's Hypersonic Missile Threat to the U.S. National Command Authority," *Real Clear Defense*, September 11, 2019, available at https://www.realcleardefense.com/articles/2019/09/11/russias_hypersonic_missile_threat_to_the_us_national_command_authority_114736.html.

[93] Pavel Podvig, "UR-100NUTTH Launch from Dombarovskiy, most likely with Project 4202 payload," *RussianForces.org*, October 25, 2016, available at https://russianforces.org/blog/2016/10/ur-100nutth_launch_from_dombar.shtml.

[94] Nikolai Litovkin, "3 Russian Weapons Systems that have no Equivalents Anywhere in the World," *Russia Beyond the Headlines*, January 15, 2019, available at https://www.rbth.com/science-and-tech/329848-3-russian-weapons-systems-that-no-one-has.

[95] "Avangard," *CSIS Missile Threat*, July 31, 2021, available at https://missilethreat.csis.org/missile/avangard/; and, "Explained: Why Russia Avangard missile will have US worried," *IndianExpress*.com, December 30, 2019, available at https://indianexpress.com/article/explained/explained-why-russia-avangard-missile-will-have-us-worried-6189727/.

[96] "Russia to use SS-19 ICBMs as Carriers for Avangard Hypersonic Glide Vehicles — source," *TASS*, March 20, 2017, available at http://tass.com/defense/995167.

[97] "From Avangard to Zircon: How Far Do Russian Missiles Fly?," *Sputnik*, May 13, 2023, available at https://sputnikglobe.com/20230512/from-avangard-to-zircon-how-far-do-russian-missiles-fly-1110296500.html.

12 of them,[98] at least until the glider is deployed on some of the new Sarmat heavy ICBMs. Its main purpose appears to be to conduct a surprise nuclear attack on critical U.S. time-urgent strategic targets.

Russian ICBM force modernization will not end with the Yars variants, the Avangard and the Sarmat. In December 2020, *TASS* reported that Colonel General Karakayev said that, "The development of new missile systems for Russia's Strategic Missile Forces (RVSN) will begin in the short- and mid-term perspective."[99] Russia has announced the new Kedr ICBM program but has provided no information about it. In June 2021, *TASS* reported the Kedr's first test launch, and said it would be mobile, silo-based, and manufactured by the Moscow Institute of Thermal Technology.[100] This means it is a solid-fuel missile. Reporting on the Kedr is highly contradictory with most sources saying that work on the program will not begin until 2023-2024.[101] Something new tested in 2021 is more likely to be an improved SS-27 Mod 2/RS-24 Yars than a completely new missile like the Kedr, which apparently is intended to replace the Yars in the 2030s.[102] The February 2022 FAS report mentioned a new ICBM called the "…Osina-RV ICBM, a follow-on system reportedly derived from the Yars ICBM…"[103] This was repeated in the May 2023 report.[104] The Osina-RV ICBM, or the 15P182, reported to have been tested in 2022, apparently is a modification of the Yars-M,[105] and has a scheduled initial operational capability (IOC) of 2025.[106] *Voenno-Boltovoi* (*Military Chat*)

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[98] Pavel Podvig, "Avangard system is tested, said to be fully ready for deployment," *RussianForces.org*, December 24, 2018, available at http://russianforces.org/blog/2018/12/avangard_system_is_tested_said.shtml.

[99] "Development of new Missiles for Russia's Strategic Forces to Begin Soon — Commander," *TASS*, December 15, 2020, available at https://tass.com/defense/1235501; "Testing of Sarmat Intercontinental Missile to be over in 2021," op. cit.; "Highlights of Russia's Arms Procurement Programme for 2018-2027," *BBC Monitoring Former Soviet Union*, December 30, 2019, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/17828B4D147ABCA0; and, "Испытания комплекса "Сармат" планируется завершить в 2021 году - Национальный центр управления обороной РФ, *Interfax*, December 24, 2019, available at https://www.militarynews.ru/story.asp?rid=1&nid =524255&lang=R.

[100] "Russia Successfully test-launches Latest ICBM — Source," *TASS*, June 28, 2021, available at https://tass.com/defense/1307845.

[101] Ivan Timofeev, "KEDR ICBM Production Starts in 2023-2024," *Dfnc.ru*, no date, available at https://dfnc.ru/en/russia-news/kedr-icbm-production-starts-in-2023-2024/; and, "Development of Russia's new-generation ICBM to begin in 2023-2024," *Eurasia Diary*, April 3, 2021, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/181A597C28E7B9B8.

[102] Leonid Nersisyan, "Russian ICBM tests shed light on Programme Progress," *ShephardMedia.com*, July 15, 2021, available at https://www.shephardmedia.com/news/defence-notes/russian-icbm-tests-shed-light-programme-progress/.

[103] Kristensen and Korda, "Russian Nuclear Weapons, 2022," op. cit., p. 106.

[104] Kristensen, Korda, and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 183.

[105] It is unclear what the Yars-M is other than obviously a major modification of the Yars ICBM. Kristensen suggested that it was the IRBM version of the Yars which was later called the RS-26. See Hans Kristensen, "Russian Missile Test Creates Confusion and Opposition in Washington," *Federation of American Scientists*, July 3, 2013, available at https://fas.org/blogs/security/2013/07/yars-m/.

[106] "Osina-RV," *Deagel.com*, no date, available at https://www.deagel.com/Offensive%20Weapons/Osina-RV/a00 4141.

said that the project began in 2019, that there are both mobile and silo-based versions of the missile, and that it will carry "various warhead payloads."[107]

Development of the Russian RS-26 Rubezh, an IRBM described as an ICBM—probably to avoid the INF Treaty ban—is reportedly on hold until 2027.[108] If it is revived after 2027, Russia will likely give it a new name and number. *Sputnik News* reported that the RS-26 can carry four 300-kiloton nuclear warheads.[109] It is also possible that instead of reviving it, Russia would develop an IRBM version of one of its new ICBMs.

According to *TASS*, the Russian program for a rail-mobile ICBM, the Barguzin, has been put on hold pending a 2027 decision.[110] Rail-mobile ICBMs would allow Russia to circumvent New START Treaty limitations as the treaty does not limit such systems. It also probably would require less manpower than road-mobile ICBMs. Fewer technicians and troops would probably be necessary to operate and guard a single train compared to what would be required to operate and guard individual ground-mobile launchers. Because the New START Treaty does not limit rail-mobile ICBMs, the development of a system like the Barguzin is a logical decision for Russia to take if it can afford to do so.

Russian Ballistic Missile Submarines

The official Russian program for ballistic missile submarines reportedly involves 10 fourth generation Borei and Borei-A submarines carrying 16 Bulava-30 missiles each.[111] The hull of the 955A Borei-A submarine apparently was modified for increased quietness.[112] In 2018, *TASS* reported that Russia planned 14 Borei submarines.[113] In April 2023, *TASS* stated that, "…the Navy will have 14 new strategic submarines: 11 Borey-A class subs and three Borey class ones."[114] In May 2023, Russia announced the development of a new SLBM to replace the Bulava-30.[115] In addition to ballistic missiles, Russian strategic missile submarines also

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[107] "Russia developing new 'Osina' Yars missile variant," *BBC Monitoring Former Soviet Union*, June 16, 2021, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/183279F7D59204B8.

[108] "Avangard Hypersonic Missiles Replace Rubezh ICBMs in Russia's Armament Plan Through 2027," *TASS*, March 22, 2018, available at https://tass.com/defense/995628.

[109] "Doomsday Weapon: Russia's New Missile Shocks and Dazzles US, China," op. cit.

[110] "Russia's Strategic Missile Forces as its Decisive Defense," *TASS*, December 19, 2017, available at https://tass.com/defense/981811.

[111] Thomas Nilsen, "Russia Launches New Borei-A class Ballistic Missile Sub," *The Barents Observer*, December 25, 2021, available at https://thebarentsobserver.com/en/security/2021/12/russia-launches-new-borey-class-ballistic-missile-sub.

[112] "Russian Submarine Hulls Modified for Better Stealth," *BBC Monitoring Former Soviet Union*, May 17, 2019, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/1737B6A90CBD3EE8.

[113] "Russia: Russia to Build 6 more Borei-A Strategic Nuclear-powered Submarines – Source," *TASS*, May 21, 2018, available at https://tass.com/defense/1005356.

[114] "The Pyotr Veliky Cruiser to Donate its name to Nuclear Submarine — Source," *TASS*, April 20, 2023, available at https://tass.com/defense/1606933.

[115] Van Brugen, "Russia Creating Unstoppable Submarine Nuclear Missiles—Report," op. cit.

reportedly carry nuclear-capable Kalibr long-range cruise missiles.[116] When deployed on a strategic nuclear ballistic missile submarine, the Kalibrs would likely have a nuclear mission.

In 2019, *TASS* reported that Russia might develop and deploy two Borei-K long-range cruise missile submarines after 2027.[117] With nuclear warheads, this would be a way of circumventing the New START Treaty. The new Kalibr-M is reported to have a range of 4,500-km, making it a strategic system in all but name**,** as a ship-based cruise missile with a range over 600 km is considered "strategic" under START Treaty definitions.[118]

At this point, Russia will apparently not go ahead with the reported Borei-B class submarines.[119] Russia has announced a program for a "5th generation" strategic missile submarine called the Husky which would carry both ballistic and cruise missiles.[120] For the time being, however, it appears to be on the back burner, as apparently there have been no official statements about it since 2020.

Russian Strategic Nuclear Bomber Capability

Russia has been modernizing its strategic nuclear bomber strike capability for two decades. Initially, this involved repairing and upgrading the Soviet legacy Tu-95 and Tu-160 bombers with more advanced nuclear and dual-capable missiles. [121] Not surprisingly, strategic nuclear upgrades were given first priority.[122] Nine new Tu-160s were produced after the demise of the Soviet Union through 2018.[123] In 2015, Russia announced a program to develop and deploy at least 50 improved Tu-160M2s (recently Russia has begun to call them Tu-160M bombers) with new engines with 10 percent better performance, a 1,000-km range increase, new avionics, new electronic warfare equipment, new weapons, an active phased array radar and a modestly reduced radar cross section.[124] Fabrication of the Tu-160M2 bombers

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[116] "All Russian Subs can be Fitted with Kalibr Missiles — Russian Navy Commander," *TASS*, March 16, 2023, available at https://tass.com/defense/1589983; and, "Meeting with Defence Minister Sergei Shoigu," *Kremlin.ru*, December 8, 2015, available at http://en.kremlin.ru/events/president/news/50892.

[117] "Russia may Build Borei-K Nuclear Subs with Cruise Missiles – Source," *TASS*, April 20, 2019, available at http://tass.com/defense/1054714; "Russia Launches R&D Work on Fifth-Generation Submarine," *TASS*, April 17, 2019, available at http://tass.com/defense/1054096.

[118] "Ukraine website details arms used in war by Russia," *BBC Monitoring Former Soviet Union*, April 1, 2022, available at https://infoweb.newsbank.com/apps/news/document-view?p=WORLDNEWS&docref=news/1891B49AD032F900.

[119] "Russia to Build 6 more Borei-A Strategic Nuclear-powered Submarines — Source," op. cit.

[120] "Research into Russia's Fifth Generation Subs well in Progress — Navy's Commander," *TASS*, March 18, 2020, available at https://tass.com/defense/1131767.

[121] Mark B. Schneider, "Russian Violations of Its Arms Control Obligations," *Comparative Strategy*, Vol. 31, No. 4 (September 2012), p. 341.

[122] Dave Johnson, *Russia's Conventional Precision Strike Capabilities, Regional Crises, and Nuclear Thresholds* (Livermore, CA.: Lawrence Livermore National Laboratory, Center for Global Security Research, February 2018), p. 38, available at https://cgsr.llnl.gov/content/assets/docs/Precision-Strike-Capabilities-report-v3-7.pdf.

[123] "Tupolev Tu-160," *Air Forces Monthly*, January 2022, p. 87.

[124] "Russia to Renew Production of Tu-160 'Blackjack' Strategic Bomber," *Sputnik*, April 29, 2015, available at https://sputnikglobe.com/20150429/1021514706.html; "Russia Wants To Build Its Very Own 'B-2 Stealth Bomber.' Here

reportedly began in 2018.[125] Two are now being tested.[126] Deputy Defense Minister Yuri Borisov has said that the combat effectiveness of the Tu-160M2 will be 2.5 times greater than that of its predecessor.[127] Reportedly, two to three Tu-160M2s will be produced each year.[128] *TASS* said that the Tu-160s will carry Kinzhal nuclear-capable hypersonic missiles.[129]

Russia apparently is also developing the Pak DA, a subsonic, stealthy, flying wing type, cruise missile-carrying bomber.[130] It is reportedly capable of carrying 30 tons of weapons including "high speed" missiles.[131] Nuclear-capable hypersonic missiles are an obvious possibility. Russia has not announced any plans for a deployment number.

"Novel" Russian Nuclear Systems Not Covered by Arms Control

Russia is also reportedly developing a nuclear-powered, nuclear-armed drone submarine designed to deliver nuclear attacks against large port cities.[132] The nuclear warhead section of the drone submarine is enormous by the standards of late Cold War nuclear weapons. Based on the line drawing of the Status-6 (now called Poseidon) on a leaked Kremlin briefing

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Come the Problems," *National Interest*, February 22, 2020, available at https://nationalinterest.org/blog/buzz/russia-wants-build-its-very-own-b-2-stealth-bomber-here-come-problems-126421; "Russia's Tu-160M2 Bomber More Advanced Than Anything Pentagon Has In Its Arsenal," *Sputnik*, June 22, 2017, available at https://sputnikglobe.com/20170622/tu160m2-prospects-analysis-1054888100.html; "Decision to Prolong Life of Tupolev Tu-160 only Correct Decision - Russian Deputy PM Borisov," *Interfax*, February 7, 2020, available at https://interfax.com/newsroom/top-stories/17608/; and, "Russia's modernized Tu-160M nuclear-capable bomber takes to the skies for the 1st time (VIDEO)," *RT*, February 6, 2020, available at https://www.rt.com/russia/480238-russian-modernized-tu160m-flight/.

[125] "Russia Launches Production of Upgraded Tu-160 Strategic Bombers," *TASS*, December 20, 2018, available at http://tass.com/defense/1037133.

[126] "Russia: Russia to ramp up Tu-160M Strategic Bomber Production in Coming Years – Rostec," *TASS*, December 30, 2022, available at https://tass.com/defense/1557695.

[127] "Russia Launches Production of Upgraded Tu-160 Strategic Bombers," op. cit.

[128] "Russia: Russia's Fifth-generation Fighter Jets to Start Arriving for Troops in 2019," *TASS*, May 24, 2017, available at https://tass.com/defense/947333.

[129] "Russia to arm Tu-160 Strategic Bombers with Hypersonic Missiles — Source," *TASS*, February 10, 2020, available at https://tass.com/defense/1118255; and, "Presidential Address to the Federal Assembly," *Kremlin.ru*, March 1, 2018, available at http://en.kremlin.ru/events/president/news/56957.

[130] Grigoriy Sysoev, "Russia Speeds Up Development of New Strategic Bomber," *Sputnik*, November 28, 2013, available at https://sputnikglobe.com/20131128/Russia-Speeds-Up-Development-of-New-Strategic-Bomber-185110769.html.

[131] Harrison Kass, "The PAK-DA Is Russia's Big Plan to Build Its Very Own B-2 Stealth Bomber," *19FortyFive.com*, July 21, 2022, available at https://www.19fortyfive.com/2022/07/the-pak-da-is-russias-big-plan-to-build-its-very-own-b-2-stealth-bomber/; "Russia's Defense Ministry to Receive First Newly-built Tu-160M Strategic Bomber," *TASS*, February 4, 2022, available at https://tass.com/defense/1398283; and, Piotr Butowski, "Russia Pushes Ahead with New Strategic Bomber," *Aviation Week*, July 29, 2022, available at https://aviationweek.com/defense-space/aircraft-propulsion/russia-pushes-ahead-new-strategic-bomber.

[132] Mark B. Schneider, "The Barbarians in the Bay: Russia's Nuclear Armed Drone Submarine," *Real Clear Defense*, July 25, 2020, available at https://www.realcleardefense.com/articles/2020/07/25/the_barbarians_in_the_bay_russias_nuclear_armed_drone_submarine_115493.html; and, Bill Gertz, "'Kanyon' Unmanned Sub to Target Harbors, Cities," *Washington Free Beacon*, September 8, 2015, available at https://freebeacon.com/national-security/russia-building-nuclear-armed-drone-submarine/.

slide, the nuclear warhead has been measured at 1.6 meters in diameter and 6.5 meters in length.[133] If this is accurate, or even close to being accurate, the nuclear yield would likely be immense. According to Russian press reports, the Poseidon carries a 100-megaton warhead, possibly salted with cobalt to intensify radioactive fallout.[134] The Russian reports on Poseidon yield have been questioned. However, unless there is a very large measurement error on the size of the warhead compartment, a 50- to 100-megaton yield is possible. Russia has considerable experience with very high-yield single warheads for its large ICBMs.[135] In the 1963 Nuclear Test Ban Treaty hearings, then Secretary of Defense Robert McNamara stated that it would be possible to develop a new warhead for the Titan II ICBM (its warhead was much smaller than the Poseidon warhead section)[136] with a 35-megaton yield without further nuclear testing.[137] Russia would certainly be able to do today what the United States was able to do 60 years ago.

A high-yield warhead of the kind that Russia suggests is on the Poseidon would clearly be a terror weapon; it appears deliberately designed to maximize civilian casualties through massive blast and fallout[138] and, hence, its use would likely violate international law.

Russia has recently tested this system.[139] *TASS* reported that the first batch of nuclear warheads for these drones has been produced.[140] In July 2022, the Belgorod, the first

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[133] Steven Pifer, "Russia's Perhaps-not-real Super Torpedo," *Brookings Institution*, November 18, 2015, available at https://www.brookings.edu/articles/russias-perhaps-not-real-super-torpedo/.

[134]Lynn Berry and Vladimir Isachenkov, "Kremlin-controlled TV airs 'Secret' Plans for Nuclear Weapon," *Associated Press*, November 12, 2015, available at https://apnews.com/article/aaa75e4bb6e84d52948b9e6d8275c71d; Pavel Felgenhauer, "Russia Leaks Data About Doomsday Underwater Nuclear Drone," *Eurasia Daily Monitor*, Vol. 12, Iss. 206 (November 12, 2015), available at https://jamestown.org/program/russia-leaks-data-about-doomsday-underwater-nuclear-drone/; and, Pavel Felgenhauer, "The Hypersonic Hype and Russia's Diminished Nuclear Threshold," *Eurasia Daily Monitor*, Vol. 17, Iss. 116 (August 6, 2020), available at https://jamestown.org/program/the-hypersonic-hype-and-russias-diminished-nuclear-threshold/.

[135] Charles Tyroler, II, ed., *Alerting America: The Papers of the Committee on The Present Danger* (Washington, D.C.: The Pergamon Brasey's, 1984), p. 46; "R-36M / SS-18 SATAN," *Federation of American Scientists*, July 29, 2013, available at http://fas.org/nuke/guide/russia/icbm/r-36m.htm; and, "Big Ivan, The Tsar Bomba (King of Bombs)," *NuclearWeaponsArchive.org*, September 3, 2007, available at https://nuclearweaponarchive.org/Russia/TsarBomba.html.

[136] The B53 warhead for the Titan II was 1.26 meters in diameter and 3.81 meters long. See "The B-53 (Mk-53) Bomb," *NuclearWeaponsArchive.org*, April 3, 2007, available at https://nuclearweaponarchive.org/Usa/Weapons/B53.html.

[137] James Herbert McBride, *The Test Ban Treaty, Military, Technological and Political Implications* (Chicago: Henry Regnery Company, 1967), p. 33.

[138] Schneider, "The Barbarians in the Bay: Russia's Nuclear Armed Drone Submarine," op. cit.; and, Sam LaGrone, "Analyst: Doomsday Nuclear Torpedo Leak Gives Insight to Russian Strategic Mindset, Ballistic Missile Defense Anxiety," *USNI News*, November 12, 2015, available at https://news.usni.org/2015/11/12/analyst-doomsday-nuclear-torpedo-leak-gives-insight-to-russian-strategic-mindset-ballistic-missile-defense-anxiety.

[139] Felix Allen, "Putin's World Record 604 ft 'City Killer' Nuclear Submarine now Primed for War Armed with Poseidon Nuke Torpedoes," *The Sun*, January 26, 2022, available at https://www.the-sun.com/news/4542914/belgorod-submarine-putin-city-killer-nuclear-drones/; and, Vijainder K Thakur, "Russia's Poseidon 'Nuke Drone' Test: Is US-Led NATO Making Mushroom Clouds Out Of A Molehill?" *Eurasian Times*, October 5, 2022, available at https://eurasiantimes.com/russias-nuclear-drone-test-rattled-us-led-nato-is-mushroom/.

[140] "First Batch of Nuclear-armed Drones Poseidon Manufactured for Special-purpose Sub Belgorod," *TASS*, January 15, 2023, available at https://tass.com/emergencies/1562553.

Poseidon-armed submarine, was turned over to the Russian Navy.[141] Russia reportedly will have 30 deployed Poseidons by 2027.[142] While this is only 30 nuclear warheads, the blast effect of these weapons would be five-to-10 times greater than ordinary Russian high-yield nuclear warheads and the fallout generated could be equivalent to up to a hundred times that of Russia's ordinary high-yield nuclear warheads.

General Cotton has stated that in addition to the Avangard, "Russia now fields nuclear-capable hypersonic systems such as…the Tsirkon land-attack cruise missile, and the Kinzhal air-launched ballistic missile, the last of which Russia has employed in Ukraine with conventional warheads."[143] Russia apparently plans to use them for both strategic and non-strategic missions. General Hyten, when Commander of U.S. Strategic Command, warned about the threat posed by Russian hypersonic weapons. He noted that a hypersonic missile "disappears, and we don't see it until the effect is delivered."[144] Existing Russian launchers for Kalibr and Oniks cruise missiles can reportedly launch the Tsirkon.[145] Widespread deployment is quite possible. Russian state-run television broadcast a "list of American targets" associated with the U.S. National Command Authority, that "…the Kremlin could strike with hypersonic nuclear missiles within five minutes if war breaks out."[146]

The Impact of the Ukraine War on Russian Strategic Nuclear Capability

Except for the reported use of a few Kh-55 nuclear cruise missiles with inert warheads against Ukraine,[147] Russia's aggression has had no apparent impact on its strategic nuclear capabilities. Similarly, it did not impact the FAS estimate of Russian nuclear warhead numbers. The FAS report, until the May 2023 edition,[148] ignored official Russian statements about the nuclear capability of the Kh-101 and the state-media reports of a nuclear capability for the Kh-555 cruise missile. As noted above, President Putin has decreed that Russia "will carry out all of our plans" regarding nuclear modernization.[149]

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[141] "Belgorod: Nuclear Submarine Armed With Poseidon Torpedoes," *Sputnik*, April 10, 2023, available at https://sputnikglobe.com/20230410/belgorod-nuclear-submarine-armed-with-poseidon-torpedoes-1109325885.html.

[142] "'Doomsday Weapon': Advanced Russian Drones to Be Test-Launched From Nuclear Sub, Report Says," *Sputnik*, February 2, 2021, available at https://sputnikglobe.com/20210212/doomsday-weapon-advanced-russian-drones-to-be-test-launched-from-nuclear-sub-report-says-1082055313.html.

[143] Cotton, *Statement of Commander Anthony J. Cotton*, op. cit., p. 8.

[144] Thomas Newdick, "Victory Day 'Bears'," *Combat Aircraft*, August 2019, p. 85.

[145] "'Deadliest Ever': Russia Launches New 4th-gen Nuclear-powered Submarine (VIDEO)," *RT*, December 25, 2019, available at https://www.rt.com/russia/476812-russia-nuclear-submarine-launched/.

[146] "Putin's US Nuclear hit list Revealed: Russian State TV Names Camp David as the Top Location the Kremlin would Target with 'Unstoppable' Hypersonic Nukes which can Strike in just Five Minutes," *Reuters*, February 25, 2019, available at https://www.dailymail.co.uk/news/article-6742481/After-Putins-warning-Russian-TV-lists-nuclear-targets-US.html.

[147] Tanmay Kadam, "Russia Fired Nuke-Capable Kh-55 Missile Into Kyiv After Simply Unscrewing 'Nuclear Warheads' — Ukraine StratCom," *The Eurasian Times*, November 19, 2022, available at https://eurasiantimes.com/ukraine-russias-nuclear-capable-kh-55-missile/.

[148] Kristensen, Korda, and Reynolds, "Russian Nuclear Weapons, 2023," op. cit., p. 174.

[149] "Meeting of Defence Ministry Board," *Kremlin.ru*, December 21, 2022, available at http://en.kremlin.ru/events/president/news/70159.

Russia has launched thousands of missiles against Ukraine, depleting its inventory.[150] Russian cruise missiles with conventional warheads have displayed reliability and accuracy problems in the war against Ukraine. While the reliability problems will likely impact the performance of Kh-101 and Kh-555 cruise missiles used with nuclear warheads, the accuracy problem will have little impact on targeting effectiveness even with low sub-kiloton yield nuclear warheads.[151] The Kh-101 is reported to have a "…circular error probable (CEP) of between 33 and 66 feet."[152] (CEP is a measure of accuracy based on a circle in which half of the attacking warheads will fall.) Any dual-capable missile will likely have more than enough accuracy for the nuclear mission. Dr. Phil Karber has stated that one in three Russian missiles used in Ukraine has destroyed its target, but if they had a 20-ton yield nuclear warhead, another third would have been destroyed.[153] In this context, targets are assumed to be fairly small and not super-hardened and/or deeply buried.

Russia is continuing to produce Kh-101 missiles,[154] but its inventory has been substantially depleted. In January 2023, Ukraine stated that Russia's stockpile of Kh-101, Kh-555 and Kalibr missiles was running low and that Moscow had only enough missiles left for two or three 80-missile strikes.[155] It is not clear from the Ukrainian statement whether they were counting the entire Russian missile inventory or excluding those that are reserved for the nuclear mission. In light of the priority given to nuclear capability in Russian strategy, it is unlikely Russia would exhaust its supply of nuclear missiles. The Kh-101 is the best Russian missile for implementing a strategy of very low-yield nuclear escalation strikes against the United States. Indeed, the repeated warnings from the Biden Administration that Russia has increased its reliance on nuclear weapons[156] suggest that Moscow would not reduce its inventory of nuclear Kh-101s by using them in conventional strikes.

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[150] Benjamin Brimelow, "Russia is Using its Newest and Oldest Missiles Indiscriminately against Ukraine," *Yahoo*, available at https://www.yahoo.com/news/russia-using-newest-oldest-missiles-222900918.html.

[151] Mark B. Schneider, "Lessons from Russian Missile Performance in Ukraine," *Proceedings*, Vol. 148/10/1,436, October 2022, available at https://www.usni.org/magazines/proceedings/2022/october/lessons-russian-missile-performance-ukraine.

[152] Alexander Mlandenov, "Russia's Heavy Hitters," *AirForces Monthly*, May 2023, p. 79.

[153] "DEFAERO Strategy Series [Oct 20, '22] w/ Dr. Philip Karber," *Defense & Aerospace Report*, October 22, 2022, available at https://soundcloud.com/defaeroreport/defaero-strategy-series-oct-20-22-w-dr-philip-karber.

[154] "Top Official Explains why Russia hasn't run out of Precision Missiles in Ukraine," *RT*, April 19, 2022, available at https://www.rt.com/russia/554134-borisov-interview-defense-industry/.

[155] Isabel van Brugen, "Russia Has This Many Strikes Left as Kh-555 Cruise Missiles Run Out—Kyiv," *Newsweek*, January 4, 2023, available at https://www.newsweek.com/russia-missiles-running-out-kh-555-ukraine-1771174.

[156] Cotton, *Statement of Commander Anthony J. Cotton*, op. cit., p. 8; Office of the Director of National Intelligence, *Annual Threat Assessment of the U.S. Intelligence Community* (Washington, D.C.: Office of the Director of National Intelligence, February 6, 2023), p. 14, available at https://www.dni.gov/index.php/newsroom/reports-publications/reports-publications-2023; and, The White House, *National Security Strategy* (Washington, D.C.: The White House, October 2022), pp. 21, 26, available at https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf.

The April 2023 Russian test of an ICBM into the Sary Shagan test range[157] was indicative of further warhead development. Sary Shagan is where Russia conducts research and development tests on new warheads and missile defense tests. According to Pavel Podvig, "The situation with the Kapustin Yar to Sary Shagan launches is a bit different. These are tests of ICBM/SLBM re-entry vehicles. Yes, maybe what is tested is their capability to penetrate missile defense. But more likely these tests contribute to the overall improvement of RVs [reentry vehicles]."[158] This could be associated with the new ICBMs about which Russian officials talk.

It is clear that Russia has a very large and expanding strategic nuclear capability. Russia has the potential to upload thousands of nuclear warheads on its strategic nuclear forces and this capability will grow dramatically with the deployment of the Sarmat heavy ICBM, supposedly later in 2023. Warhead uploads may have already been covertly implemented since the end of the New START Treaty's on-site inspections more than three years ago. Russia will continue to modernize its strategic nuclear forces and is unlikely to stop when it reaches its 100 percent objective since there are announced follow-on ICBM and SLBM programs. Other than the Sarmat, there is little public information about the other new and improved Russian ICBMs that are under development. However, the pattern of Russian force expansion is likely to continue. The Biden Administration's stated objective is to reduce U.S. reliance on nuclear weapons. This is likely to be very difficult when an adversary is dramatically increasing its emphasizes on nuclear capabilities for coercive and prospective war-fighting purposes.[159]

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[157] Liam Coleman, "Putin Launches Huge New Ballistic Rocket and Takes Down Target in Kazakhstan," *Metro.com*, April 12, 2023, available at https://metro.co.uk/2023/04/12/putin-launches-huge-new-ballistic-rocket-and-takes-down-target-in-kazakhstan-18596094/.

[158] Pavel Podvig, April 12, 2023, available at https://twitter.com/russianforces/status/1646266841109610497.

[159] See, for example, Keith B. Payne and David J. Trachtenberg, *Deterrence in the Emerging Threat Environment: What is Different and Why it Matters*, *Occasional Paper*, Vol. 2, No. 8 (August 2022), available at https://nipp.org/papers/deterrence-in-the-emerging-threat-environment-what-is-different-and-why-it-matters/.