RUSSIA'S NONSTRATEGIC NUCLEAR WEAPONS AND WESTERN AIR SUPREMACY

Roy Boone
David Rehbein
John A. Swegle
Christopher Yeaw

Western advantages in fifth-generation aircraft and precision-guided munitions threaten Russia, which does not have a true fifth-generation fighter. Expecting that the early stages of conflict will be decisive, Russia is likely to employ theater-strike systems to degrade or defeat NATO attack systems and the associated airfields, command-and-control nodes, radars, and supporting infrastructure. If conventional weapons are insufficient, Russia could employ nonstrategic nuclear weapons. Russia's use of very-low- and ultra-low-yield nuclear weapons appears to be predicated on a belief that their use will not trigger a strategic nuclear exchange. This asymmetry, in which each side's favored defensive option is also the greatest threat to the other side, creates a dilemma for those who wish to control nonstrategic nuclear weapons.

Airpower has assumed an increasingly important role in projected conflict for the United States and NATO. Alliance nations, particularly those on the eastern periphery, perceive a need for this defensive air combat capability to ensure their security. On the other hand, for historical and geographic reasons, Russia is apprehensive about threats along its European border. In this regard, Russia views the growing effectiveness of US and NATO airpower from Operation Desert Storm in 1991 through the Kosovo conflict in 1999 to Operation Iraqi Freedom in 2003 as validation these capabilities can be used offensively against it.

Against large numbers of stealthy fifth-generation F-22s and F-35s, backed by fourth-plus-generation F-15EXs and Block III F-18E/Fs, Russia's air defenders are likely to experience high attrition, or possibly even be overwhelmed in the decisive early stages of a military conflict. The US military is expected to retain this advantage well into the future, as it is already flight testing its latest sixth-generation fighter aircraft, while Russia's newly deployed Su-57, even given its virtues, has failed to truly

Roy Boone, an independent consultant supporting the National Strategic Research Institute (NSRI) at the University of Nebraska, holds a master of science in nuclear engineering from Mississippi State University.

David Rehbein, an independent consultant supporting the NSRI, holds a master of science in nuclear physics from the University of Minnesota and a master of arts in international relations and finance from Webster University.

Dr. John A. Swegle, an independent consultant supporting the NSRI, is the coauthor of High Power Microwaves*, 3rd ed. (2019).*

Dr. Christopher Yeaw is the NSRI associate executive director for Strategic Deterrence & Nuclear Programs.

reach fifth-generation status. Based on clear technological and numerical inferiority, Russian political and military leadership see the need for a range of nonstrategic nuclear capabilities to even the odds.[1]

Russian research and development into ultra-low-yield (ULY) and very-low-yield (VLY) nuclear warheads in the range of tens to hundreds of tons of high-explosive-equivalent for nonstrategic nuclear weapons (NSNW) reduces the barrier to use. Underwriting this dependence on these weapons is a gap Russian military analysts perceive between nonstrategic nuclear weapons use at some very limited level of violence and the necessary conditions for even a limited strategic nuclear response.[2] This article argues Russian military planners and political leaders have identified a need for theater-range ULY and VLY nuclear systems in order to blunt NATO airpower that they expect as the inevitable opening gambit of any conflict with the West. Further, this employment of nonstrategic nuclear weapons could provide Moscow's most probable pathway across the nuclear threshold.

The asymmetry in these two approaches has implications for elements of Alliance stability, deterrence, defense planning, and nuclear arms control between the two sides. Using the last as one example, the limited nonstrategic nuclear options on the US side largely eliminate its leverage for nonstrategic nuclear-nuclear trades in a negotiation. Unfortunately, the problem is only exacerbated by the fact that what the United States and NATO perceive to be their most effective defensive option is regarded by Russia as the greatest offensive threat against it and a major motivator for the possession of nonstrategic nuclear weapons.

US and NATO Fifth-Generation Weapons Advantage

The F-22 and the F-35, currently the world's only true fifth-generation combat aircraft, underpin NATO air superiority. The differences in NATO and Russian airpower are stark. The Alliance has a 3.4:1 advantage in combat aircraft and an even greater 4:1 advantage in such aircraft with a primary air-to-air mission. To date, over 1,000 fifth-generation aircraft have been built in the United States, largely for NATO nations including the United States—142 F-22 and 890 F-35s.[3] The F-35 is the only fifth-generation fighter currently in production. While output will be somewhat affected by COVID-19, projections indicate that about 2,000 fifth-generation aircraft will be built by 2030.[4]

1. Michael Kofman et al., *Russian Military Strategy: Core Tenets and Operational Concepts* (Arlington, VA: Center for Naval Analysis, August 6, 2021), 32, https://www.cna.org/.

2. Kofman et al., *Russian Military Strategy*, 32; and authors' extensive personal experience.

3. John Venable, "Congress Should Stop the Air Force from Retiring F-22s," Breaking Defense, September 20, 2022, https://breakingdefense.com/; and Chris Galford, "Agreement between Pentagon, Lockheed Martin to Net up to 398 F-35 Jets for U.S. Military," Homeland Preparedness News, January 4, 2023, https://homelandprepnews.com/.

4. Stephen Losey, "F-35 Costs Have Been Declining. That's About to Change," *Defense News*, November 18, 2022, https://www.defensenews.com/.

In addition to NATO's planned fifth-generation acquisitions, the United States is already developing sixth-generation fighters. In 2019, the US Air Force announced it had built and flown a prototype sixth-generation fighter.[5] The US Navy also has a program to develop a sixth-generation fighter, and both services have reported they hope to begin production by the end of this decade.[6]

These fifth-generation aircraft are distinguished by several features. First, stealth incorporates specific design elements, including limiting engine exhaust and electronic signals, that reduce the range at which hostile radars and other sensors can detect, track, and engage the aircraft.[7] Second, enhanced situational awareness includes the integrated avionics that fuse data from advanced multispectral sensors and offboard data to provide a real-time operating picture of the battlespace. The F-35 has active and passive sensors that can see in all directions and at night.[8]

Third, electronic warfare capabilities offer a suite of offensive and defensive capabilities that can detect hostile emitters, geolocate them and identify specific threats, and jam, degrade, or avoid them.[9] Fourth, advanced engine performance from the Pratt & Whitney F135 engine offers the most powerful fighter engine ever built and includes features such as low-observable exhaust and thermal management.[10]

Fifth, networking capabilities in the F-35 can gather, exploit, and move information from aircraft to aircraft even in widely-spaced aircraft formations. This enables a complete, real-time view of the battlespace. This ability to collect, synthesize, and share information is at the heart of a radical change in combat tactics. The F-35 will play quarterback in modern aerial combat—directing individual aircraft to specific targets in real time.[11]

Stealth confers enormous relative advantage, offering first-look, first-shot, and first-kill capabilities. Look involves the F-35's APG-81 active electronically scanned array (AESA) low-probability-of-intercept radar for air-to-air and advanced air-to-ground application, as well as high-resolution mapping, multiple ground moving target identification and track, electronic warfare, and ultra-high-bandwidth communications.[12] Shoot and kill involves the AIM-120 advanced medium-range air-to-air missile, an active-radar-guided, medium-range, supersonic air-to-air missile. The latest

5. Valerie Insinna, "The US Air Force Has Built and Flown a Mysterious Full-Scale Prototype of Its Future Fighter Jet," *Defense News*, September 15, 2020, https://www.defensenews.com/.

6. Michael Tyrrell, "US Navy Reveals More on Plans for Sixth Generation Fighter Jet," *Aerospace Manufacturing*, April 20, 2021, https://www.aero-mag.com/.

7. Deborah Lee James and Daniel Gouré, *The Implications of Fifth-Generation Aircraft for Transatlantic Airpower, A Primer* (Washington, DC: Atlantic Council, October 7, 2019).

8. James and Gouré, *Fifth-Generation Aircraft*.

9. Todd Caruso, "AN/ASQ-239 F-35 EW Countermeasure System," BAE Systems (website), n.d., accessed January 24, 2023, https://www.baesystems.com/.

10. "F135, The World's Most Advanced Fighter Engine," Pratt & Whitney, n.d., accessed January 24, 2023, https://prattwhitney.com/.

11. James and Gouré, *Fifth-Generation Aircraft*.

12. Caruso, "AN/ASQ-239"; and Kate Mauss, "AN/APG-81 and the F-35 Lightning II," Northrop Grumman (website), n.d., accessed January 24, 2023, https://www.northropgrumman.com/.

version, AIM-120D, with a range of about 90 miles, offers improved range, GPS-assisted guidance, updated data links, and jam resistance, in addition to greater lethality.[13]

In 2019, the Air Force announced it was developing the AIM-260 joint air tactical missile with the Navy to replace advanced medium-range air-to-air missiles with a longer range (possibly up to 180 miles) and more capable weapon to counter high-end threats.[14] Initial operating capability was expected in 2022 but so far has not been observed. The Air Force refers to the joint air tactical missile as the next air-to-air dominance weapon.[15]

Russia currently has no fifth-generation aircraft and may not have any by the end of this decade.[16] Despite Russia's claims to the contrary, its newest fighter aircraft, the Su-57, falls short of true fifth-generation performance in a number of respects, including the radar cross section, the radar, and the engine.

Radar Cross Section

Radar cross section is the effective area of a body such as an aircraft as seen by a radar. The smaller the radar cross section, the shorter the range at which an object can first be detected. Unclassified sources indicate the F-22 has a radar cross section of about 0.0001–0.0002 square meters (comparable in size to a steel marble), and the F-35 has a radar cross section of about 0.0015 square meters (comparable in size to a metallic golf ball).[17] In comparison, the fourth-generation MiG-29 has a radar cross section of 5 square meters. Analysis of the Sukhoi company's patents for the T-50 prototype of the Su-57 called for a radar cross section of 0.1–1 square meter.[18] To compare, if an F-22 with a radar cross section of 0.0001 square meters is detectable at 100 kilometers, an Su-57 with a radar cross section of 0.1 square meters is detectable at 567 kilometers.[19]

Radar

Advanced aircraft use multifunction AESA radars that can also perform electronic warfare roles. The United States has much more experience in the production of these

13. Aaron M. U. Church, *USAF & USSF Almanac 2020: Weapons & Platforms*, *Air Force Magazine*, June 2020, https://www.airforcemag.com/; and Garrett Reim, "US Air Force Claims Longest Air-to-Air Missile Shot with AIM-120 AMRAAM," *Flight Global*, April 14, 2021, https://www.flightglobal.com/.

14. John A. Tirpak, "As Air Force Ramps Up JASSM, Work Begins on Its Replacement," *Air & Space Forces Magazine*, August 5, 2021, https://www.airforcemag.com/.

15. Rachel S. Cohen, "Air Force Developing AMRAAM Replacement to Counter China," *Air & Space Forces Magazine*, June 20, 2019, https://www.airandspaceforces.com/.

16. Tirpak, "JASSM."

17. "F-35 Joint Strike Fighter (JSF) Lightning II," GlobalSecurity.org, n.d., accessed November 26, 2022, https://www.globalsecurity.org/.

18. Piotr Butowski, "PAK FA Stealth Features Patent Published," *IHS Jane's 360*, January 10, 2014, https://archive.ph/ZHbOH.

19. Abhirup Sengupta, "Was the 'Stealth Feature' of the Su-57 Just a Ruse?," Quora, May 14, 2018, https://www.quora.com/.

devices and is now building third-generation devices. The AESA radar on the Su-57 is basically Russia's first such radar and is expected to be far less capable in both the radar and electronic warfare roles.[20]

Engine

The Su-57 entered production with an engine other than its originally intended model, since that engine (known as Article 30, or *izdeliye* 30) will likely not be available until the late 2020s at the earliest. As a consequence, the current engine is less powerful and less stealthy than intended.[21]

Precision-Guided Munitions

The US military relies on precision-guided munitions (PGMs)—air- and sea-launched missiles, multiple-launch rockets, and guided bombs—to execute military operations. These guided munitions are intended to destroy a point target and minimize collateral damage. Using advanced guidance systems, these weapons are launched at long ranges to attack an enemy without risking American forces. Accordingly, Russia's large and sophisticated anti-access/area-denial systems are likely to increase the value of PGMs. As a result, the Department of Defense has argued it requires and is procuring longer-range munitions to meet these and other new threats.[22] A few are worth highlighting.

The joint air-to-surface standoff missile (JASSM) is a stealthy, precision-guided cruise missile designed to defeat defended high-value targets, including enemy air defenses. There are several configurations of this missile: AGM-158A (JASSM), AGM-158B (JASSM-ER), and the AGM-158D (JASSM-XR), with ranges of 230 miles, 620 miles, and 1,120 miles, respectively.[23] There is also the AGM-158C, a long-range anti-ship missile.[24]

The AGM-88G, designed to suppress enemy air defenses, is an extended-range version of the current high-speed anti-radiation missile, which is already in production and service. Improvements to the AGM-88G include warhead lethality, advanced

20. Abhirup Sengupta, reply to "Why Is the Radar on the Sukhoi Su-57 Not as Advanced as the Radar on the Lockheed Martin F-22 Raptor?," Quora, October 21, 2022, https://www.quora.com/.

21. Abhirup Sengupta, reply to "What Is the Difference between Su-57 and F-22 Engines?," Quora, September 29, 2022, https://www.quora.com/.

22. John R. Hoehn, *Precision-Guided Munitions: Background and Issues for Congress*, R45996 (Washington, DC: Congressional Research Service [CRS], June 11, 2021), https://crsreports.congress.gov/.

23. Missile Defense Project, "JASSM/JASSM ER," Missile Threat, Center for Strategic and International Studies (CSIS) (website), last modified July 30, 2021, https://missilethreat.csis.org/; Brian W. Everstine, "USAF to Start Buying 'Extreme Range' JASSMs in 2021," *Air Force Magazine*, February 14, 2020, https://www.airforcemag.com/; Frank Wolfe, "USAF Requests $711 Million for 525 'Max Production' of JASSM-ER," Defense Daily, June 7, 2021, https://www.defensedaily.com/; and Church, *Almanac 2020*.

24. Church, *Almanac 2020*.

seekers, a classified range extension, and networking capability.[25] The Air Force is also using the AGM-88G as the basis for its next-generation stand-in attack weapon to equip the F-35A with comprehensive suppression/destruction of enemy air defense capability.[26]

As final examples, the GBU-39 small-diameter bomb I and the GBU-53 STORMBREAKER are precision-guided munitions with explosive armaments of approximately 100 pounds or less, capable of striking targets in all weather from up to 46 miles away. The GBU-39 is designed to attack fixed targets, and the GBU-53 can attack moving targets. Their small size allows them to be carried in fighter aircraft internal weapon bays or to increase overall load-out to enable more independent strikes per sortie.[27] Eight of these weapons will fit internally on the F-35A.[28] Moreover, the bombs are retargetable after release.[29] The range of these glide bombs allows them to attack modern Russian surface-to-air missile systems comfortably outside the range in which the radar can track an F-35.

Russia's Expectations and Concerns

According to one expert, if fighting breaks out with NATO, the Russian military will "expect a US aerospace blitzkrieg which cannot be blocked at the outset."[30] The effectiveness of American and NATO airpower in Operation Desert Storm in Iraq (1990–91), Operation Deliberate Force in the Bosnian conflict (1995), Operation Allied Force in the Kosovo conflict (1995), and Operation Iraqi Freedom (2003) justify this expectation.[31] Assuming "that the initial period of war will be decisive," Russia will move rapidly to deflect, attrit, and disorganize the US response with the goal of undermining US political will and disrupting the Allied plan of operations or creating enough pain to cause the attackers to de-escalate. And if Russia fails to achieve those goals conventionally, "there is always theater employment of nonstrategic nuclear weapons, an area where Russia does not suffer credibility problems."[32]

---

25. Stefano D'Urso, "US Navy Launched an AGM-88G Advanced Anti-Radiation Guided Missile–Extended Range for the First Time," Aviationist, August 5, 2021, https://theaviationist.com/; Church, *Almanac 2020*; and "US Navy's AGM-88G AARGM-ER Missile Enters Production Phase," Global Defense Corp, September 7, 2021, https://www.globaldefensecorp.com/.

26. Garrett Reim, "US Air Force Requests Information on New Anti-Radiation Missile for F-35A," Flight Global, January 10, 2020, https://www.flightglobal.com/.

27. Flight International in association with Ruag, *World Air Forces 2020*, Flight Global, 2020, https://www.flightglobal.com/.

28. John Keller, "F-35 Block 4 Jet Fighter Could Become Killer for the Navy with Small Diameter Bomb II, Aim 9X Block II," *Military & Aerospace Electronics*, February 18, 2019, https://www.militaryaerospace.com/.

29. Church, *Almanac 2020*.

30. Michael Kofman, "It's Time to Talk about A2/AD: Rethinking the Russian Military Challenge," War on the Rocks, September 5, 2019, https://warontherocks.com/.

31. David E. Johnson, *Learning Large Lessons: The Evolving Roles of Ground Power and Air Power in the Post–Cold War Era* (Santa Monica, CA: RAND Corporation, March 7, 2007), https://www.rand.org/.

32. Kofman, "A2/AD."

Russia has taken two notable actions to respond with urgency to the NATO air advantage. In 2015, Russia created the aerospace forces military branch, which is on par with their ground forces and navy and aggregates the Russian air force, the aerospace and missile defense forces, and the space forces. The Russian military also realizes that given the expectation of a rapidly developing situation, these units require fully staffed and equipped permanent readiness troops.[33]

Russia's expectation of holding a weak conventional military hand means Russia's military analysts predict the need for an asymmetric response.[34] This approach is similar to that anticipated over 50 years earlier by Herman Kahn, who recognized that for a technologically and economically inferior Soviet Union, the possession of tactical nuclear weapons in large numbers was the equalizer.[35]

Active Defense

Three elements are integral to Russia's active defense against aerospace attack. (1) Air defense systems protect strategically important targets. Additionally, forward army units are being integrated with new bistatic over-the-horizon radars and a network of radars covering the Barents Sea. (2) Missile defense systems cover the Moscow area and are integrated with ballistic missile early-warning radars ringing the country and launch-warning satellites in space. (3) Theater-strike systems are used to degrade or defeat NATO attack systems, including airfields, command-and-control nodes, radar systems, and supporting infrastructure.[36]

Russia is in the process of overhauling its ballistic missile and air attack early-warning radars by replacing older systems, some of which were placed on the territory of former Soviet republics. To reduce costs, Russia designed and built or is building 12 new modular ballistic-missile warning radars of the Voronezh type, with models operating in the meter and decameter wavelength ranges.[37] These radars ring the country from

33. Nikolai Makarov, "Speech before the Academy of Military Sciences," *Vestnik Akademii Voennykh Nauk* 2, no. 39 (2012); S. V. Surovikin, "Forms for Employing and Organizing Command and Control of a Joint Troop (Force) Grouping in the Theater of Military Activity," *Vestnik Akademii Voennykh Nauk*, 1, no. 46 (2014); Samuel Charap et al., *Russian Grand Strategy, Rhetoric and Reality*, RR4238 (Santa Monica, CA: RAND Corporation, 2021), https://www.rand.org/; and Andrew S. Bowen, "Russian Armed Forces: Capabilities," In Focus 11589 (Washington, DC: CRS, June 30, 2020), https://sgp.fas.org/.

34. Kofman et al., *Russian Military Strategy*, 32.

35. Herman Kahn, *On Escalation: Metaphors and Scenarios* (New York: Praeger, 1965).

36. Kofman, "A2/AD."

37. "General Designer Saprykin: Russia's Early Warning System Can Track Missile Launches from Anywhere in the World," TASS, February 15, 2021, https://tass.ru/.

sites at Lekhtusi, Olenegorsk, Vorkuta, Pechora, Yeniseysk, Mishelevka, Barnaul, Orsk, Armavir, and Pionersky.[38]

The hardware cost alone for those radars is roughly 55 billion rubles, comparable to the cost of two to three Borei-A fleet ballistic missile submarines. (A 2012 contract for five submarines totaled 100 billion rubles.) Two additional radars of the new Yakhroma type are to be built in Crimea and on the Chukchi Sea.[39]

New Konteiner bistatic, over-the-horizon radars are to be built for aircraft early-warning, cruise missile, and short- to intermediate-range ballistic missile attack. The first such radar was built and deployed in December 2019 with a transmitter near Gorodets and a receiver near Kovylkino.[40] Construction of a second radar began near Zeya in the far eastern Amur region, although completion is delayed.[41] A third is planned for Kaliningrad, and a fourth may be built at an undisclosed location in the Arctic.[42]

These radars cost about 10 billion rubles each. Another type of over-the-horizon radar, the Rezonans-N—claimed to have enhanced ability to detect stealthy and hypersonic targets—is deployed at five locations around the Barents Sea to protect Russia's ballistic missile submarine launch bastion as well as the Northern Fleet and other defense facilities.[43] According to a source in the military-industrial complex as reported in TASS, there are plans to build as many as five additional Rezonans-N radars in the Russian Far East, starting with an undisclosed location on Sakhalin Island.[44]

These radars are available for networking with Russia's mobile missile defense units. The main long-range systems are the S-300 series (S-300P type for air defense units, S-300V to protect ground units, and S-300F aboard ship); S-350 with smaller, more maneuverable missiles; S-400, a more capable successor to the S-300P and S-300F series; and the even more capable S-500 to be used for air and missile defense and

38. "Deep in the Sky," LiveJournal, February 15, 2012, https://archive.is/; "Construction of a Radar Station Began in Vorkuta," KomiInform, September 26, 2015, https://komiinform.ru/; Ilya Kramnik, "Arithmetic SPRN: Minus Two 'Dneprs,' Plus One 'Voronezh,'" *RIA Novosti*, May 26, 2021, https://ria.ru/; and "Three Advanced Early Warning Radars Enter Service in Russia," TASS, December 19, 2017, https://tass.com/.

39. "Russia to Deploy Latest Early Warning Radar in Crimea," TASS, February 15, 2021, https://tass.com/; and "Russia to Build Newest Missile Attack Warning Radar on Chukchi Peninsula by 2030," TASS, January 12, 2021, https://tass.com/.

40. Tony Roper, "Russian OTHR 29B6 Konteyner Analysis," February 25, 2020, *Planes and Stuff* (blog), https://planesandstuff.wordpress.com/.

41. "The Media Found Out Where the Second 'Container' Radar Station Is Deployed," MIL.Press, December 15, 2020, https://xn--b1aga5aadd.xn--p1ai/; and "On the Amur, a Radar Station Will Be Built to Control US Aviation, the Source Said," VPK, December 16, 2020, https://vpk.name/ (originally published in *RIA Novosti*).

42. "Russia's Advanced Radar in Kaliningrad to Monitor Entire Territory of Europe—Source," TASS, March 18, 2020, https://tass.com/; and Joseph Trevithick, "Russia Plans to Set Up Massive New Radar Array to Help 'Control' the Arctic Region," The Drive, December 2, 2019, https://www.thedrive.com/.

43. Svetlana Tsygankova, "Several Russian Radars to Be Deployed in the Arctic by the End of 2021," RGRU, April 14, 2021, https://rg.ru/.

44. "Source: The Russian Federation Will Deploy in the Sakhalin Region a 'Hunter for Invisible' Radar Station 'Rezonans-N,'" TASS, August 23, 2021, https://tass.ru/.

possibly in an antisatellite role.[45] Each of these systems consists of a missile launcher carrying canisterized missiles sealed at the factory, a vehicle with a loading crane to reload missiles, long-range detection and shorter-range targeting radars, and a control vehicle. As an example, S-400 launchers can carry 4 missiles and control vehicles can manage up to 12 launchers, with each 12-launcher unit networked with 5 others—spaced at distances of tens of kilometers.[46]

The new S-500 system is capable of networking with S-500s, S-400s, and S-300s.[47] Different types of missiles can be loaded with each system. The defense radar servicing these systems can see aerial targets over the horizon and has a maximum range of about 400 kilometers for large targets like the airborne warning and control system (AWACS) aircraft. Russia's air defense is multilayered as well, with shorter-range Buk missiles and the Pantsir system for protection at even shorter ranges.[48]

The problem for Russia is the detectability of low-flying stealthy cruise missiles and stealthy NATO aircraft that can attack targeting and long-range search radars before the aircraft are even detected.[49] Possible mitigating factors playing in Russia's favor are the strength of the network of warning radars and networked air-defense radars and Russia's electronic-warfare capabilities; however, both topics are beyond the scope of this analysis.

As mentioned, active defense for Russia also includes a strike element aimed at disrupting and reducing the ability of an adversary to mount air attacks. Russia can cover much of NATO with 2,500-kilometer-range Kalibr land-attack cruise missiles (the SS-N-30A) fired from submarines in the Black and Norwegian Seas, as well as the 9M729 ground-launched cruise missile (the SSC-8) launched from bases at Shuya and Voronezh.[50] Several other systems include the ship-launched hypersonic Tsirkon (SS-N-33) missile, which has a range of about 1,000 kilometers; the hypersonic air-launched Kinzhal (Kh-37M2), with a range of 2,000–3,000 kilometers for launch from

45. "S-300," Arms Russia, https://arms-russia.ru/; "S-350E Vityaz 50R6 Surface-to-Air Defense Missile System," Army Recognition, August 18, 2022, https://www.armyrecognition.com/; "Anti-aircraft Missile System S-400 'Triumph,' " Missile Technology, https://missilery.info/; "S-500 Prometheus 55R6M Triumfator-M Air Defense Missile System," Army Recognition, December 15, 2022, https://www.armyrecognition.com/; and Brian Wang, "Russia's S-500 Missile System Still in Development but the 77N6 Hypersonic Missiles Are Key to a Real Ballistic Missile Defense," *Nextbigfuture* (blog), July 20, 2016, https://www.nextbigfuture.com/.

46. "SAM S 400: Purpose, Features, Characteristics, Range," https://bo-priboy.ru/.

47. Zachary Keck, "Russia's S-500, the Ultimate Missile Defense System," *National Interest* (blog), January 18, 2020, https://nationalinterest.org/.

48. Michael Kofman, "Russian A2/AD: It Is Not Overrated, Just Poorly Understood," *Russia Military Analysis* (blog), January 25, 2020, https://russianmilitaryanalysis.wordpress.com/.

49. Reim, "Anti-Radiation Missile."

50. Defense Intelligence Ballistic Missile Analysis Committee, *2020 Ballistic and Cruise Missile Threat* (Washington, DC: Defense Intelligence Agency, January 11, 2021), https://media.defense.gov/; US Department of State (DOS), *Adherence and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments* (Washington, DC: DOS, August 2019), https://www.state.gov/; and Missile Defense Project, "9M729 (SSC-8)," Missile Threat, CSIS, March 31, 2022, https://missilethreat.csis.org/.

the MiG-31K or Backfire bomber, respectively; or the long-range Kh-101/-102 air-launched cruise missiles from strategic Bear-H or Blackjack bombers, which can cover Europe.[51] These weapons are all dual-capable, conventional, and nuclear.[52]

Similarly, certain missiles for the S-300P series and S-400, and the S-500, have nuclear warheads. Low-yield nuclear warheads for S-300 and S-400 were designed at the All-Russian Scientific Research Institute of Experimental Physics (VNIIEF).[53] A photograph of the claimed nuclear warhead for the S-300PT was featured in a 2019 blog post.[54] In addition, TASS has indicated in the past that at least some missiles carried by S-400s can be used in a surface-to-surface mode.[55] More recently, the use of S-300P missiles in a surface-to-surface mode in Ukraine has been reported.[56]

Russia's NSNW Response

Declassified Central Intelligence Agency analysis of Russian thinking on ultra-low-yield and very-low-yield nuclear weapons from August 2000 suggests "the need for subkiloton nuclear weapons with minimal long-term contamination had been argued in the media by senior Ministry of Atomic Energy (Minatom) officials, nuclear weapons scientists, and military academics since the mid-1990s." The same report also suggested unnamed Russian advocates were said to "cite clean, very-low-yield weapons as an 'asymmetric response' to US superiority in conventional weapons."[57]

This analysis followed an April 30, 1999, meeting of the Russian Federation Security Council that, according to then-Council Secretary Vladimir Putin, dealt with a concept for the use of nuclear weapons, including tactical nuclear weapons.[58] Investigative journalist Pavel Felgengauer, reporting in *Segodnya*, wrote that this included a plan to develop a new, low-yield nuclear warhead.[59] What is clear from available infor-

51. Thomas Nilsen, "Northern Fleet Makes Ready for Long-Range Test of Tsirkon Hypersonic Missile," *Barents Observer*, November 2, 2020, https://thebarentsobserver.com/; "Kh-32 Air-Launched Cruise Missile," Military-Today.com, n.d., accessed January 24, 2023, http://www.military-today.com/; "Russian Strategic Bomber to Extend Kinzhal Hypersonic Missile's Range—Source," TASS, July 18, 2018, https://tass.com/; and Missile Defense Project, "Kh-101/Kh-102," Missile Threat, CSIS, July 31, 2021, https://missilethreat.csis.org/.

52. Hans M. Kristensen and Matt Korda, "Russian Nuclear Weapons, 2021," *Bulletin of the Atomic Scientists* 77, no. 2 (2021), https://doi.org/.

53. A. V. Veselovsky, "65 Years of Glorious History Is a Guarantee of Stability and Development," *PRO-Atom*, February 3, 2011, http://www.proatom.ru/.

54. Diana Mikhailova, "Nuclear Warhead of an Anti-Aircraft Guided Missile 5V55S SAM S-300PT," LiveJournal, December 3, 2019, https://diana-mihailova.livejournal.com/.

55. "Russian Troops in Crimea Receive S-400 Antiaircraft Missile System," TASS, August 12, 2016, https://tass.com/.

56. Thomas Newdick, "Russia Now Firing S-300 Surface-to-Air Missiles at Land Targets in Ukraine: Official," The Drive, July 8, 2022, https://www.thedrive.com/.

57. Central Intelligence Agency, Office of Transnational Issues, "Evidence of Russian Development of New Subkiloton Nuclear Warheads," intelligence memorandum, August 30, 2000 (redacted for release).

58. "Documents Adopted at the Meeting of the Security Council on the Development of Nuclear Forces," *Interfax*, April 29, 1999.

59. Pavel Felgengauer, "Limited Nuclear War? Why Not!," *Segodnya*, May 6, 1999, 1, 2.

mation is that Russia's interest and work on these types of nuclear weapons dates back at least two decades.

According to the Defense Intelligence Agency, as of May 2019, "Russia's stockpile of nonstrategic nuclear weapons, already large and diverse, [was] being modernized with an eye towards greater accuracy, longer ranges, and lower yields to suit their potential war-fighting role."[60] In developing these capabilities, Russia understood the asymmetric advantage it would bring to a fight with NATO in Europe.

The limitation on collateral damage from ULY and VLY air-to-air missiles may not be fully appreciated. In "Ground Zero Population 5," a video made in 1957 at the Nevada Test Site, five officers and a cameraman stand under a 2-kiloton explosion from an air-to-air missile at 18,500 feet above them. No one was injured and none of the participants experienced any symptoms.[61] Of note: the picture of the men flinching shown in the article is not at the time of the explosion, but at the time the sound of the blast reached them, in the same way that thunder follows lightning.

In short, under the right conditions, low-yield nuclear weapons are not weapons of mass death and destruction. Russia is well aware of this and sees such nuclear weapons as usable on the battlefield. For nuclear weapons of tens or hundreds of tons yield, collateral damage and casualties are even lower and have the potential, in the apparent view of the Russian leadership, to serve as a tool for leveling the playing field against NATO airpower.

Russia's Escalation Philosophy and Strategy

The conflict between Russia and NATO is likely to reside at the boundary of what Russian military analysts characterize as regional and large-scale conflict, depending on the degree to which NATO strikes Russia and Russia strikes NATO.[62] These analysts believe there is an escalatory gap between the use of nonstrategic nuclear weapons and the circumstances that create a strategic nuclear exchange.[63]

This gap may widen even further as Russia develops ULY and VLY nonstrategic nuclear weapons. Such weapons, combined with highly accurate Russian precision-guided munitions, create a very potent and usable combination that increases the downtime of stricken airfields and dramatically increases the number of high-priority NATO targets, to include possible nonstrategic nuclear weapons launchers and launch sites. Further, it is possible that the more destructive effect of ULY and VLY warheads demands fewer PGMs as delivery devices, an issue of growing significance.

---

60. Robert P. Ashley Jr., "Russian and Chinese Nuclear Modernization Trends" (remarks, Hudson Institute, Washington, DC, May 29, 2019), https://www.dia.mil/.

61. Robert Krulwich, "Five Men Agree to Stand Directly under an Exploding Nuclear Bomb," National Public Radio, July 17, 2012, https://www.npr.org/.

62. "Mission and Objectives of the Russian Armed Forces," Ministry of Defence of the Russian Federation (website), https://eng.mil.ru/.

63. David S. Yost, "Russia's Non-Strategic Nuclear Forces," *International Affairs* 77, no. 3 (July 2001).

Beyond the Russian assessment of a gap between regional NSNW use and a strategic exchange, the evidence also indicates the Russian military has less aversion to the use of nonstrategic nuclear weapons than NATO. Russia's wide variety of dual-capable systems are an indicator of this view. While it is highly unlikely there is a nuclear warhead for every dual-capable weapon, it is highly likely there are at least some nuclear warheads for almost every type of theater-range weapon system.

Building the warheads is not a challenge for Russia, provided a 2014 estimate of 1,000 plutonium pits per year in Russia is comparable to a similar number of warheads per year.[64] Assuming this also means 1,000 warheads are built yearly, the production complex has the capacity to support 10,000 to 20,000 total warheads.[65]

Russia has some advantages over the United States in managing escalation in the nuclear realm. These advantages include the fact that Russia has a host of escalatory targets to be attacked within the European theater without having to strike highly escalatory targets outside the region (American territory) and run the risk of escalating from a regional to a large-scale conflict. In comparison, NATO has a paucity of regional escalatory targets outside Russia, so that strikes against the Russian homeland are almost required, opening up European members and the United States to retaliation, potentially leaving NATO self-deterred.

Further, Russia's force of ULY and VLY nuclear weapons targets a gap in the NATO arsenal and is able to achieve military objectives while also achieving psychological effects. NATO and the United States have focused far more on conventional responses to Russia's use of nonstrategic nuclear weapons and have fewer nuclear response options.

Russia's use of NSNW would also act as a substantial jolt to the Alliance and strain unified decision-making among member states. Transconflict fractures may prove operationally determinative, while postconflict fractures may constitute an acceptable outcome for Russia, even under status quo ante conditions. Potential political challenges for NATO include limited support from southern European member states not directly affected by Russia's aggression, wavering support of the NATO nuclear mission from nuclear weapons host nations, and questions of whether the territorial integrity of NATO member states on Russia's border is worth nuclear conflict. Putin appears to believe he can severely stress or fracture NATO with the discrete use of NSNW, which he believes allows Moscow to "dial in" pressure on the Alliance.[66]

Implications of the Conventional-Nuclear Asymmetry

Consideration of the conventional-nuclear asymmetry between the two sides could proceed in several directions, including the strength of the NATO Alliance in the face

64. Houston T. Hawkins, "Rethinking the Unthinkable," *National Security Science* (June 2014), https://permalink.lanl.gov/.

65. Mark B. Schneider, "Will Russia Build 8,000 Nuclear Weapons by 2026?," RealClear Defense, January 26, 2018, https://www.realcleardefense.com/.

66. Pierre de Druzy and Andrea Gilli, "Russia's Nuclear Coercion in Ukraine," *NATO Review*, November 29, 2022, https://www.nato.int/.

of nuclear threats or use, further conventional and nonstrategic nuclear force development, the evolution of military doctrine, and approaches to nuclear arms control. The article will address this last direction—approaches to nuclear arms control. Although talks are currently stalled between the two sides on a successor to New START (New Strategic Arms Reduction Treaty) that is at least hoped to include NSNW, the clock is running on the existing treaty, which expires in February 2026 with no provision in the text for further renewal.

Since the early 1990s, the United States has tried to limit Russia's nonstrategic nuclear weapons. These attempts have basically been unsuccessful, as evidenced by the nonbinding, unilateral presidential nuclear initiatives (PNIs) of 1991 and 1992, and a hoped-for accompaniment to New START that never materialized. Indeed, the PNIs—unilateral, voluntary, unverified pledges with general correspondence between the two sides—arguably resulted in the loss of negotiating leverage on NSNW for the United States when Russia reneged on its pledges.

The PNIs began with US President George H. W. Bush in a televised September 1991 address and his January 1992 State of the Union address and were answered in televised addresses by USSR President Mikhail Gorbachev in October 1991 and by Russian Federation President Boris Yeltsin the day after Bush's State of the Union address.[67]

Although the PNIs contained both strategic and nonstrategic elements, this discussion will focus on the nonstrategic elements. In his first address, Bush pledged to eliminate all nuclear artillery shells and tactical ground-launched missiles capable of carrying nuclear warheads. In addition, the development of the tactical version of the air-launched short-range attack missile was halted, and shortly after, NATO announced a reduction in the remaining air-delivered tactical nuclear gravity bombs in Europe. Finally, all tactical naval nuclear weapons on ships and naval aircraft were to be removed to central storage, with many to be dismantled and destroyed.

In response, Gorbachev announced the planned elimination of all nuclear artillery, nuclear warheads for short-range missiles, and nuclear mines, and the withdrawal of all tactical nuclear weapons from naval ships and aircraft to central storage, with the elimination of some. Yeltsin reaffirmed Gorbachev's planned elimination of the ground forces' nuclear weapons, and his pledges were more quantitative with regard to air and naval tactical nuclear weapons: eliminate one-half of all air-defense nuclear warheads, one-third of all sea-launched nuclear warheads, and one-half of all air-launched tactical nuclear warheads.

While the reductions seemed broad in scope, from the US standpoint, the PNIs ultimately failed in their goal of reducing and eliminating Russia's NSNW. In 2006, Assistant Secretary of State Stephen Rademacher declared that while the United States

67. Susan J. Koch, "The Presidential Nuclear Initiatives of 1991–1992," Center for the Study of Weapons of Mass Destruction, Case Study 5 (Washington, DC: National Defense University Press, September 2012); and *The New START Treaty, Hearings before the Senate Committee on Foreign Relations,* 111th Cong. (2010) (statement of Rose Gottemoeller, Assistant Secretary of State for Verification, Compliance, and Implementation, chief US negotiator in Post-START negotiations), 239, and (question by Senator Richard Lugar), 243.

had honored its PNI pledges, the Russian side had not completely fulfilled its pledges.[68] In 2021, the US State Department report on other nations' compliance with their treaties and commitments stated Russia had not met all its PNI commitments, specifically noting it had not eliminated all the warheads for its ground-based tactical missiles.

Nonstrategic nuclear weapons have not been included in any of the Strategic Arms Reduction Treaties (START, the unratified START II, and the only outlined START III), and NSNW were not a part of the New START negotiations, by agreement between the presidents of the two countries.[69] At the New START signing ceremony, however, then-US President Barack Obama stated his belief that the strategic agreement would be followed with talks including nonstrategic and nondeployed nuclear weapons.[70]

The US Senate reinforced that sentiment in its resolution of ratification for the treaty, where one of the conditions levied on the president was that he seek to initiate negotiations to address the difference in the holdings of NSNW on each side and verifiably secure and reduce their numbers.[71] Further, the president was urged to pursue measures aimed at building confidence in the numbers and security of the two nations' NSNW. Nevertheless, despite Secretary of State John Kerry's announcement at the 2015 Nuclear Nonproliferation Treaty (NPT) Review Conference that the United States had a total of 4,717 warheads as of September 2014, Russia issued no corresponding statement about its nuclear-warhead count.[72]

With the five-year extension of New START by Presidents Joe Biden and Putin in 2021, the United States and Russia reengaged the Strategic Stability Dialogue "to lay the groundwork for future arms control and risk reduction measures."[73] Speaking at the September 2021 NATO Conference on Weapons of Mass Destruction, Arms Control, Disarmament, and Nonproliferation, Under Secretary of State for Arms Control and International Security Bonnie Jenkins said the United States "will seek to address all nuclear warheads, including . . . so-called nonstrategic nuclear weapons."[74] Not

68. DOS, *Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments* (Washington, DC: DOS, April 15, 2021), https://www.state.gov/.

69. The White House, Office of the Press Secretary, "Joint Statement by President Dmitriy Medvedev of the Russian Federation and President Barack Obama of the United States of America," April 1, 2009, The Obama White House Archives (website), https://obamawhitehouse.archives.gov/.

70. The White House, Office of the Press Secretary, "Remarks by President Obama and President Medvedev of Russia at New START Treaty Signing Ceremony and Press Conference," April 8, 2010, The Obama White House Archives (website), https://obamawhitehouse.archives.gov/.

71. Resolution of Ratification: Senate Consideration of Treaty Document 111-5, 111th Cong. (2010), https://www.congress.gov/.

72. John Kerry, "Remarks at the 2015 Nuclear Nonproliferation Treaty Review Conference," New York, NY, April 27, 2015, https://2009-2017.state.gov/.

73. The White House Briefing Room, "US-Russia Presidential Joint Statement on Strategic Stability" (Washington, DC: The White House, June 16, 2021), https://www.whitehouse.gov/.

74. Bonnie Jenkins, "Nuclear Arms Control: A New Era?," remarks to NATO Conference on WMD Arms Control, Disarmament, and Nonproliferation, Copenhagen, Denmark, September 6, 2021, https://www.state.gov/.

surprisingly, the Strategic Stability Dialogue has been frozen because of Ukraine.[75] Further, as of February 21, 2023, Putin announced that Russia was suspending participation in New START.[76] As it stands today, the dynamic of deterrence and defense causes each side to lean most heavily on what it does best. For NATO and the United States, especially in the early days of any high-intensity conflict, airpower—advanced aircraft and precision-guided munitions—has become a decisive element. For Russia, aerospace defense is important; however, if conventional defense alone is not enough, Russia maintains an extensive set of NSNW options. The irony is each side considers its options to be defensive; however, those same options appear to be the most threatening offensive options to the other side.

Ultimately the United States has a problem with finding the right leverage to induce Russia to cut NSNW numbers. As mentioned above, the United States lost much of its leverage for direct, symmetric reductions in nonstrategic nuclear weapons when so many of its own NSNW options were unilaterally eliminated as the Cold War wound down. The development of countering potentially tradable nonstrategic nuclear weapons by the United States seems to lack support at this time.

Asymmetric trades are difficult to construct. Western airpower and Russian NSNW have evolved as primary defense and deterrence options for each side, even as they constitute the greatest threat to the other side. Russia frequently points to its desire to reestablish limits on US and NATO missile defense (even as, somewhat ironically, defense contractor Almaz-Antey develops increasingly capable air defense systems with antimissile applicability). But the US Senate's aforementioned resolution to ratify New START eliminated NSNW/missile-defense trades as a matter of policy. And while beyond the scope of this paper, conflicting demands on missile defense played a rather complicated role in the failure to ratify START II. **Æ**

---

75. "Russia-US Strategic Stability Dialogue Formally 'Frozen,' Says Senior Diplomat," TASS, April 30, 2022, https://tass.com/.

76. Vladimir V. Putin, "Presidential Address to Federal Assembly," February 21, 2023, Official website of the President of Russia (English version), http://en.kremlin.ru/events/.