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Long Shadows

Deterrence in a Multipolar Nuclear Age

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TABLE OF CONTENTS

01	Executive Summary
02	Introduction
04	U.S. Nuclear Profile
08	Russian Nuclear Profile
12	Chinese Nuclear Profile
16	North Korean Nuclear Profile
20	Country Comparison
24	Recommendations
25	Conclusion
28	Appendix: American, Russian, Chinese, and North Korean Nuclear Missiles

WE ARE ENTERING AN UNPRECEDENTED
MULTIPOLAR NUCLEAR WORLD WHERE
THE UNITED STATES MUST SIMULTANEOUSLY
DETER TWO NUCLEAR GREAT POWERS, AND
THE NUCLEAR DANGERS ARE GROWING.



Executive Summary

This report examines the nuclear policies and postures of the United States and its three primary nuclear adversaries, China, Russia, and North Korea. It concludes that the world is entering a multipolar nuclear era, which is unprecedented, and far more complex and challenging than the Cold War. The current nuclear order has been gradually shifting over the past decade. Russia remains the United States' only nuclear peer, but the arms control regime that constrained the superpowers' nuclear arsenals is disintegrating. Relations between Washington and Moscow have worsened since Russia's full-scale invasion of Ukraine and Russian President Vladimir Putin's nuclear saber-rattling. China's nuclear arsenal is growing in size and sophistication, potentially enabling Beijing to launch conventional attacks behind its nuclear shield. This development will shape both competition among Beijing, Washington, and Moscow and potential future military confrontations. Similarly, North Korea has a small but expanding number of deployed nuclear weapons and is improving its missile technology.

In this new nuclear environment, the United States must deter two nuclear-armed great powers as well as a regional nuclear power from launching conventional and nuclear attacks on itself and its allies. As the number of nuclear-armed states grow, interactions become more complex and the risks of miscalculation and misperception increase. The ramifications of this new reality are not well understood, aside from the implication that there is a growing risk that nuclear weapons might be used.

The study's findings have five primary implications for American policy and nuclear posture. To improve strategic stability and enhance deterrence, the United States should take several courses of action.

- First, President Joe Biden's administration should maintain current U.S. declaratory policy and implement existing modernization plans for the U.S. triad and nuclear infrastructure. This is not to suggest that the United States should give up its long-term goal of reducing the role of nuclear weapons in U.S. national strategy. But American leaders must be clear-eyed about the current security environment and aware of the potential repercussions of suddenly changing its nuclear policy and posture in a very dynamic and increasingly dangerous nuclear environment.
- Second, the Department of Defense (DoD) should renew its focus on nuclear deterrence as a part of its strategy of integrated deterrence. For several decades, the DoD has focused on deterring conventional or gray zone attacks, but the nuclear shadow falls over all forms of competition and conflict with Russia, China, and North Korea. The Pentagon needs to truly integrate its planning across all levels of conflict and recognize that nuclear considerations shape actions across the entire spectrum.
- Third, the United States should take steps to strengthen deterrence and crisis stability against North Korea.
- Fourth, the DoD must study escalation risks across a range of conventional and conflict scenarios with China, Russia, and North Korea to understand likely flashpoints and red lines.
- Fifth, the United States should pursue strategic dialogues with China and Russia and establish communication links and crisis mechanisms to avoid misperception and inadvertent escalation.

Introduction

Before invading Ukraine in February 2022, Russian President Vladimir Putin cautioned that “those who may be tempted to interfere . . . must know that Russia will respond immediately, and the consequences will be such as you have never seen in your entire history.” To ensure that there was no misunderstanding, Putin reminded his audience that “today’s Russia remains one of the most powerful nuclear states” and “it has a certain advantage in several cutting-edge weapons.” Thus, “there should be no doubt . . . that any potential aggressor will face defeat and ominous consequences should it directly attack our country.”¹ A few days later Putin reinforced these threats by announcing a “special service regime” for Russia’s deterrence forces.²

It was not clear exactly if and how this nuclear alert shifted the posture of Russia’s nuclear forces. It may have simply entailed connecting the circuits for Russia’s nuclear command and control network, which are not linked during peacetime,³ pairing nonstrategic or tactical nuclear weapons with their warheads, generating strategic nuclear forces,⁴ or simply increasing the number of personnel in nuclear command centers.⁵ Several days after the alert announcement, Russian nuclear-armed submarines conducted an exercise in the Barents Sea, and Russia’s Strategic Rocket Forces dispersed road mobile intercontinental ballistic missile (ICBM) launchers in Siberia.⁶ While some dismissed these moves as pure bluster, Putin’s overt nuclear saber-rattling was intended to deter the West from intervening on the side of Ukraine and raised the risks of nuclear use. Escalation could be inadvertent if, for instance, Putin decided that individual volunteers from Western nations fighting with Ukrainian forces constituted an outside intervention.⁷ Or because Russia’s invasion of Ukraine was getting bogged down, Putin could deliberately employ a nuclear weapon to compel the West to desist and a Ukrainian surrender. Regardless, the war in Ukraine has raised the specter of nuclear use.

Unlike during the Cold War, the United States cannot simply focus its attention on Russia. China too is expanding its nuclear arsenal likely to deter American intervention in a conflict over Taiwan or in the South China Sea. In summer 2021, open source analysts discovered that China was developing three new ICBM silo fields.⁸ Then in October the *Financial Times* reported that Beijing had tested what may have been an orbital weapon armed with a hypersonic glide vehicle (HGV) that could evade U.S. missile defenses. Admiral Charles Richard, the Commander of U.S. Strategic Command, characterized

these “breathtaking” developments as a “strategic breakout” by China,⁹ while General Mark Milley, the Chairman of the Joint Chiefs of Staff, said the hypersonic weapons test was “very close” to a “Sputnik moment.”¹⁰

Although these events were in the headlines, they point to larger shifts in the international environment that are underappreciated and whose implications are not well understood. China appears poised to enter the elite ranks of nuclear superpowers by fielding a significantly expanded nuclear stockpile and a triad of delivery systems. At the same time North Korea is rapidly moving from a nascent nuclear state to one with an array of advanced missiles and a small but growing arsenal of warheads, while Russian nuclear modernization, which includes fielding advanced technologies, such as hypersonic weapons, and upgrades to its large stockpile of nonstrategic nuclear weapons, continues apace.¹¹ The long nuclear shadow now extends to multiple adversaries, each of which could come into conflict with the United States in any number of different possible scenarios.¹²

Setting aside hyperbolic claims about any one of these developments, none of which individually is that alarming, collectively these trends are creating a tectonic strategic shift as the United States must deter two nuclear-armed great powers simultaneously and one nuclear-armed regional power from conventional and nuclear attacks against itself and its allies. As the Russian invasion of Ukraine has revealed, the risks of nuclear use are growing. Russia has brandished its nuclear weapons as a “shield for conventional aggression,” and as their nuclear arsenals expand other opponents may follow suit.¹³

Because the United States retains a quantitative advantage over the growing nuclear powers and relative parity with the Russians, strengthening deterrence might not require new nuclear weapons or delivery systems. But it will require a renewed emphasis on nuclear strategy and weapons and tightly linking conventional and nuclear strategy, planning, doctrine, and capabilities.¹⁴ To truly realize the Biden administration’s strategy of integrated deterrence, American officials need to stop treating nuclear weapons as an afterthought, to further explore the connection between the conventional and nuclear balances, and to gain a better understanding of our adversaries’ perceptions on these issues so that they can avoid inadvertent escalation.¹⁵

For several decades after the dissolution of the Soviet Union, U.S. nuclear policy had been focused on reducing the risk of nuclear war through arms control and limiting the role that nuclear weapons played in

American strategy.¹⁶ Throughout this period the risk that nuclear weapons might be employed receded—the primary threats were nuclear proliferation and that a terrorist group might obtain a nuclear weapon or fissile material.

By 2018, the geopolitical environment had changed significantly, and former President Donald Trump's administration asserted that the primary challenge to American security was the "reemergence of long-term strategic competition" with a revisionist China and Russia.¹⁷ Due to these developments, the *2018 Nuclear Posture Review* (NPR) concluded that buttressing deterrence required the United States to field a low-yield warhead for the submarine-launched ballistic missile (SLBM) and a nuclear-armed sea-launched cruise missile. Moreover, the United States announced that it might consider employing nuclear weapons in response to "non-nuclear strategic attacks."¹⁸

The Biden administration's *Interim National Security Strategic Guidance*, however, seems to promise a return to the Obama era's nuclear policy, pledging to "reduce the role of nuclear weapons in our national security strategy," seek new arms control agreements "where possible," and "engage in meaningful dialogue with Russia and China," while "ensuring our strategic deterrent remains safe, secure, and effective and that our extended deterrent commitments to our allies remain strong and credible."¹⁹ As a candidate, Biden pledged to "demonstrate our commitment to reducing the role of nuclear weapons" and indicated that the "sole purpose" of nuclear weapons should be "detering—and, if necessary, retaliating against a nuclear attack."²⁰ Thus there is speculation that the NPR, which is embedded in the larger National Defense Strategy (NDS), might modify American declaratory policy or take other steps to fulfill Biden's promises.

Progressive members of Congress and nonproliferation advocates have continued to press Biden to diminish the role of nuclear weapons in American strategy by adopting a no-first-use or sole purpose declaratory policy, terminating plans to modernize or reducing the size of the ground-based leg of the U.S. nuclear triad, and cutting new nuclear weapons that began under the Trump administration.²¹ While reducing the role of nuclear weapons is a laudable long-term objective, the United States also needs to be sensitive to the security environment that it

faces today and the potential short-term consequences of sudden changes to U.S. nuclear policy or posture. Unilaterally pursuing the reduction of nuclear weapons may increase the risk of conventional war and nuclear use.

The 2018 NPR singled out Moscow as the most concerning nuclear competitor because of its growing dependence on nuclear weapons and apparently reduced threshold for nuclear use. In the past few years, it has become clear that the United States also must simultaneously bolster deterrence against other competitors. Pyongyang views nuclear weapons as critical to its survival and has a growing store of nuclear warheads.²² Moreover, North Korea has demonstrated notable improvements in the quality, quantity, range, and diversity of its delivery platforms.

Although North Korea's developments are worrisome, China has been declared the Department of Defense's (DoD) "pacing challenge."²³ Until recently, the People's Liberation Army (PLA) was viewed as increasingly problematic because of its conventional force modernization and expansion, but it also is significantly increasing its nuclear arsenal and upgrading and diversifying its

strategic delivery platforms. Historically, China has fielded a "limited deterrent,"²⁴ with only a few hundred nuclear weapons, but it has been taking steps to expand the size of its modest nuclear stockpile and to develop a triad of sea- and air-

launched delivery platforms to complement its upgraded ground-launched missiles. The latest DoD report projects that China is on pace to more than triple the size of its deliverable warheads by 2027 and to have 1,000 nuclear warheads by 2030.²⁵

For the first time, the United States faces two nuclear-armed great powers as well as a nuclear-armed regional adversary that it seeks to deter from attacking not only the U.S. homeland, but also its allies. Although the fundamental tenets of deterrence and tools like arms control remain unchanged, the current and future situation is more complex and challenging than the Cold War.²⁶ Multiple nuclear powers complicate the calculus of how much and what is needed to deter, increase the risk of miscommunication and misperception, and reduce the likelihood of multilateral cooperation. Moreover, new technologies and domains, such as hypersonic weapons, cyber, and space, could further weaken strategic stability and increase the risk of nuclear escalation.

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This report is the first in a series on nuclear deterrence in a multipolar world. It aims to contribute to the discussion by surveying the nuclear landscape of the United States and its three nuclear rivals. It is important to emphasize that this is an open-source assessment based on the best information available, but because Russia's, China's, and North Korea's nuclear programs are shrouded in secrecy, these numbers should be treated with caution. In particular, there is less confidence in the estimates of North Korea's and China's nuclear arsenals than Russia's, because Moscow provides information on its strategic nuclear weapons as a part of the 2010 New Strategic Arms Reduction Treaty (New START). It also is worth noting that objective balance of nuclear forces matters less than each country's perceptions of others' nuclear policies and postures, and that perceptions can diverge significantly from reality.²⁷

The next four sections in turn outline the current nuclear postures of the United States, Russia, China, and North Korea and consider future projections of the nuclear arsenals for China and North Korea. Section five comparatively assesses these postures and considers future trends. The final section offers conclusions about the emerging strategic environment and considers the implications for American nuclear posture and force structure.

U.S. Nuclear Profile

Nuclear weapons have been an important part of U.S. national security strategy since their use against Japan in 1945. At the height of the Cold War, when concerns about the strategic balance with the Soviet Union were paramount, the U.S. nuclear arsenal peaked at more than 30,000 warheads. The purpose of these weapons was to deter nuclear attacks on the United States and its allies, and to deter a Soviet conventional attack on Western Europe.²⁸ To make America's pledge to defend its NATO allies against larger Warsaw Pact conventional forces credible, the United States reserved the right to employ nuclear weapons first against them.²⁹

Since the end of the Cold War, successive U.S. administrations have dramatically reduced the size of the U.S. nuclear arsenal as well as the role of nuclear weapons in national security strategy.³⁰ The Obama administration went the farthest by embracing the long-term goal of achieving a nuclear-free world—or reaching “global zero”—and pledged to make progress on American nuclear disarmament.³¹ Achieving this goal required improving the U.S. military's conventional capabilities so that they were sufficient to deter not only conventional

attacks, but also chemical and biological weapons use. Former President Barack Obama aspired to move toward a policy in which the sole purpose for nuclear weapons would be to deter a nuclear attack against the United States or its allies. Ultimately, however, the Obama administration shied away from officially shifting U.S. declaratory policy to one of “no first use” or “sole purpose,” and maintained that Washington reserved the right to employ nuclear weapons “in extreme circumstances to defend the vital interests of the United States or its allies and partners.”³²

The Trump administration's 2018 NPR expanded on this statement by threatening nuclear use in response to “non-nuclear strategic attacks,” which could include major cyberattacks against civilians or civilian infrastructure.³³ Concerned about potential Russian use of tactical nuclear weapons, the Trump administration also invested in new American nonstrategic nuclear weapons that were believed to offer flexibility and an enhanced ability to make tailored deterrent threats more credible.³⁴

President Biden appears poised to reverse the Trump administration's nuclear policy and to resurrect Obama's emphasis on reducing the role of nuclear weapons in national security.³⁵ The Biden administration's *Interim National Security Guidance* tries to strike a delicate balance by promising a smaller role for nuclear weapons and stressing the need to avoid arms races, while maintaining a secure strategic deterrent and upholding the United States' commitment to defend its allies.³⁶ On multiple occasions, President Biden has endorsed narrowing the circumstances under which the United States would consider employing nuclear weapons to only one situation: in response to a nuclear attack on the United States or its allies. This is the so-called “sole purpose” policy.³⁷

While similar to a “no first use” policy, some argue that “sole purpose” policy is more ambiguous and could be interpreted narrowly or more broadly. Advocates of sole purpose maintain that an “appropriately crafted” policy can support the United States' extended deterrent commitments and not overly constrain U.S. employment options, while skeptics contend that this is a meaningless change because practically there is no difference between no first use and sole purpose, and it is “unrealistic to have it both ways.”³⁸ Worried allies have voiced their opposition to any change in U.S. nuclear policy, which is viewed as diminishing America's commitment to protect them, and a shift could spur nuclear proliferation among U.S. partners.³⁹ Further, while allies may believe that sole purpose reflects a more restrained nuclear policy, it is not clear that adversaries would find

such a promise credible, and thus they are unlikely to reciprocate.⁴⁰ While the 2022 NDS and embedded nuclear posture review almost certainly will back away from the increased emphasis on nuclear weapons during the Trump years, it might decisively resolve these issues of U.S. declaratory policy or continue to equivocate.

Nuclear Posture

The end of the Cold War and subsequent arms control agreements with the Soviet Union and its successor state, the Russian Federation, significantly reduced the number and types of U.S. nuclear delivery systems and their respective warheads.⁴¹ New START mandates the existing limits on strategic warheads and intercontinental range delivery systems that the United States and Russia have. New START also caps the total number of deployed and non-deployed delivery systems at 800 to prevent either nation from quickly being able to expand its strategic arsenal. In March 2021, Biden and Putin agreed to extend New START for another five years with it expiring in 2026.⁴²

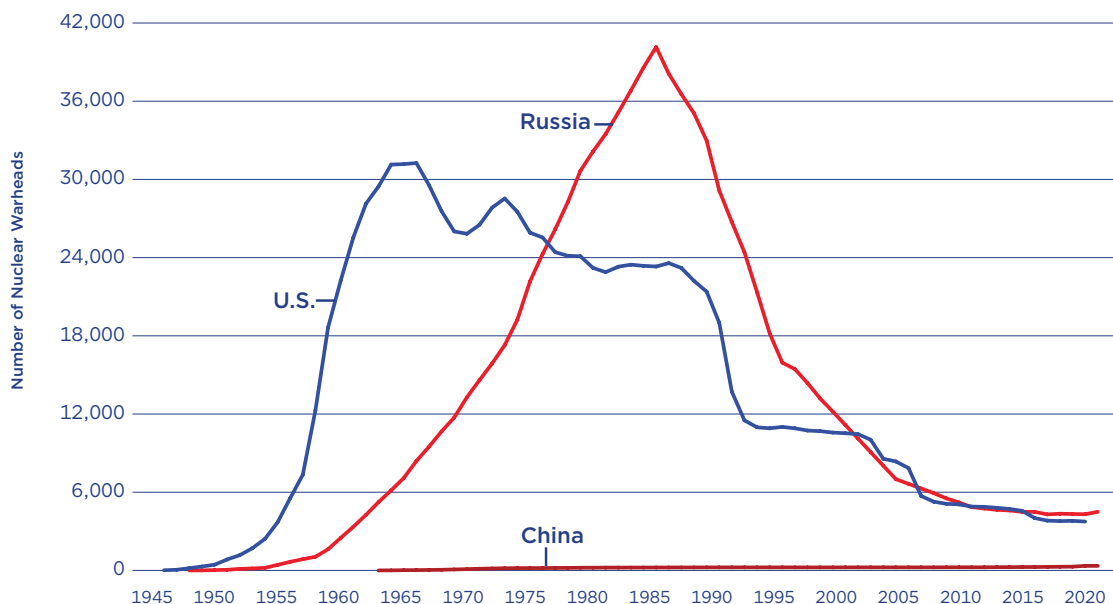
Both nations have met or stayed below the New START thresholds of 1,500 treaty-accountable nuclear warheads and 700 deployed strategic delivery systems.⁴³ As of September 1, 2021, the United States reported having 665 deployed launchers and 1,389 treaty-accountable warheads along with another 135 non-deployed launchers.⁴⁴

As a result of bilateral arms control treaties with Russia, the United States has decreased its nuclear stockpile by more than 85 percent since its Cold War peak.⁴⁵ However, the United States still holds the second largest nuclear arsenal in the world, consisting of 3,800 active (vice treaty-accountable) warheads—1,800 deployed to units and the rest in reserve.⁴⁶

The U.S. president, as the commander in chief of the U.S. military, has the sole authority over the use of American nuclear weapons.⁴⁸ Congress has no role in this decision.⁴⁹ The president may consult senior military leaders, who may advise the president, but their concurrence is not required, and no one can overrule lawful presidential orders.⁵⁰ The president can delegate nuclear launch authority to military commanders, but this has not occurred in recent times.⁵¹ Instead, the president maintains positive control over nuclear employment, meaning that nuclear use requires concrete and specific authorization.

To assure a second-strike capability under positive control, it is necessary to quickly detect incoming nuclear attacks, to securely relay this information to the president, and then reliably relay any alert or launch orders to ICBM launch centers, nuclear missile submarines, and aircraft. American early warning systems, including ground-based radars and space-based sensors, identify possible incoming attacks, while space-based

AMERICAN, SOVIET/RUSSIAN, AND CHINESE NUCLEAR WARHEAD STOCKPILES: 1945–2021⁴⁷



The United States had the largest nuclear arsenal until it was surpassed by the Soviet Union in the mid-1970s. Until recently, China has retained a modest nuclear stockpile, but its overall size remains much smaller than those of the United States and Russia.

communications form the backbone of strategic communications.⁵² Anti-satellite weapons and cyberattacks pose a growing threat to the United States nuclear command, control, and communications (NC3) system.⁵³

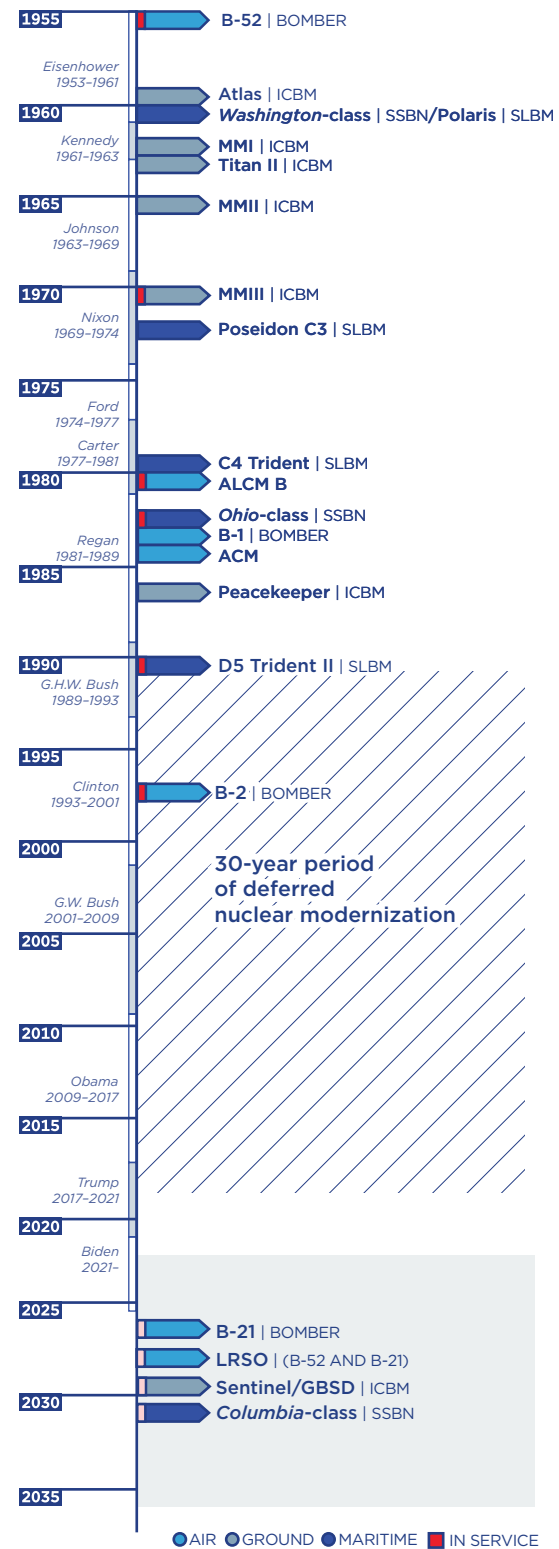
U.S. Strategic Command is the combatant command responsible for executing nuclear operations, which includes forces from all five services. The United States maintains a large but aging inventory of nuclear delivery systems across the air, land, and undersea domains. For three decades, the United States has deferred modernizing its nuclear weapons or acquiring new delivery systems, and now many of these systems are reaching the end of their planned service lives.⁵⁴ As a consequence, the entire triad and NC3 system simultaneously need to be recapitalized. The Congressional Budget Office (CBO) estimates the total cost of operating and modernizing American nuclear forces between 2021–2030 to be \$634 billion with about \$188 billion devoted to nuclear weapons and delivery system modernization.⁵⁵

The air leg of the American strategic triad includes 20 stealthy B-2 Spirit and 46 B-52 Stratofortress bombers. Although the B-2 can carry air-launched cruise missiles (ALCMs), because it is the only bomber capable of penetrating adversary airspace, its primary strategic mission is close-in strikes with the B61-7, B61-11, or B83-1 gravity bombs.⁵⁷ The B-52 can carry gravity bombs but will be primarily used to launch standoff nuclear strikes from outside of the range of enemy air defenses. The B-52s can carry up to 20 AGM-86B ALCMs.⁵⁸

The B-52s are undergoing extensive modernization to extend their service life for another 30 years, which would mean that they will have been a part of the U.S. strategic air arm for almost 90 years.⁵⁹ The venerable bombers, however, will be armed with a new nuclear weapon, the AGM-181 long-range standoff (LRSO) cruise missile. In addition to being longer range than the current ALCM, the LRSO will be stealthy so that it can slip through enemy air defenses. It is not expected to be operational until the late 2020s. The Air Force also plans on phasing out the B-2 and replacing it with a new, slightly smaller stealth bomber, the B-21 Raider.⁶⁰ The B-21 is supposed to be tested publicly for the first time in 2022 and will reach its initial operating capability (IOC) by 2026, but it will not be nuclear qualified until at least two years after it reaches its IOC.⁶¹ Both the stealthy B-2s and B-21s will be able to carry LRSO, which will enhance their capability by enabling different mission profiles.

This infographic depicts major U.S. nuclear weapons programs and the three-decade gap in which no major nuclear weapons modernization occurred. It omits efforts to modernize subcomponents of U.S. nuclear weapons (e.g., W76 super-fuze or Minuteman III guidance system) that have improved existing weapons' performance.

U.S. NUCLEAR MODERNIZATION FROM 1955–2035⁵⁶



The land-based missile leg of the U.S. triad consists of 400 silo-based Minuteman III ICBMs, which were first fielded in 1970.⁶² Originally, the Minuteman III was expected to be phased out in the 1980s, but their service life has been extended several times.⁶³ To remain in compliance with the New START treaty, each Minuteman ICBM is armed with only one warhead, although half of the missiles are capable of carrying up to three W78 warheads.⁶⁴ The ground-based leg of the triad remains on alert so that the United States has a capability to launch a retaliatory nuclear attack while under attack, but U.S. ICBMs are reportedly not in a hair-trigger launch-under-attack posture. Instead, “to strengthen deterrence, the United States maintains the capability to launch nuclear forces under conditions of an ongoing attack. However, owing to the mutually-supporting elements of the nuclear Triad, U.S. nuclear forces are postured to withstand an initial attack and provide maximum decision-making time for a President to gather information and respond in a time, place, and manner of our choosing.”⁶⁵

In 2014, the Air Force completed an analysis of alternatives for the future ICBM force that concluded that a new ICBM was required. The Defense Department adopted the Air Force’s recommendation and began to develop a new ICBM called the Ground-Based Strategic Deterrent (GBSD). GBSD, which was just named Sentinel (LGM-35A), is expected to have an initial flight test in 2023, reach its initial operational capability in fiscal year 2029, and to have fielded the full force of 400 missiles by 2036.⁶⁶

Critics have targeted the American ICBM force as a whole, and the Sentinel program in particular, for cancellation or reduction. To make the case against a new ICBM, nonproliferation advocates argue that ICBMs are unnecessary, vulnerable, risky, and too expensive.⁶⁷ Defenders of ICBMs contend that the ground-based missiles enhance deterrence and strategic stability by reducing an adversary’s confidence that it could successfully execute a disarming first strike against U.S. nuclear forces.⁶⁸ Moreover, the Air Force maintains that extending the life of the Minuteman III is not technically possible or cost-effective, and that a new ICBM offers upgraded capabilities and that over the long run Sentinel will ease maintenance burden and reduce costs.⁶⁹ Air Force officials warn that any further delays in the Sentinel program risks creating a gap in which the United States lacks a fully functioning ICBM force if Minuteman III operations become unsustainable and the Sentinel is not yet online.⁷⁰

The largest and most survivable component of the American strategic triad is the undersea leg.⁷¹ The U.S. Navy currently operates 14 *Ohio*-class nuclear ballistic missile submarines (SSBNs), each of which carries up to 20 D-5 Trident II SLBMs.⁷² Eight SSBNs are based at Naval Base Kitsap in Washington, and six are based at Naval Base King’s Bay in Georgia. Each D-5 can carry up to eight warheads, but it is believed that typically four or five warheads are loaded to remain in compliance with the New START treaty. Thus, the SLBM force includes more than 1,500 SLBM warheads, although, unlike the ICBM and bomber legs, most of these are not actively deployed, and not all of these warheads are treaty accountable.⁷³ In 2019, the U.S. Navy fielded the W76-2 eight-kiloton yield warhead for the D-5 SLBMs, and it is estimated that the Navy has around 25 of these lower-yield weapons.⁷⁴ Typically only two to four of the “boomers” are at sea at any time.

In 2010, the Obama administration directed the Navy to develop the next-generation SSBN named the *Columbia* class.⁷⁵ It is planned that the SSBN fleet will shrink from 14 *Ohio*-class to 12 *Columbia*-class SSBNs because the new boats will not require midlife refueling, a process that can take submarines out of operation for up to 40 months.⁷⁶ The *Columbia*-class submarines will be quieter than the *Ohio*-class boats and armed with 16 D-5 Trident II SLBMs until the next-generation SLBM is acquired in 2039.⁷⁷ The Navy began construction on the first *Columbia*-class SSBN in FY2021 and is expected to start the second in FY2024.⁷⁸ One *Ohio*-class boat is slated to retire annually beginning in 2027.⁷⁹

In addition to the forces that make up the triad, the United States also has nonstrategic nuclear weapons, which are married to shorter range delivery systems and/or possess lower yield warheads than most strategic nuclear systems, and are not constrained by existing arms control agreements. The Trump 2018 NPR argued that the United States needed additional options to deter limited nuclear use by potential adversaries, such as Russia.⁸⁰

The primary American nonstrategic nuclear weapon is the B61 gravity bomb, which can be delivered by nuclear-capable F-15E, F-16, and eventually F-35 fighters.⁸¹ As a part of NATO’s nuclear deterrence mission, the United States maintains B61 bombs in Europe. Though they remain under U.S. control, they are allocated to Belgian, Dutch, German, and Italian fighters for delivery.⁸² Additionally, the 2018 NPR called for the Navy to develop a new nuclear sea-launched cruise missile, but it is unclear whether the Biden administration will continue this new program.⁸³

The United States also has invested in air and missile defenses to protect against nuclear strikes.⁸⁴ To defend the homeland, the United States has 44 ground-based interceptors in Alaska and California and 20 additional interceptors are planned to be deployed. This system only defends against limited and relatively uncomplicated ICBM threats from North Korea and, potentially in the future, Iran.

Additionally, the Army and Navy have the Terminal High Altitude Area Defense (THAAD) and Aegis theater missile defense systems. The Army has seven THAAD batteries, including deployments to Guam and South Korea, while the Aegis system is based on destroyers and cruises and ashore in Eastern Europe. These missile defense interceptors rely on a global network of ground, sea, and space sensors to detect and track ballistic missile launches and are intended to engage much lower velocity missiles such as medium- and intermediate-range ballistic missiles.

Finally, the Army has the Patriot Advanced Capability-3 system to defend point targets against cruise missile and short-range ballistic missile (SRBM) attacks.

Russian Nuclear Profile

Russia has the largest nuclear arsenal in the world.⁸⁵ Since the end of the Cold War, Moscow has increasingly relied on its nuclear weapons to deter nuclear and conventional attacks against it.

There are disagreements in the West about Russian nuclear doctrine and declaratory policy and, specifically, whether it plans to preemptively use nuclear weapons. Some argue that Russia has significantly lowered its threshold for nuclear use and intends to employ nonstrategic or tactical nuclear weapons early in any conflict with NATO to compel termination of the war on favorable terms. The intent of this so-called “escalate to de-escalate”⁸⁶ strategy is to exploit Western divisions with nuclear coercion. A revisionist Russia could employ its nonstrategic nuclear weapons as a signal of resolve to force the West to capitulate and accept a fait accompli attack on a NATO member state.⁸⁷ Others dispute this interpretation, pointing to the fact that Russia has bolstered its conventional capabilities so that it can manage escalation short of nuclear employment, thereby making it less necessary for Moscow to use nuclear weapons early in any war.⁸⁸

All analysts and observers agree that nuclear weapons are central to Russia’s concept of deterrence and potentially could be employed to achieve battlefield effects

in a war. In 2020, Russia released an update to its declaratory policy, which specified four situations in which Moscow could employ nuclear weapons, while averring that it “considers nuclear weapons exclusively as a means of deterrence.”⁸⁹ First, Russia might use nuclear weapons if it receives “reliable” warning that ballistic missiles have been fired at it or its allies—this is often referred to as a “launch on warning” or “launch under attack” doctrine. Second, Russia would retaliate with nuclear weapons if it or its allies were attacked with nuclear or other weapons of mass destruction. Third, Russia could launch a nuclear strike if an adversary attacks critical governmental or military sites that support Russia’s strategic deterrent. Finally, Russia could use nuclear weapons to defeat a conventional attack that puts “the very existence of the state in jeopardy.”⁹⁰ Russia’s actions during the 2022 war in Ukraine suggest that this list of situations is not exhaustive. At the beginning of the invasion, Putin threatened to use nuclear weapons to deter third parties from intervening in the war and from directly attacking Russia.⁹¹

A revisionist Russia could employ its nonstrategic nuclear weapons as a signal of resolve to force the West to capitulate and accept a fait accompli attack on a NATO member state.

Since the end of the Cold War, the same bilateral arms control treaties that have helped motivate major reductions in the size of the U.S. nuclear inventory have likewise resulted in significant shrinkage of Russia’s nuclear arsenal, which peaked in 1986 with more than 40,000 deployed warheads.

In September 2021, Russia declared that, in accordance with the New START treaty, it had 1,458 treaty-accountable warheads deployed on 527 ICBMs, SLBMs, and heavy bombers.⁹² The 2022 Bulletin of Atomic Scientists estimates that Russia retains a nuclear force that consists of approximately 4,447 deployed and reserve strategic and nonstrategic nuclear warheads. Approximately 1,588 of these are deployed on strategic delivery vehicles—a similar triad of ICBMs, SLBMs, and bombers—while an additional 2,889 strategic and nonstrategic warheads are operationally available but in storage.⁹³ Russia’s ICBM force is assigned 1,185 warheads, while 800 warheads are allocated to submarines, and 580 are assigned to bombers.⁹⁴

In addition to the weapons allocated to forces, Moscow has a stockpile of 1,500 retired warheads that are waiting to be dismantled. Russia thus has 5,977 warheads that are deployed, in reserve, or waiting to be decommissioned. Both Russian and U.S. operational reserves—and perhaps some intact retired warheads—are weapons that either side could choose to deploy after the New START treaty lapses in February 2026 or if they decide to disregard existing treaty obligations.

The president, who is the supreme commander in chief of the Russian armed forces, can authorize the use of nuclear weapons, which have a launch under attack posture.⁹⁵ In 2018, Putin remarked at an international policy forum that “our strategy of nuclear weapons use doesn’t envision a preemptive strike.” Instead he explained that “only when we become convinced that there is an incoming attack on the territory of Russia, and that happens within seconds, only after that we would launch a retaliatory strike.”⁹⁶ Russia’s 2020 strategic deterrence policy states that Russia maintains its command and control at a level of high readiness so that it can “guarantee[e] the infliction of unacceptable damage on an aggression in whatever situation.”⁹⁷ Putin’s 2022 nuclear warning before the Ukraine invasion suggests that its nuclear forces could be used to prevent intervention in Ukraine and in response to a conventional attack on Russia.

Russia, like its Soviet predecessor, harbors deep concerns about decapitation strikes against its leadership and attacks against its command and control system. Cyberattacks pose a growing threat to strategic command and control systems.⁹⁸ To assure its ability to launch a second strike while under attack, Russia has redundant communications pathways and is believed to have a semi-automated command and control system, called Perimeter, that pre-delegates nuclear launch authority.⁹⁹ Perimeter is a so-called “dead hand” system, which would be activated only if there had been confirmed nuclear explosions on Russian territory and communications to senior political and military leaders had been severed.¹⁰⁰ In this system, a human operator still retains the authority to decide whether to launch the weapons.¹⁰¹ In 2020, it was announced that Russia is building a new hardened nuclear command and control center for senior leadership and Strategic Rocket Forces (SRF) officials.¹⁰²

Moscow is nearing the end of a decades-long modernization program for its nuclear forces. In December 2020, Putin stated that 86 percent of Russia’s strategic weapons had been modernized.¹⁰³ Russia has a mix of ground-based, air-launched, and sea-based nuclear

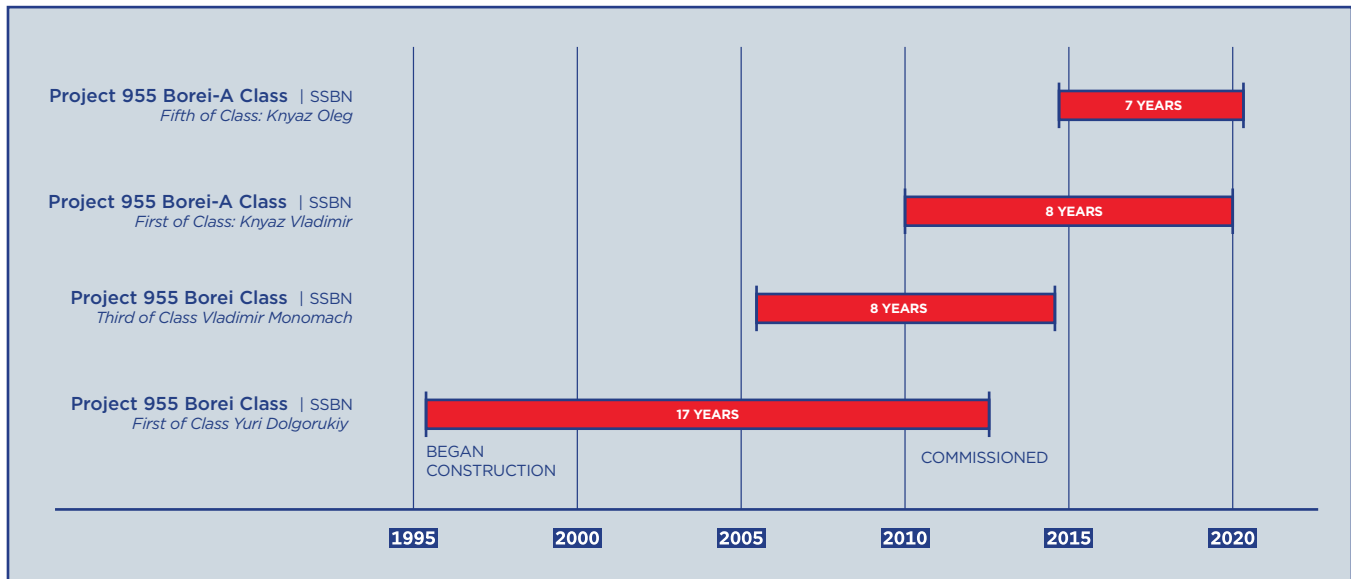
delivery systems. Land-based ICBMs make up over 56 percent of Russia’s strategic launchers and carry 46 percent of its strategic nuclear warheads. The SRF, a separate branch of the Russian armed forces, operate 310 silo-based and road-mobile ICBMs. While the New START treaty limits the Russian ICBMs to 700 warheads, Russia has 1,185 warheads deployed and in storage.¹⁰⁴

According to Defense Minister Sergei Shoigu, “over 95 percent of our strategic missile forces are continuously ready for combat use.”¹⁰⁵ In silos, Russia has two remaining Soviet-era ICBM models, the SS-18 (RS-20V) and SS-19 (RS-18), but they are scheduled to be retired and replaced by the SS-27 Mod 2 (RS-24 Yars), which can carry up to four warheads, and the heavy SS-X-30 (RS-28 Sarmat), which will have 10 or more warheads on each missile.¹⁰⁶ The SS-27 Mod 1 (RS-12M Topol-M) carries a single warhead, but, like most Russian missiles, it includes countermeasures to defeat ballistic missile defense systems and has both silo and road mobile variants.¹⁰⁷ The SRF also has a road-mobile variant of the SS-27 Mod 2 (RS-24 Yars), which is entering into service as the SS-25 (RS-12M) missiles are retired. Russian ICBM bases are distributed across Russia’s vast hinterland.

The air leg of Russia’s strategic triad consists of two divisions of nuclear-capable heavy bombers under the Russian Aerospace Forces’ Long-Range Aviation Command. These divisions consist of one regiment of Tu-160 Blackjack bombers and three regiments with Tu-95MS Bear bombers for a total of 60 to 76 bomber aircraft. Only 50 bombers are counted under the New START limits.¹⁰⁸

The bombers are based at Engels in southwestern Russia and at Ukrainka in Russia’s far east.¹⁰⁹ Both bombers can carry the legacy As-15 Kent (Kh-55) and the new As-23B (Kh-102) nuclear ALCMs. A Tu-160 can be armed with 12 As-15B (Kh-55) ALCMs, while different variants of the Tu-95MS can be loaded with six to 16 cruise missiles.¹¹⁰ Russia only has 580 air-launched nuclear weapons, but the Russian bomber fleet has the capacity to carry more than 800 nuclear weapons.¹¹¹

Russia is significantly upgrading its Tu-160 fleet, refurbishing some with new engines, avionics, and mission systems, while building new airframes.¹¹² At the same time, Russia is developing the next-generation stealth bomber, called the PAK-DA, which is expected to begin production in 2027, although given the delays in their other aircraft programs, this date seems ambitious.¹¹³

RUSSIA'S BOREI-CLASS SUBMARINE: DEVELOPMENT TIMELINE¹¹⁴

Russia is developing a next-generation SSBN—the Borei class—but this acquisition program has been plagued by delays.

The Russian Navy operates the undersea leg of the Russian triad with 12 operational nuclear-armed SSBNs in the Northern Fleet at Gadzhievo and in the Pacific Fleet at Vilyuchinsk. Seven of the SSBNs are of the Cold War-era Delta class and there are five new Borei-class boats, the first of which joined the Northern Fleet in 2013.¹¹⁵ Each SSBN can carry 16 SLBMs with multiple warheads. Most of the Delta-class boats carry the RSM-56 (SS-N-23 Sineva) SLBM, each of which can carry four warheads, while the new Borei-class boats carry the RSM-56 (Bulava) SLBM, which can carry up to six warheads.¹¹⁶ A maximally loaded Russian SSBN fleet could carry 912 warheads, but due to the New START limits, the number today is probably only 624.¹¹⁷

Russia plans to procure a total of 10 Borei-class SSBNs, but the program has been plagued by delays, although production speed is improving. The first Borei-A/II boats finally became operational in 2020.¹¹⁸ The Borei-A/IIs have enhanced noise reduction and a lower magnetic signature, making them harder to detect.¹¹⁹

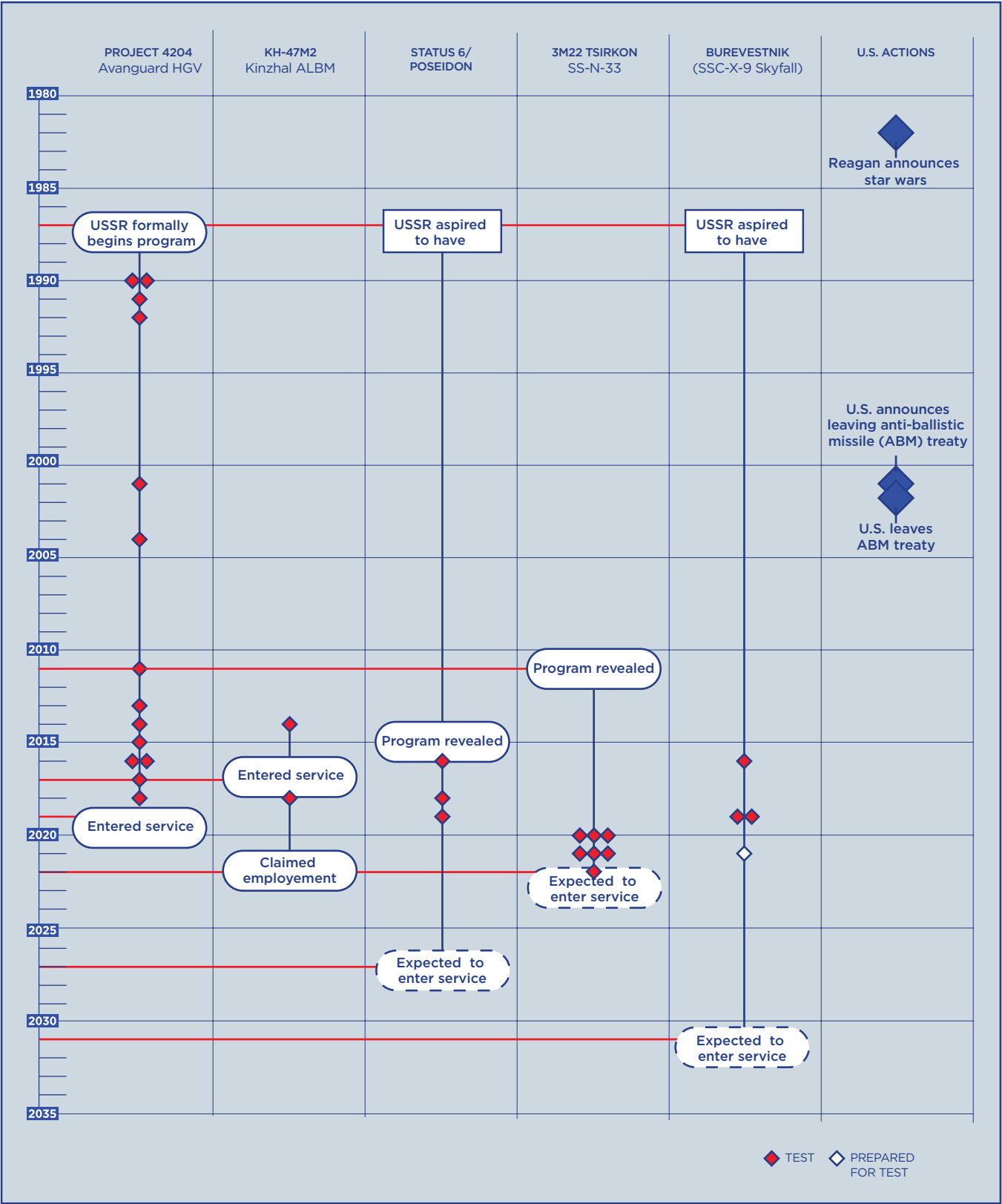
In addition to strategic nuclear weapons, Russia also has approximately 2,000 nonstrategic or tactical nuclear weapons that are allocated to its air, sea, ground, and air defense forces.¹²⁰ These weapons are not constrained by existing arms control agreements. Although the number of Russian nonstrategic nuclear weapons has been declining, Moscow is modernizing these weapons and building a sophisticated set of dual-capable delivery systems that can carry conventional or nuclear warheads. Key dual-capable delivery systems—launchers that can carry with nuclear or conventional payloads—include the

SS-26 (9K720 Iskander) SRBM, the Kaliber sea-launched land attack cruise missile (LACM) (SS-N-30A/3M14), and a long-range air-launched ballistic missile known as the Kh-47 M2 Kinzhal.

The Russian Navy has the largest nonstrategic nuclear stockpile, which consists of approximately 935 warheads. Information about these systems is often spotty, but the Russian Navy likely has a nuclear capable version of the SS-N-26 (3M-55) cruise missile that can be used against land targets and ships.¹²¹ The Russian Air Force's Tu-22 Backfire bombers, Su-24 Fencer fighter bombers, Su-34 Fullback fighter bombers and the MiG-31K fighters could be used to deliver the approximately 500 non-strategic weapons assigned to the air force. All these aircraft can carry nuclear gravity bombs, while the Backfires also can be loaded with Kh-22 (AS-4 Kitchen) ALCMs. Additionally, Russia has around 380 nonstrategic nuclear warheads for its aerospace defense missile systems, including the S-300 (SA-20) and S-400 (SA-21) interceptors as well as 10-kiloton warheads for its A-135 anti-ballistic missile interceptors that defends Moscow.¹²² Russian ground forces, including the 12 SS-26 (9K720 Iskander) SRBM brigades, are armed with approximately 70 tactical warheads.¹²³ Russia's ground-launched cruise missiles, including the SSC-7 (9M728) and SSC-8 (9M729), are also nuclear capable.¹²⁴

In addition to these more traditional nuclear weapons, Putin has publicly highlighted the development of a range of "novel" nuclear delivery systems, including hypersonic weapons, a nuclear-powered cruise missile (Burevestnik), and a nuclear-powered unmanned

RUSSIA'S NOVEL NUCLEAR DELIVERY SYSTEM DEVELOPMENT, 1980-2025¹²⁵



For decades, Russia has sought to develop novel nuclear weapons delivery platforms that can defeat American missile defenses, but this effort only made significant progress in the last decade or so.

underwater vehicle (Poseidon).¹²⁶ Of these, Russia has made the most progress in hypersonics. The Kinzhal air-launched ballistic missile has been deployed since 2018 on MiG-31Ks,¹²⁷ while the Avangard HGV was first deployed in 2019 and two SS-19 (UR-100) regiments are now equipped with it.¹²⁸ Lagging only slightly behind is the Tsirkon (3M-22, SS-N-33) antiship hypersonic cruise missile intended for ships and submarines, which was successfully tested in 2020 and 2021 and is expected to enter production in 2022.¹²⁹ Putin has tied the development of all of these novel nuclear weapons to the United States' withdrawal from the Anti-Ballistic Missile Treaty in 2002 and subsequent development of missile defenses.¹³⁰

Russian military doctrine and posture emphasize shielding its forces from air and missile attacks with a layered defensive system that includes air- and ground-based sensors and different types of surface-to-air missiles.¹³¹ Because Moscow worries that NATO will use massed conventional or nuclear air and missile strikes in the opening phases of a conflict,¹³² Russia fields sophisticated and resilient integrated air and missile defense systems with redundant, overlapping, and mobile components.¹³³

Putin has tied the development of all of these novel nuclear weapons to the United States' withdrawal from the Anti-Ballistic Missile Treaty in 2002 and subsequent development of missile defenses.

To protect Moscow, Russia has deployed the A-135 anti-ballistic missile system, which includes 68 nuclear-armed 53T6 Gazelle interceptors. Russia currently is upgrading Moscow's missile defenses and will call the new system the A-235.¹³⁴ In addition to the 1980s-era S-300V (SA-23) medium-range surface-to-air missile, which can engage aircraft and provides point defense against cruise and ballistic missiles, Russia has also fielded the longer-range S-400 (SA-21) surface-to-air missile, which can engage targets out to 400 kilometers.¹³⁵ The S-400 has been deployed to Kaliningrad, Crimea, and Syria.¹³⁶

Russia's next-generation air defense system, the S-500 Prometheus, began development in 2010 but has experienced significant delays and is not expected to enter full-scale production until 2025.¹³⁷ Ultimately, Russia intends to field 10 S-500 battalions. The S-500

not only extends the air defense envelope out to 600 kilometers, but it has a more powerful radar to spot stealthy aircraft and can track and engage up to 10 ballistic missile targets simultaneously.¹³⁸ The S-500 will also reportedly have some capability against satellites and hypersonic weapons.¹³⁹

Russia remains the most capable nuclear weapons state and is nearing the completion of a long-term program to modernize its nuclear forces. Although its nuclear arsenal is not growing, Moscow is fielding more capable strategic and nonstrategic nuclear weapons and delivery systems, including a number of advanced launchers that are intended to evade missile defenses. The poor performance of Russian conventional forces in the war in Ukraine may make Moscow more reliant on nuclear weapons going forward, although economic sanctions are likely to limit its ability to produce new weapons.

Chinese Nuclear Profile

China developed nuclear weapons to enhance its security and military power, raise its international stature, and indicate technological sophistication.¹⁴⁰ Since China's first nuclear test in 1964, the almost exclusive purpose of its nuclear arsenal has been to deter an enemy from launching a nuclear attack on China or attempting to coerce China with nuclear threats.¹⁴¹ Thus, Chinese writings on nuclear policy and strategy have centered on a "self-defensive" nuclear capability intended to deter nuclear attacks with a "lean and effective nuclear force."¹⁴² Beijing's declaratory policy is one of assured retaliation coupled with an ambiguous no-first-use pledge.¹⁴³ Until recently, China's no-first-use policy was credible because it was matched by China's modest nuclear posture. The degree of Chinese nuclear self-restraint was unusual. Since the 1970s or early 1980s China had a "small and vulnerable arsenal"¹⁴⁴ of ICBMs to support its strategy of "minimum deterrence."¹⁴⁵ Minimum deterrence required only enough nuclear weapons to inflict unacceptable damage on a few adversary cities, the lowest threshold for establishing a credible deterrent.¹⁴⁶

In the late 1980s, as China began to grow as a global power, Chinese strategists began to discuss "limited deterrence," which envisioned the prospect of limited employment of nuclear weapons against military targets, but the PLA did not have the capability to execute such a strategy.¹⁴⁷ Chinese nuclear doctrine and declaratory policy have shifted only incrementally over the past two decades, and its posture, which consisted of a comparatively small inventory of mostly ground-based missiles, was congruent with the minimum deterrence strategy.

Since the mid-2000s, questions about the credibility of China's no-first-use-policy have grown as Chinese strategists have openly debated its relevance in changing geopolitical circumstances and as China's nuclear arsenal has expanded.¹⁴⁸ There are increasing signs that China is moving away from its very reserved and anomalous nuclear policy of assured retaliation. Chinese strategists and military leaders have suggested that Beijing might use nuclear weapons in other situations including: in response to an American intervention in a conflict with Taiwan, conventional counterforce strikes against Chinese nuclear weapons, or in response to attacks that threaten the Chinese Communist Party's hold on power.¹⁴⁹ While Chinese leaders continue to affirm the no-first-use policy, the expansion and modernization of China's nuclear capabilities have fueled suspicions that Beijing has secretly amended its nuclear policy to include a few exceptions when it would consider being the first to use a nuclear weapon.¹⁵⁰

China's nuclear forces are in the middle of transformation from a limited deterrent force to something more.¹⁵¹ China's nuclear program lacks transparency, so the exact size and shape of its current nuclear posture—let alone its future plans—are not known, but it is clear that its nuclear forces are expanding both quantitatively and qualitatively, with enhancements in readiness and command and control.

As of 2021, China has roughly 350 nuclear strategic warheads in its inventory and a nascent strategic triad of delivery systems. Command and control over China's nuclear forces is believed to be highly centralized and in the hands of China's top political and military leaders. Official defense documents indicate that "China's nuclear force is under the direct command of the Central Military Commission (CMC)," and that it is responsible for all key decisions about nuclear use.¹⁵² It is believed that the CMC passes its orders to the General Staff, which in turn relays the order to the relevant service headquarters and then to tactical units, although this may differ by service.¹⁵³ The PLA Rocket Force (PLARF), PLA Air Force (PLAAF) and PLA Navy (PLAN) all have nuclear missions.¹⁵⁴

China's airborne leg is the least developed component of its nuclear triad. While bomber aircraft were used for nuclear tests in the 1960s and 1970s, the PLAAF was without a nuclear mission for several decades. Nonetheless, its medium-range H-6K bomber retains the capability to carry an estimated stockpile of approximately 20 nuclear-armed gravity bombs.¹⁵⁵

In 2018, China reassigned a nuclear mission to the PLAAF, presaging more changes. In 2019, it paraded the H-6N, a modernized dual-capable version of the Soviet Tu-16 bomber, and fielded it in 2020.¹⁵⁶ Because the H-6N can be refueled while in the air, it could be used as an intercontinental delivery system especially if it is carrying the CH-AS-X-13, a 3,000-kilometer range nuclear-capable air-launched ballistic missile (ALBM). The CH-AS-X-13's long range and speed would allow Chinese bombers to launch standoff nuclear strikes that can penetrate missile defenses.¹⁵⁷

In the future, China will likely build more H-6N bombers as well as test and field its fifth-generation stealth bomber, the H-20, which would provide it with a penetrating, intercontinental range bomber with an expanded conventional or nuclear payload.¹⁵⁸

Most of the PLA's nuclear forces are in the PLARF's ground-launched component.¹⁵⁹ This consists of an estimated 280 launchers and 258 nuclear warheads. Only 110 of these are full-range ICBMs that can range the continental United States, and at least 60 more can also reach Guam.¹⁶⁰ For nearly two decades, the foundation of the PLA's ICBM

Until recently, China's no-first-use policy was credible because it was matched by China's modest nuclear posture.

force has been the older "transportable" DF-4 (CSS-3) and silo-based DF-5 (CSS-4).¹⁶¹

China's upgraded newer variant of the DF-5 (CSS-4) is capable of being armed with multiple independent reentry vehicles (MIRVs).¹⁶² The newest solid-fueled ICBMs, the DF-31 (CSS-10 Mod 2) and DF-41 (CSS-20), are road mobile and have features that help them to evade missile defenses. The DF-41 (CSS-20) can carry multiple warheads, and the first units became operational in 2020.¹⁶³

As noted, in the past year, open source analysts have discovered construction sites for roughly 300 new missile silos at three different locations, which represents a significant departure from China's past nuclear posture.¹⁶⁴ It is not clear how China plans to use these new silos, but it may fill some or all of these silos with the DF-41 (CSS-20) ICBMs, which may or may not be armed with multiple warheads. Regardless of precisely how these silos are used, this will be a significant expansion of China's nuclear capability. China likely will focus on producing more ICBMs and equipping them with more survivable delivery systems and MIRV capabilities.

Historically, the PLA's rocket forces have been maintained at a very low alert level with warheads stored separately from the missiles. The PLARF appears to be improving the readiness of its rocket forces and may even be moving toward a launch-on-warning posture as its satellite early warning constellations come online.¹⁶⁵

Compared to China's land-based missiles, the PLA's undersea nuclear strike capability is small and not particularly sophisticated, but it does provide Beijing a semblance of a second-strike capability. China deployed its first SSBN in 1981—its single Xia-class Type 092 submarine. It was noisy, and its SLBMs lacked sufficient range to target the United States from Chinese waters.¹⁶⁶

Its successor, the Jin-class Type 094 SSBN, marks a significant improvement in stealth, range, and capability, though the fleet is still not very quiet compared to American and Russian submarines.¹⁶⁷ The PLAN currently operates six of the Type 094 SSBNs, which are equipped with JL-2 (CSS-N-14) SLBMs with a range between 7,200 and 9,000 kilometers.¹⁶⁸ The Jin-class submarines, therefore, would need to pass through several maritime chokepoints to range all targets in the United States.

In line with Chinese President Xi Jinping's 2018 directive to grow the strength of China's SSBN force, the PLAN plans to field eight SSBNs by 2030.¹⁶⁹ The PLAN is also likely to begin construction on the next-generation Type 096 SSBN in the next few years, which is anticipated to carry a JL-3 SLBM, which will likely have a longer range to allow the Chinese SSBNs to operate in more secure waters.¹⁷⁰

China's nuclear arsenal also contains some nonstrategic or tactical weapons. China's first nuclear weapons were medium-range ballistic missiles (MRBMs) and intermediate-range ballistic missiles (IRBMs), and today the PLARF also has a variety of accurate, dual-capable medium- (DF-21 CSS-5), and intermediate- (DF-26 CSS-18) range ballistic missiles.¹⁷¹ These land-based ballistic missiles are road mobile and have ranges of approximately 2,150 and 4,000 kilometers, respectively.¹⁷² While the PLARF has a large number of SRBMs, only the DF-15 (CSS-6) is thought to be nuclear capable,¹⁷³ and many of the MRBM and IRBM missiles probably are armed with conventional warheads. While the MRBMs and IRBMs can hold at risk numerous targets in India and Russia, the presence of these dual-capable missiles suggests that the PLARF may have a mission that goes beyond an assured retaliation to warfighting. As mentioned previously, the PLAAF also probably has a small number of gravity bombs on dual-capable medium-range H-6K bomber aircraft.¹⁷⁴

One area of potential concern regarding China's dual-use capabilities is the co-location of conventional and nuclear missile capabilities at Chinese bases. While open-source materials make this difficult to assess, the majority of the brigades are thought to be equipped exclusively with either nuclear or conventional

missiles, positioned separately on the bases, and using different command and control chains.¹⁷⁵ However, some may share support regiments, warhead transportation, and/or physical command and control infrastructure. Additionally, the growing number of DF-26 (CSS-18) missiles is alarming due to their "hot swapping" capability, which allows the PLA to rapidly exchange conventional and nuclear warheads on the missiles.¹⁷⁶ Distinguishing between a conventional or nuclear-armed missile is extremely difficult, especially from the air. There is the risk of inadvertent escalation if the United States were to strike what it thought were conventional missiles that were actually nuclear-armed.

In line with its doctrine of self-defensive limited deterrence, the PLAAF has built a multi-tiered defensive system to protect its forces, consisting of Russian-sourced S-300 (SA-20) medium-range surface-to-air missiles, as well as China's newer-generation indigenous HQ-9 (CSA-9) medium- to long-range surface-to-air missiles, which closely resemble the Russian S-300.¹⁷⁷ For longer-range threats, China acquired the Russian S-400 (SA-21) system. It is also domestically developing a mid-course missile interceptor, assessed to have a ballistic missile defense role to secure the upper tier of its layered missile defense, which was tested in February 2021.¹⁷⁸

China likely will continue to modernize and expand its nuclear forces, with a particular focus on increasing the forces' survivability, reliability, and ability to penetrate defenses. China perceives U.S. missile defense systems and U.S. conventional precision strike capabilities as undermining its deterrent posture.¹⁷⁹ Among near-term improvements are likely to be hypersonic missiles to help assure its second-strike capability by ensuring that some of its missiles can penetrate American missile defenses. In 2020, China fielded its first hypersonic weapon, the DF-17 MRBM armed with an HGV.¹⁸⁰ In the summer of 2021, China tested what could be an orbital bombardment system that was equipped with an HGV, which could evade U.S. missile defense radars.¹⁸¹ If used as an orbital bombardment system—circling the earth rather than following a straight-forward ballistic trajectory—it would fly at a lower altitude, making it difficult to track and reducing warning time.¹⁸² During this test, the HGV may have deployed a counter-measure or a submunition, a technological feat that would require significant sophistication.¹⁸³

Recent discoveries of new missile silos indicate that China is expanding its nuclear arsenal beyond previous expectations. To support this expansion, it may require increased fissile material production to build new warheads, but there is significant uncertainty about whether China has the capacity to do this, given the opacity of its nuclear weapons

programs.¹⁸⁴ According to U.S. Defense Department projections, the PLA may possess up to 700 deliverable nuclear warheads by 2027 and 1,000 by 2023.¹⁸⁵

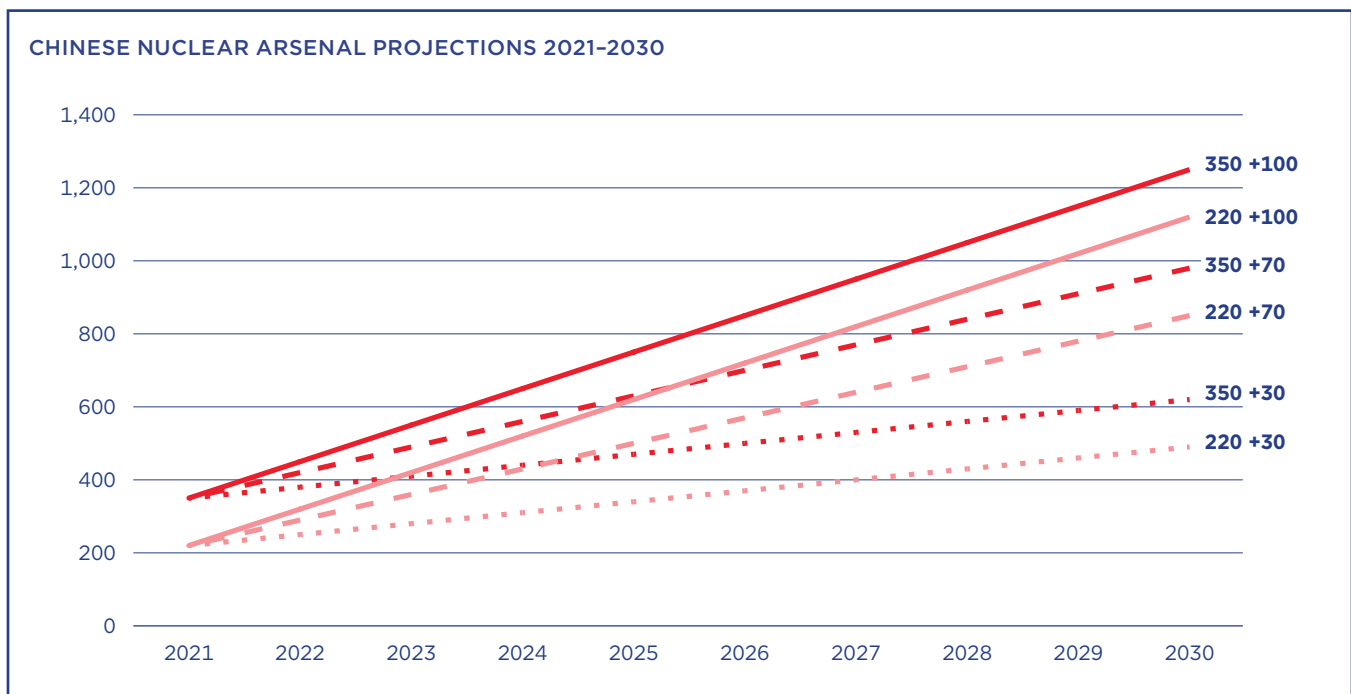
Because uncertainty is so great, it is worth considering a range of possible Chinese nuclear futures. Using different starting assumptions, we developed several different cases that varied the starting size of China's nuclear stockpile and its rate of growth to illustrate the range of potential outcomes.¹⁸⁶ These cases should be seen as sketches that lay out the hypothetical contours and illuminate the possible high and low bounds of future Chinese nuclear weapons stockpiles.

We developed low, medium, and high cases based on different rates of production for new nuclear weapons. In the low case, Beijing could leave many of its new silos empty and play a shell game with its mobile ICBMs to make them more difficult to target, strengthening its secure second-strike capability mainly by increasing the survivability of its force.¹⁸⁷ In this situation, China could expand its nuclear arsenal using only existing stockpiles of fissile material, which could result in a rough doubling of its size.¹⁸⁸ In the low-end scenario, we project China's arsenal grows by 30 warheads a year.¹⁸⁹

In our medium case, China would seek to differentiate itself from other middle nuclear powers, like the United Kingdom or India, as part of moving toward Xi's goal of having a "world-class military."¹⁹⁰ Although Beijing would not aim for parity with the other two superpowers,

it would become the third state to field more than 1,000 nuclear weapons. Indeed, some Chinese commentators have identified the 1,000-weapon threshold as a goal.¹⁹¹ This could be done by arming each of a smaller number of ICBMs with multiple warheads and rounding out the air and undersea legs of the PLA's triad. Chinese leaders may believe that 1,000 nuclear weapons are sufficient counterweights to the United States, insulating them from American nuclear coercion and allowing them to undertake lower levels of gray zone or conventional aggression. Our middle case assumes that China builds 70 new warheads annually until 2030 and aligns with the 2021 Defense Department projection for 2030.

In the high-end case China would strive to equal the American and Russian nuclear arsenals. This race toward parity may be driven by Xi's ambition to have a "world-class military," China's fears about the United States' growing ballistic missile defenses, because nuclear advocates within the PLA have grown stronger, or some combination of these factors.¹⁹² To do this, Beijing would need to not only use all of its assessed existing military fissile stockpiles, but to produce additional fissile material using two civilian reactors that are currently under construction. If it were to mobilize all these resources, one estimate concludes that, conservatively, China could have 1,270 nuclear warheads by 2030.¹⁹³ For this high-end case, we assume that China adds 100 warheads a year.



This graph shows projections of Chinese nuclear arsenal size, starting from different 2021 estimates and three different growth rates. These are based on the authors' estimates and the cases developed for this paper.

For each of these three cases, we consider two different starting conditions—one in which China has the Defense Department’s 2020 estimate of low 200s of warheads, and the Bulletin of Atomic Scientists’ 2021 estimate of 350 warheads.¹⁹⁴ In the lowest case, starting with 220 weapons, China more than doubles its nuclear stockpile to 490 weapons by 2030, and in the high-end case, it reaches 1,120 weapons by 2030. With a 2021 stockpile of 350 warheads, China could have 620 weapons in the low-end case by 2030 and a high-end projection of 1,250 warheads.¹⁹⁵ This analysis suggests that the starting stockpile matters less than Chinese nuclear strategy and its overall international ambitions.

North Korean Nuclear Profile

The Democratic People’s Republic of Korea (DPRK) is the newest nuclear weapons state. It has conducted six nuclear tests, including one in 2017 with an “advanced nuclear device” with a yield of 140–250 kilotons.¹⁹⁶ Relative to the other powers described here, it has a minuscule nuclear stockpile estimated to be between 10–50 warheads and one class of delivery system, consisting of several types of inaccurate MRBMs. Nevertheless, we included it because the Kim regime has prioritized the DPRK’s nuclear program, and Pyongyang has a rapidly growing nuclear arsenal with a diverse array of increasingly accurate, powerful, and long-range delivery systems.¹⁹⁷ Moreover, the goal of denuclearizing the DPRK is no longer realistic. It is therefore important to understand the likely trajectory of the DPRK’s nuclear weapons development and to seriously consider what is needed to deter a nuclear-armed North Korea.

The North Korean state is shrouded in secrecy and largely cut off from the outside world, leaving considerable uncertainty about its nuclear doctrine and posture. In 2013, an official statement proclaimed that nuclear weapons “serve the purpose of deterring and repelling the aggression and attack of the enemy,” and that the DPRK would not threaten or use nuclear weapons against non-nuclear states “unless they join a hostile nuclear weapons state in its invasion.”¹⁹⁸ Notably, this formulation does not distinguish nuclear from conventional attacks, possibly meaning that nuclear weapons might be used to repel either type of aggression.¹⁹⁹

After its fourth successful nuclear test in 2016, Pyongyang asserted that it was a “responsible nuclear state” and would not “be the first to use nuclear weapons nor transfer” them “as long as the hostile forces for aggression do not encroach upon its sovereignty.”²⁰⁰ However, many other statements by North Korean leader

Kim Jong Un and the North Korean media contradict the no-first-use declaration and indicate that North Korea might adopt a strategy of asymmetric escalation in which it employs nuclear weapons in a conventional conflict to defeat a joint U.S.–South Korea attack.²⁰¹ In short, it is possible—perhaps even likely—that North Korea has a strategy to preemptively use nuclear weapons to defeat an imminent threat to the regime or state.²⁰²

It is important to point out that a preemptive strategy of asymmetric escalation is rational given the Kim regime’s goals, capabilities, and threat perceptions.²⁰³ The DPRK views the outside world as fundamentally hostile and aims to ensure that North Korea remains an independent country under the rule of the Kim family.²⁰⁴ Kim sees nuclear weapons as the ultimate guarantor of the state’s security and as a deterrent against attacks from its more conventionally powerful enemies—the United States and the Republic of Korea (ROK). Nuclear weapons also help bolster Pyongyang’s coercive leverage, enabling it to advance its interests against the U.S.–South Korea alliance. Moreover, Kim wants to avoid the fate of Iraqi and Libyan leaders who ended their nuclear weapons programs only to find themselves deposed by external powers.

Estimates about the size of North Korea’s nuclear arsenal are hindered by the regime’s lack of transparency. In 2006, the DPRK, then led by Kim Jong Il, conducted its first nuclear test, which was an unimpressive explosion of less than one kiloton. Since then, North Korea has detonated five more nuclear weapons with growing explosive yields. The last test in 2017 was either a thermonuclear device or one that used a mixed fuel composite design that exceeded 100 kilotons. While Kim Jong Un proclaimed that North Korea’s nuclear deterrent was “complete” after the 2017 nuclear and ICBM tests, that has not slowed the pace of the DPRK’s missile development or the assessed growth in its nuclear forces.²⁰⁵ The number of nuclear weapons that the DPRK has is a function of the amount of fissile material—either plutonium or high enriched uranium—that it has produced, and the weapons’ design and yield.²⁰⁶

In 2021, the Bulletin of Atomic Scientists estimated that North Korea has sufficient nuclear material for 40–50 simple lower-yield nuclear weapons, but that it might have built fewer to conserve some of its fissile material.²⁰⁷ In the latter case, the DPRK may have 10–20 assembled warheads with 10–20 kiloton yield that can be carried by its MRBMs.²⁰⁸ Alternatively, if the DPRK has prioritized producing higher-yield thermonuclear weapons, it may have from four to 14 thermonuclear weapons and two to 27 single-stage nuclear weapons with lower yields.²⁰⁹

Kim is said to be the only person capable of authorizing the use of nuclear weapons.²¹⁰ North Korea's state-sponsored media have emphasized Kim's central role in ordering North Korea's nuclear tests and missile force alerts.²¹¹

Since 2016, Kim has expressed an interest in developing nonstrategic nuclear weapons. Although it is unclear exactly what this means, analysts believe this suggests that the Kim regime is seeking to develop short-range and potentially lower-yield weapons that it would use against military targets. Should this be true, the DPRK may decide in the future to delegate the authority to use tactical nuclear weapons to lower echelons to enable the rapid and effective employment of these capabilities in the event of a conflict.²¹²

At this moment, North Korea probably only has one way of delivering a nuclear weapon—with one of its MRBMs. However, the North Korean People's Army's Strategic Force has a very vigorous ground-based missile program, and the Navy is developing SLBMs. It is unknown whether North Korea has miniaturized its nuclear warheads to such an extent that they can be carried by a wide range of missiles. Most analysts agree that North Korea likely has armed its road-mobile MRBMs—the Hwasong-7 (Nodong), Hwasong-9 (SCUD-ER), and the Pukguksong-2 (KN-15)—with nuclear warheads.²¹³

The DPRK has fewer than 100 launchers of the Hwasong-7 (Nodong) MRBM, which has a range of more than 1,200 kilometers.²¹⁴ Additionally, the Strategic Force is armed with the Hwasong-9 (SCUD-ER), an improved variant of the Soviet-produced short-range SCUD missile with a 1,000-kilometer range. The newer Pukguksong-2 (KN-15), which was first tested in 2017, also has a range of 1,000 kilometers and is the first solid fueled ground-based North Korean missile, making it safer to operate and able to launch more quickly.²¹⁵

The MRBM force is likely based in a “missile belt” 90–150 kilometers north of the demilitarized zone, allowing it to hold at risk targets across the Korean peninsula and most of the Japanese islands.²¹⁶ North Korea's MRBM force is road mobile, making it challenging to target, and the Pukguksong-2 (KN-15) is on a tracked vehicle enabling it to move off-road, thereby further improving its survivability.²¹⁷ Because of their poor accuracy, the Hwasong-7 (Nodong) and Hwasong-9 (SCUD-ER) MRBMs most likely would be

used to target civilian targets, such as cities, but the more advanced Pukguksong-2 (KN-15) may be more precise and able to hit military targets.²¹⁸

Pyongyang has sought to develop missiles that extend beyond northeast Asia and in particular to reach outlying U.S. Pacific Islands, such as Guam and Hawaii. The DPRK has two IRBMs: the Hwasong-10 (Musudan) and the Hwasong-12 (KN-17). With a range of more than 3,000 kilometers, the Hwasong-10 (Musudan) could reach Guam, but its poor testing record suggests that it has reliability issues.²¹⁹ The Hwasong-12 (KN-17) has performed better in tests and, with a range of 4,500 kilometers, can reach targets on Guam and in parts of Alaska.²²⁰

Kim seems determined to develop ICBMs, and North Korea has three active ICBM programs: the Hwasong-14 (KN-20), Hwasong-15 (KN-22), and Hwasong-17 (KN-28),²²¹ the first two of which were successfully tested in 2017. The North Korean state media's claim that the Hwasong-14 (KN-20) can “strike anywhere on earth” exaggerated the missile's range, which is only 10,000

kilometers. Nonetheless, the Hwasong-14 (KN-20) is the first North Korean missile that can reach North America, though limited mainly to targets on the West Coast.²²²

The Hwasong-15 (KN-22) is the largest and most capable North Korean ICBM that has been successfully tested, and with a range of 12,000 kilometers, it can reach targets anywhere in the United States. In an October 2020, parade North Korea showcased a new, very large ICBM, the Hwasong-17 (KN-28), which was carried on an 11-axle truck. The Hwasong-17's (KN-28) size may enable it to carry a larger warhead or multiple warheads and decoys.²²³ It is unclear whether any of these ICBMs are fully operational, as North Korea has not yet demonstrated a reentry vehicle that can withstand the stress of an ICBM trajectory.

Additionally, the DPRK is investing in upgrading its SRBM force to make it more accurate and effective as a tactical nuclear delivery system. Since Kim agreed to a moratorium on testing long-range ballistic missiles in 2018, most of North Korea's approximately 45 tests have been of shorter-range missiles.²²⁴

Pyongyang's first ballistic missiles were the Hwasong-5 and Hwasong-6 liquid-fueled SCUD variants with ranges of 300 and 500 kilometers respectively. North Korea's Strategic Force has produced improved variants of these notoriously inaccurate missiles, which have been designated as the KN-21 and KN-18, and equipped them with maneuverable warheads.²²⁵

North Korea probably only has one way of delivering a nuclear weapon—with one of its MRBMs.

Additionally, the DPRK has successfully fielded the Hwasong-11 (KN-02), a very accurate weapon, albeit with a range of only 120 kilometers.²²⁶ Finally, North Korea is developing three new solid-fueled SRBMs the KN-23, KN-24, and KN-25. These next-generation SRBMs have enhanced precision and may be armed with conventional or nuclear warheads. Like the Russian SS-26 (9K720) Iskander missile, the new North Korean SRBMs fly quasi-ballistic trajectories so that they can maneuver to penetrate air defenses.²²⁷

The Strategic Force is developing other capabilities to evade U.S. and South Korean missile defenses, including long-range cruise missiles and hypersonic weapons. In September 2021, North Korea successfully tested a long-range likely nuclear capable LACM. Although North Korea already has short-range cruise missiles, the new LACM has a 1,500-kilometer range and can use the additional distance to fly around or under air defense radars, making it difficult to intercept, particularly if fired in salvos with ballistic missiles.²²⁸

North Korea may be planning to use tactical nuclear weapons, such as its SRBMs and cruise missiles, against military targets early in a conflict while preserving its smaller ICBM force as an escalatory option.²²⁹

North Korea also claimed that it tested HGVs in September 2021 and January 2022. The 2021 missile test used a Hwasong-8 booster and indeed appeared to have been a hypersonic glider, although how well it performed is unclear. There have been questions about whether the January 2022 test was really a hypersonic glider or a maneuverable reentry vehicle.²³⁰ Regardless, the pursuit of hypersonic weapons is intended to ensure that DPRK missiles can overcome American and South Korean defenses.

In addition to investing heavily in land-based missiles, Pyongyang is also developing an undersea nuclear launch capability. In 2014, the North Korean navy fielded a single diesel electric ballistic missile submarine—a Gora-class boat—that could be armed with one Pukgksong-1 (KN-11) SLBM.²³¹ This sub and missile combination, however, appears to have been a prototype, and neither are being developed further.

In 2017, it was discovered that the North Korean navy was building a more capable Sinpo-class diesel electric submarine that may have improved endurance and at least three missile launch tubes that carry newer versions of the Pukgksong SLBMs.²³² Pyongyang has tested the Pukgksong-3 (KN-26), which has a 1,900-kilometer range, and paraded the untested Pukgksong-4 in 2020 and Pukgksong-5 in 2021. Both are believed to have longer range and larger payloads.²³³

If North Korea develops an operational undersea nuclear delivery vehicle, it would enhance its second-strike capability. Moreover, the North Korean subs could fire missiles from well outside the limits of launch areas located on its territory, enabling them to avoid existing missile defenses such as the THAAD system in South Korea.²³⁴ The U.S. Defense Intelligence Agency estimates that the DPRK's undersea leg is likely to expand slowly, and even the newer Sinpo submarines remain far inferior to U.S. and South Korean submarines.²³⁵

North Korea has an antiquated air defense system of mostly fixed surface-to-air missile sites. Despite dense coverage around the capital and other strategic locations, North Korea's air defenses would afford it minimal protection against a U.S. air campaign.²³⁶ Given that North Korea's air force and air defenses could not fend off large American and South Korean air attacks, the North has sought to secure its nuclear and missile forces through diversification, dispersion, and mobility. The majority of North Korea's missiles are carried on truck-based launchers and are road mobile.

North Korea's ground-launched missile bases are spread across three missile belts and its missile force employs extensive camouflage, concealment, and deception. Most of these facilities are hardened and include underground facilities that shelter missile stockpiles, launchers, and other supporting equipment. In the event of a crisis or conflict, North Korea's missile launchers would likely move to predesignated firing locations on their base and after launching their missile return to the hardened or underground shelters or, time permitting, disperse off-base to fire and then meet a supporting unit to rearm at a third location.²³⁷ Either way, mobility combined with an abundance of hardened and underground facilities would make it difficult for an adversary to confidently find and destroy all of the DPRK's missiles and nuclear weapons.²³⁸

In September 2021, North Korea fired a KN-23 SRBM from a railroad car. This was another first for North Korea's Strategic Force. Limits to North Korea's rail and electrical systems likely will prevent rail-mobile missiles from becoming a large-scale mode of missile deployment. Nevertheless, even a limited rail-mobile launch capability that makes use of North Korea's many railroad tunnels enhances the survivability of North Korea's missile forces and makes it harder for an adversary to successfully execute a disarming first strike.²³⁹

There are multiple indications that North Korea may be accelerating the development of its nuclear arsenal and missile capabilities. In August 2021, the

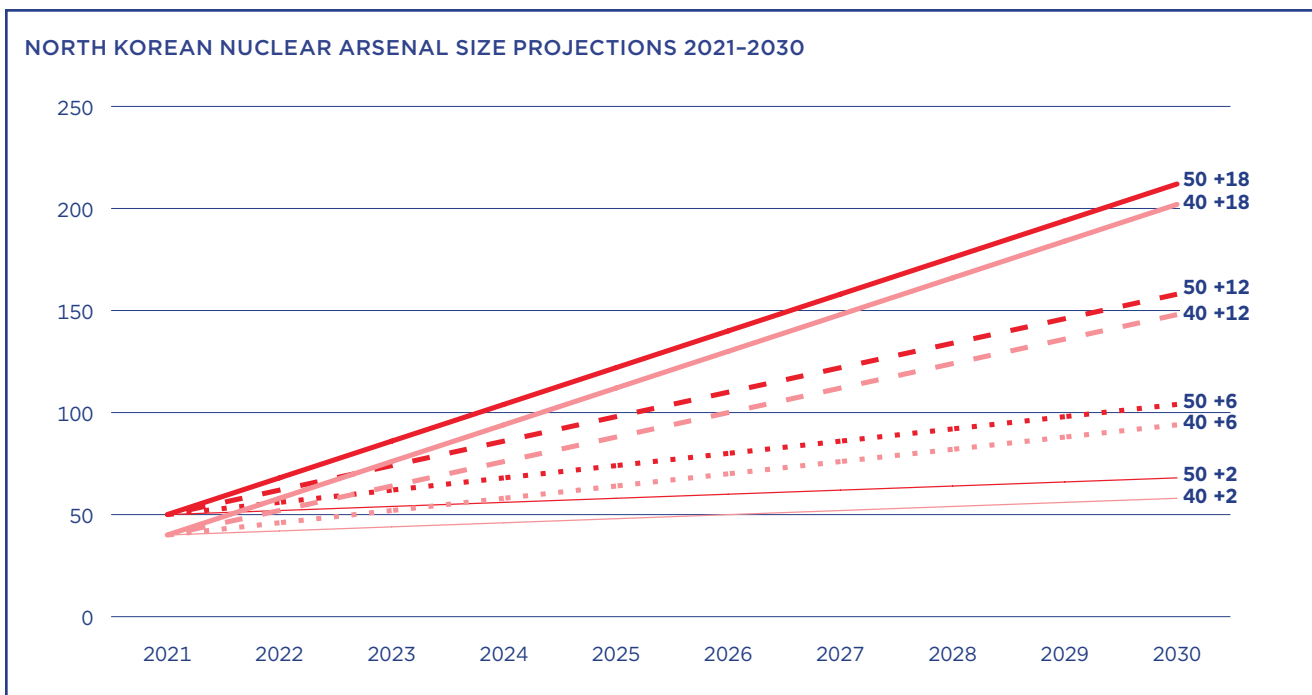
United Nation's atomic energy agency reported that it appeared that North Korea had restarted its plutonium nuclear reactor.²⁴⁰ In January 2022, North Korea threatened that it might resume tests of long-range missiles and has conducted at least five short-range missile tests.²⁴¹ North Korea has a very small nuclear arsenal, but given uncertainty about the exact size, composition, and location of Pyongyang's nuclear warheads and delivery systems, it is not something that assuredly can be destroyed in a preemptive blow. Instead of focusing on the unattainable goal of nuclear disarmament, the United States needs to understand the likely trajectory of the DPRK's nuclear weapons development and to seriously consider how to deter a nuclear-armed North Korea and manage escalation on the peninsula, while simultaneously deterring two nuclear-armed great powers.

Kim Jong Un's goals and plans for North Korea's nuclear program have been remarkably consistent and transparent. North Korea seeks nuclear weapons to ensure the regime's survival and to enhance its international standing.²⁴² At the Eighth Workers Congress in 2020, Kim laid out a series of next steps for the DPRK's nuclear program, and since then he has realized most of these milestones.²⁴³ Nevertheless, there is more uncertainty about North

Korea's current nuclear capabilities and its ability to produce fissile material, so we outline four potential cases that consider four plausible growth rates.²⁴⁴

In the lowest case, we assume that Pyongyang can only produce enough fissile material for two additional warheads a year. This may be due to setbacks in its nuclear production capacity or the lack of resources to devote to the nuclear weapons program perhaps caused by harsher international sanctions. In the second case, we take renowned North Korean nuclear expert Sigfried Hecker's projection that Pyongyang can produce enough fissile material for six warheads a year.²⁴⁵ The third case uses the 2017 Defense Intelligence Agency estimate that North Korea could produce 12 warheads a year, while the fourth case assumes a very high rate of production of 18 warheads a year.²⁴⁶ This high-end case supposes that Pyongyang has a much larger secret nuclear production program, that it has mastered this process, and that its production does not experience significant interruptions.

We present these four cases using two different starting positions—40 nuclear warheads, which is the low-end Bulletin of Atomic Scientists estimate, and 50 warheads as a high-end estimate. In the most pessimistic case where North Korea starts with 40 nuclear weapons and can only add two per year, it would have 58 warheads by 2030. This 2030 estimate increases to



This graph shows projections of North Korea's nuclear arsenal size, starting from different 2021 estimates and four different growth rates. These are based on the authors' estimates and the cases developed for this paper.

94 if Pyongyang can produce six weapons a year, and 148 if it can produce 12. If North Korea has 50 warheads in 2021, it could have 104 warheads if it adds six a year, or 158 if it builds 12 annually. In either case where North Korea produces 18 warheads a year, it ends up with more than 200 warheads by 2030, but this is a highly optimistic case from North Korea's perspective.

Thus, we estimate that North Korea's 2030 nuclear arsenal is likely to range from 58 to 200-plus weapons. While even the largest of this inventory is small compared to what the three superpowers' will likely have in 2030, the question is not whether it is big enough to stand comparison with them. Rather, the important considerations are threefold. First, does it suffice to achieve the regime's stated goal of deterring direct attack on North Korea? Second, does it evolve to provide the DPRK with a nuclear warfighting capability it could employ against U.S. and ROK forces in a conflict? Third, does North Korea seek to use its nuclear status to coerce other actors?

Country Comparison

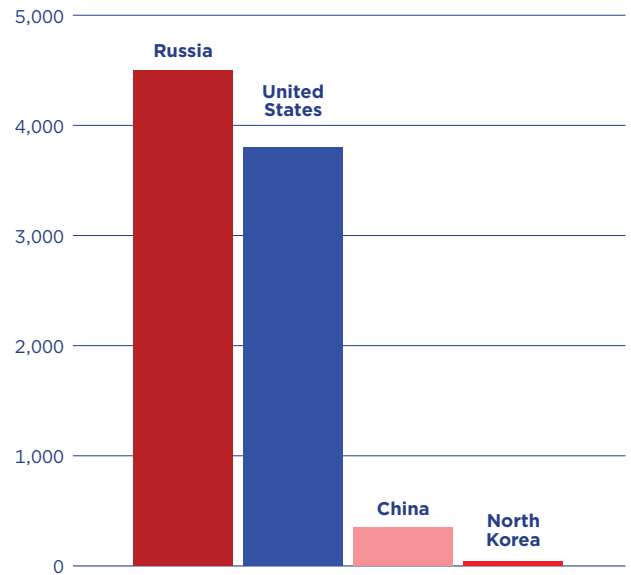
The preceding four sections outlined each country's nuclear policy and posture. In this section, we assess the nuclear capabilities of each of the countries relative to each other. This comparative analysis focuses on several key aspects of the nuclear arsenals: their size, the number and type of launchers, nonstrategic nuclear weapons, and new technologies and capabilities that could affect strategic stability. Ideally, one would also conduct additional comparative analysis of the nuclear weapons' accuracy and warhead yield estimates, which would provide insight into whether the weapons could be used to effectively target and destroy an opponent's nuclear weapons (counterforce attacks) or if they were simply inaccurate weapons of mass destruction that could be used against civilian targets (countervalue attacks).²⁴⁷ Given the uncertainty associated with the publicly available information about accuracy and warhead yield, we limited our assessment to more basic metrics.

Nuclear Arsenal Size

Comparing the nuclear stockpiles of the four countries in 2021 leads to one stark conclusion: Russia and the United States are in a different class than China and North Korea. The U.S. and Russian nuclear arsenals are roughly 10 times the size of China's modest stockpile and 100 times the size of North Korea's embryonic stores.²⁴⁸

One snapshot, however, does not capture the overarching trends. If you look at warhead counts from 1945

AMERICAN, RUSSIAN, CHINESE, AND NORTH KOREAN NUCLEAR WARHEADS IN 2021²⁴⁹

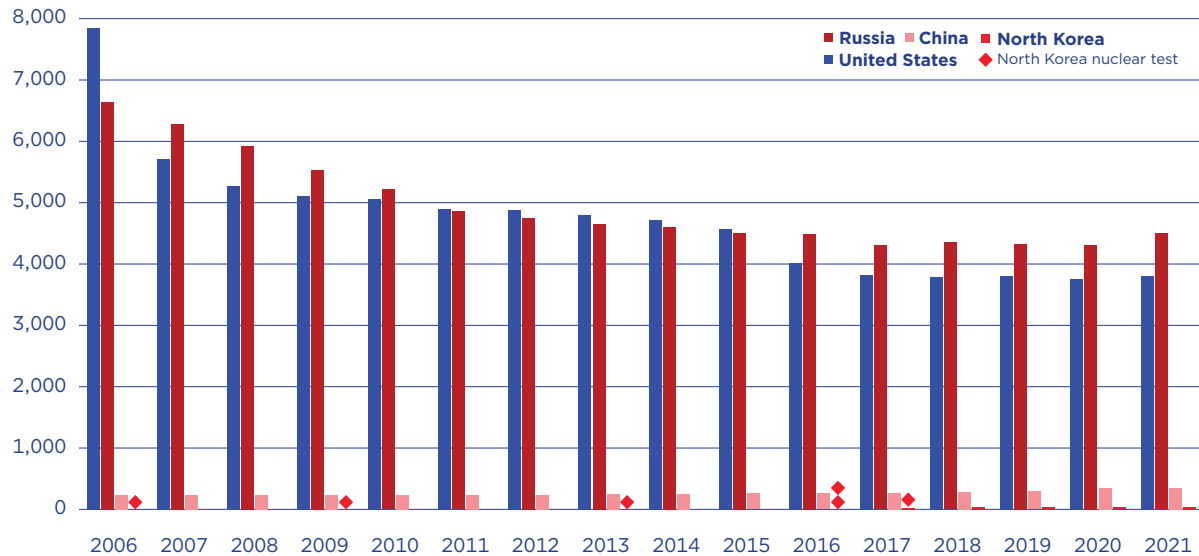


This graph depicts the estimated number of nuclear warheads that the United States, Russia, China, and North Korea have in 2021. The Bulletin of Atomic Scientists estimates that North Korea could have enough fissile material to produce 40 to 50 simple warheads. This chart depicts 40.

until 2021, there has been a steady decline in U.S. and Russian inventories since the mid-1980s, although this leveled off once the New START caps were reached. Conversely, over the same period Chinese and North Korean nuclear capabilities have grown, although very gradually. China's nuclear stockpile, which only consisted of 240 warheads in 2010, has grown by more than 30 percent. Since 2010, North Korea conducted four nuclear tests, the last of which was in 2017. At that point, the Bulletin of Atomic Scientists estimated that North Korea had enough fissile material to produce 20 simple warheads and that estimate increased to 30–60 warheads by 2018.²⁵⁰ In 2021, that estimate was narrowed to 40–50 warheads.²⁵¹

The New START treaty constrains U.S. and Russian strategic arsenals and launchers, but it is set to expire on February 4, 2026. Another bilateral arms control treaty could replace it, but worsening American-Russian relations, especially in the context of the Russian invasion of Ukraine in 2022, have dimmed these prospects. In the absence of a new arms control treaty, Washington and Moscow easily could increase their deployed weapons. Moreover, because of their reserve warheads and the unused capacity on existing launchers, this change in

AMERICAN, RUSSIA, CHINESE, AND NORTH KOREAN NUCLEAR STOCKPILES AND MILESTONES: 2006–2021²⁵²



This chart depicts the size of U.S., Russian, Chinese, and North Korean nuclear stockpiles from 2006 to 2021 and indicates when North Korea tested a nuclear weapon. It shows the leveling off of the U.S. and Russian nuclear arsenals due to the New START treaty and the small but steady growth of Chinese and North Korean nuclear weapons programs over the past few years.

posture could be executed without producing anything new but simply require a change in policy. As such, it could be implemented rapidly

Although the sizes of U.S. and Russian nuclear reserves are similar, the United States appears to have an edge in its upload capacity. This conclusion should be taken with caution because we do not have great confidence in the maximum capacity of Russian missiles. By fully exploiting the latent capacity of its missiles and bombers, Washington could deploy approximately 3,200 warheads, while Moscow could build to “only” about 2,400 deployed warheads.²⁵³ America’s apparent advantage is largely because each Trident D-5 SLBM can hold eight warheads and half of the Minuteman III ICBMs can carry two additional warheads.

Going forward, there is even greater uncertainty about which nation will have an upload advantage due to incomplete information about new delivery systems that are under development. It is unclear whether Sentinel will be able to carry more than one warhead, and the B-21 bomber reportedly is going to have a smaller payload than the B-2.²⁵⁴ Russia, meanwhile, is retiring the SS-18 (RS-20V) and SS-19 (RS-18) ICBMs, which have a larger upload capacity than the SS-27 (RS-12M1 and RS-12M2) variants, but it is also developing the SS-X-30 (RS-28) Sarmat and the SS-N-32 (RSM-56) Bulava SLBM, which can carry at least 10 and six warheads, respectively.²⁵⁵

Without further information, it is unclear which great power would be able to expand its nuclear arsenal more rapidly, given existing stockpiles of weapons and delivery systems.

Projecting the future nuclear inventories for China and North Korea is more difficult given their lack of transparency about their nuclear weapons programs. Because uncertainty is so great, it is worth considering a range of possible nuclear futures for both Beijing and Pyongyang. In the sections on these countries, we developed several different cases that varied the starting size of each nation’s nuclear stockpile and its rate of growth to illustrate the gamut of potential outcomes.²⁵⁷ These cases could be seen as defining reasonable upper and lower bounds of future nuclear weapons stockpiles in China and North Korea.

When comparing projections for warhead stockpiles from 2021 until 2030, it is apparent that, even with no further deployments on their parts, the United States and Russia remain head and shoulders above a growing China and North Korea. Only in the medium and high cases is China approaching the number of deployed U.S. and Russian warheads, but both Washington and Moscow will likely retain their large reserve stockpiles that they could actively deploy if not constrained by a new arms control deal post-2026.

However, although neither China nor North Korea come close to matching American or Russian strategic forces, both are significantly expanding their current nuclear capacity. In the medium or high cases, China could deploy a nuclear force that is 50 to 70 percent of the size of the current deployed nuclear arsenal of the United States. Nevertheless, if China is on track to

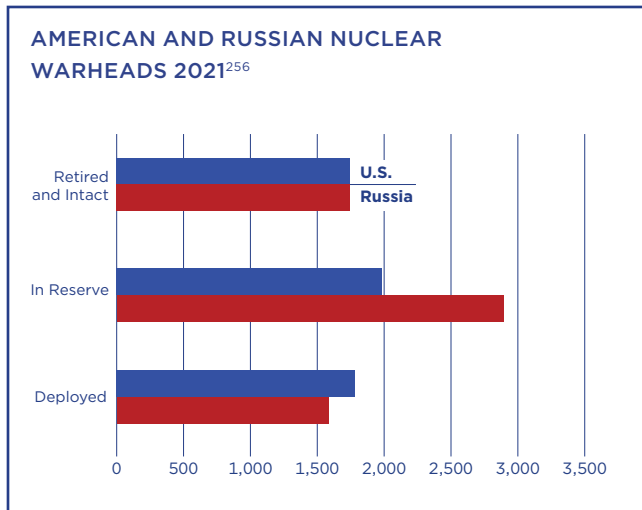
have around 1,000 nuclear warheads and significantly improved delivery systems by 2030, it has reached a point where it needs to become a larger factor in U.S. strategic planning.

Launcher Comparison

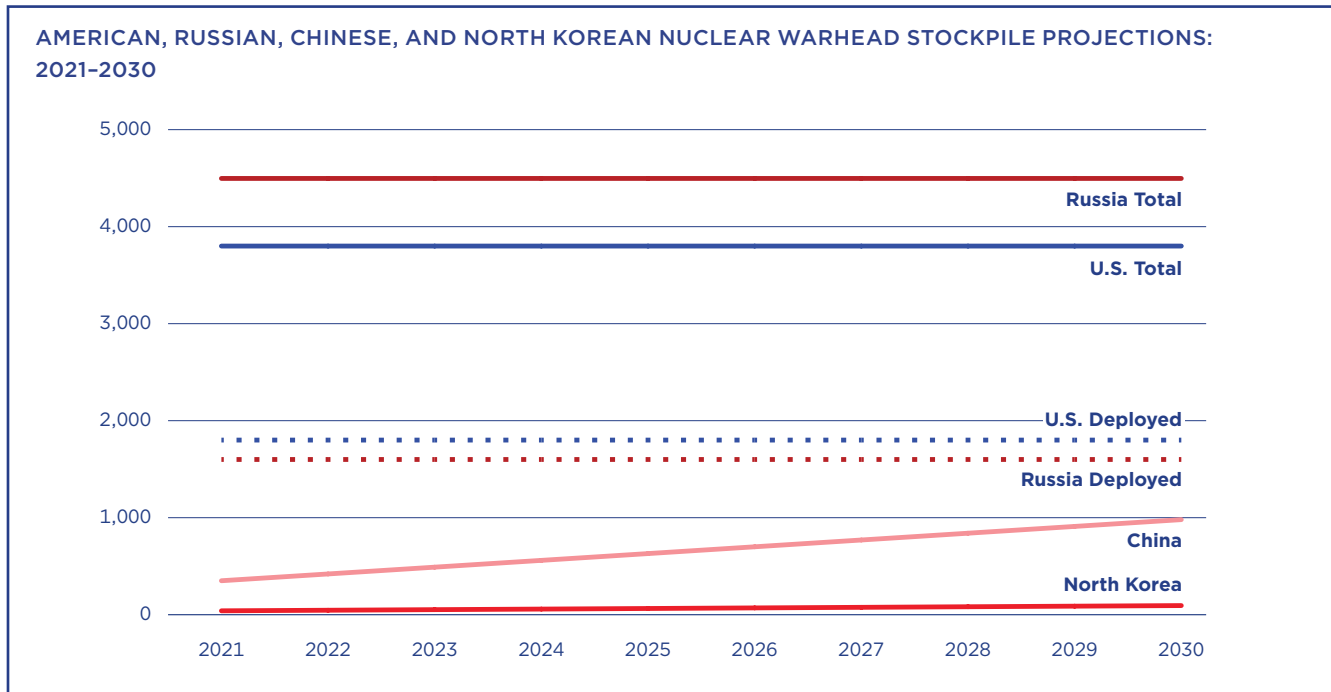
Another key area to look for similarities and differences is in each country's launcher inventories. This comparative section focuses on strategic launchers only defined as ICBMs, SLBMs, and bomber aircraft—the so-called triad of delivery systems.

All four nations are heavily invested in the ground-based leg of the triad. The United States has the most ICBMs with 400 Minuteman III missiles, while Russia has 310 ICBMs and China has 122 ICBMs. When one looks a little closer, however, there are differences between these. All American ICBMs are based in fixed and hardened silos, while Russia, China, and North Korea have or are building road-mobile ICBMs. Out of Russia's ICBMs, 58 percent are mobile, while 78 percent of Chinese ICBMs are road mobile. All of the ICBMs being developed by North Korea are road mobile.²⁵⁸

There are more differences in the undersea leg of the triad. Because the U.S. Navy operates *Ohio*-class SSBNs, each of which carries 20 SLBMs, the United States has the largest number of undersea-launched nuclear

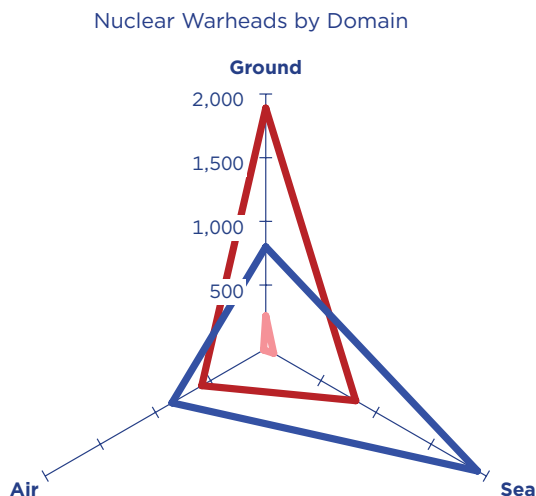


This chart depicts the number of American and Russian nuclear warheads in 2021 that are deployed with forces, in storage, or have officially been retired, but are still intact. The total number of warheads represents the upload capability for each state if the New START treaty limits were ignored or removed.

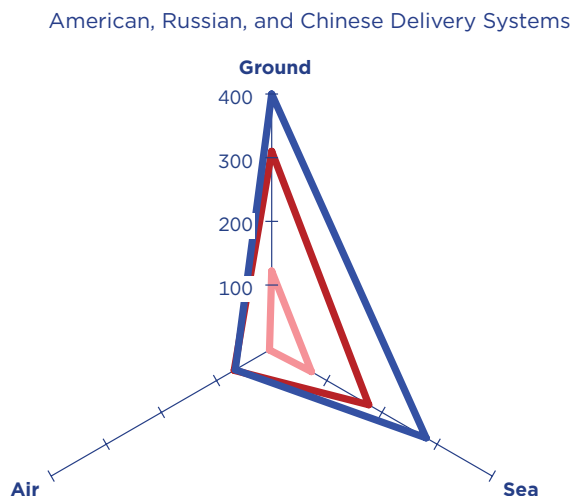


This graph compares trajectories for each country's nuclear arsenal size out to 2030, assuming the American and Russian stockpiles remain static and using the medium cases for China and North Korea. It uses a Chinese arsenal in 2021 of 350 and the medium case, which adds 70 weapons a year, and a North Korea starting arsenal of 40 adding a modest six weapons a year. The American and Russian warhead counts are direct line extensions of their 2021 numbers. (Derived from CNAS analysis detailed earlier in the paper.)

AMERICAN, RUSSIAN, AND CHINESE STRATEGIC WARHEADS BY DOMAIN²⁶²



AMERICAN, RUSSIAN, AND CHINESE STRATEGIC LAUNCHERS²⁶²



These charts show the number of strategic delivery platforms and nuclear warheads by domain for the United States, Russia, and China in 2021. The American and Russian numbers only include strategic delivery platforms, while the Chinese warheads include nonstrategic systems such as MRBMs and IRBMs. The charts omit North Korea given the uncertainties about its inventories.

weapons. Russia's 11 SSBNs can carry only 176 SLBMs, and China's six Jin-class submarines can hold 72 SLBMs. When the *Columbia*-class SSBN is deployed, the number of U.S. undersea launchers will decline because the 12 *Columbia*-class boats each carry 16 SLBMs for a total of 192 SLBMs.²⁵⁹

The air leg of the triad also reveals significant differences between the nuclear great powers and the smaller nuclear-armed states. While the United States and Russia have a similar number of strategic bombers, 62 and 68 respectively, it is estimated that China only has four H-6N bombers, although that number almost certainly will increase.²⁶⁰ The PLAAF is also in the early stages of developing a stealthy long-range bomber called the H-20. North Korea does not have the ability to deliver a nuclear weapon from the air.

Examining the number of warheads assigned to each leg of the triad reveals further differences. The United States has the most robust undersea capability with 1,920 warheads designated for SLBMs compared to 816 by Russia and 72 by China. In contrast, the United States has only allocated 800 warheads to its 400 ICBMs, while Russia has assigned 1,889 warheads for its 310 ICBMs, and China 208 warheads for its 122 ICBMs. The United States has the most air-delivered nuclear weapons when one counts both ALCMs carried by the B-52 and gravity bombs carried by the B-2, while Russia has 580 bomber-delivered nuclear weapons. This comparison

drives home that the nations have different strategies for ensuring their second-strike capability. The United States has invested heavily in the undersea leg of its triad, which is relied on for its survivability in the wake of an enemy first strike. While Russia also has a capable SSBN force, it appears to be relying mainly on the mobility of its newer ICBMs to secure its second-strike capability. China, meanwhile, has long been vulnerable to disarming first strikes by either Russia or the United States. Their remedy to this mainly has been to field mobile ICBMs, although they are also seeking to put to sea a more robust fleet of SSBNs.²⁶¹

Nonstrategic Weapons

Another area where there are asymmetries is in non-strategic nuclear weapons inventories. Less precise information is available about these stocks, but we do know that the United States has a modest nonstrategic arsenal consisting of 230 air-delivered B-61 bombs. There also are plans to develop a nuclear sea-launched cruise missile, which may or may not be going forward pending the nuclear posture review.

In contrast, Russia has approximately 1,900 nonstrategic nuclear weapons that can be launched from the sea, ground, and air. China also has shorter-range missiles, many of which are dual capable including DF-21(CSS-5), DF-26 (CSS-18), DF-15 (CSS-6), DF-17 (CSS-17). Today, all of North Korea's operational nuclear missiles could

be characterized as nonstrategic because they likely are armed with lower yield warheads and would be delivered by MRBMs or maybe SRBMs. Pyongyang is also investing significant resources in developing more accurate and penetrating SRBMs and LACMs, thus expanding its array of tactical nuclear weapons.

Emerging and Disruptive Technologies and Trends

New military capabilities and domains of conflict, such as hypersonic weapons and cyberattacks, may complicate deterrence and weaken strategic and crisis stability. Russia, China, and North Korea, for example, are all investing in hypersonic missiles that are believed to have nuclear missions.²⁶³ Additionally, Moscow has a nuclear-powered cruise missile and unmanned submarine under development. In the summer of 2021, China tested a possible orbital bombardment system with a hypersonic glider payload. Beijing has reportedly already fielded HGVs on its DF-17 (CSS-12) MRBMs, and North Korea has reportedly twice tested an HGV. The speed and maneuverability of hypersonic weapons makes them a challenge to track and can delay defenses' abilities to pinpoint their targets.

Experts disagree about the likely effects of emerging technologies on stability.²⁶⁴ Growing nuclear arsenals, new capabilities, and novel delivery systems could potentially lower the thresholds for nuclear use, entangle conventional and nuclear capabilities, increase the vulnerability of existing weapons, and increase incentives for a first strike.²⁶⁵ These are issues that we will examine in greater detail in future research.

This comparative assessment makes it clear that while China and North Korea are making great strides in their nuclear arsenals, the United States and Russia remain in a league of their own and will continue to be so for the foreseeable future. There are notable asymmetries between these different countries' nuclear postures. It is important to recognize differences, but that does not necessarily translate into strengths or weaknesses. The United States should not seek to mirror its rivals' nuclear capabilities, but instead should consider how to take advantage of American strengths to exploit its rivals' weaknesses. Additional assessments are required to understand the implications of these differences, but comparisons are likely to be more difficult because the United States cannot simply focus on Russia and assume that any other nuclear rivals are lesser included cases. Instead, U.S. officials need to carefully think through what it takes to bolster stability and strengthen deterrence against each rival individually, and then collectively what that amounts to.

Recommendations

To improve strategic stability and enhance deterrence, the United States should do several things.

First, the Biden administration should maintain current U.S. declaratory policy and implement existing modernization plans for all three legs of the triad and nuclear command, control, and communications.

Relations with Moscow have reached a post–Cold War nadir due to Russia's invasion of Ukraine and Putin's brandishing of nuclear weapons. At the same time, China and North Korea are expanding their nuclear stockpiles and developing new delivery systems. Not surprisingly, U.S. allies and partners are concerned about the rapidly shifting nuclear landscape and the potential for additional military aggression. Given the fluid geopolitical situation and uncertainty about Moscow, Beijing, and Pyongyang's intentions, it would be unwise to significantly change American nuclear policy or posture.

Second, the Defense Department should renew its focus on nuclear deterrence as a part of its strategy of integrated deterrence.

If the Defense Department is not deliberate in how it designs its strategy, it could be unbalanced—neglecting strategic dynamics to concentrate on conventional threats and gray zone tactics without recognizing the relationship between these levels of conflict. Because Russian and Chinese aggressive actions below the threshold of conventional conflict are in the news nearly every day, they have received a disproportionate amount of attention and are a focus of combatant commands. Moreover, since the end of the Cold War, American defense plans and policy have tended to assume that conventional conflicts would not escalate to nuclear use. Most of the Defense Department, therefore, has had the luxury of cordoning off nuclear weapons and treating that as a separate problem that was Strategic Command's responsibility. That is no longer possible. Putin's threat to use nuclear weapons has limited the international community's response to Russia's brutal and full-scale invasion of Ukraine.

China and North Korea also may be emboldened by their growing nuclear arsenals and launch conventional attacks against their neighbors under the shelter of their nuclear umbrellas. Today, the nuclear shadow falls

over all forms of competition and conflict with Russia, China, and North Korea. The Pentagon needs to truly integrate its planning across all levels of conflict and recognize that nuclear considerations shape actions across the entire spectrum.

Third, although Russia and China are greater threats, the United States should not ignore North Korea and the growing consequences of instability on the Korean Peninsula.

With an operational nuclear force, North Korea is not the same threat that it was five years ago, and U.S. and South Korean plans and policies need to be updated to reflect the new situation. Both Pyongyang and Seoul have offensive doctrines and are developing the capabilities to execute destabilizing offensive concepts. Steps need to be taken to mitigate the danger of war on the Korean Peninsula and to strengthen crisis stability.

Fourth, the Defense Department needs to study escalation risks across a range of conventional conflict scenarios.

The scenarios that the United States faces today differ significantly from the Cold War, even against a well-known opponent like Russia.²⁶⁶ Defense officials need to explore how limited wars might spiral so that they may better anticipate, avoid, and manage escalation. The Pentagon should examine a range of scenarios with China, Russia, and North Korea to understand likely flashpoints and its adversaries' red lines with an eye toward reducing the risk of inadvertent escalation.

Fifth, the United States should pursue a strategic dialogue with China and Russia and put in place communication links and crisis mechanisms to help manage escalation.

Neither of these initiatives is likely to be welcomed, especially by Beijing, and it is important for American officials to go in with realistic expectations of what can be achieved.²⁶⁷ Strategic dialogue could lead to a new bilateral U.S.-Russian arms control agreement, but it is not likely to produce multilateral arms control agreements in the near term. Nonetheless, all parties have an interest in a forthright dialogue to improve mutual understanding and avoid inadvertent escalation. Direct communications are important, especially during a crisis, and can lessen misperception and miscommunication.

Conclusion

This report has aimed to take stock of the nuclear policies and postures of the United States and its three primary nuclear rivals—Russia, China, and North Korea. We therefore have covered only a part of the global strategic landscape, which includes five additional nuclear weapons states and an aspiring nuclear power in Iran.²⁶⁸ Nevertheless, this partial assessment has demonstrated that the nuclear order is undergoing a transition. Each development in and of itself is small, but cumulatively these incremental changes are having a momentous effect. We are entering an unprecedented multipolar nuclear world where the United States must simultaneously deter two nuclear great powers, and the nuclear dangers are growing. China has emerged as a great power with significant conventional might and a burgeoning nuclear arsenal. The PLA's nuclear posture has evolved from about 50 vulnerable and inaccurate ICBMs kept at a low state of readiness to 350 nuclear weapons that can be rapidly delivered by increasingly accurate missiles fired from the land, sea, and air. Beijing has not tipped the conventional or nuclear balance of military power in its favor yet and may never do so, but the PLA has made enough strides in both areas to earn the great power moniker.

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Nevertheless, even in the most optimistic (or pessimistic, depending on how you view it) case, China's strategic forces will not equal those of the United States or Russia by 2030. But China does not need strategic parity to significantly alter the dynamics of its relationship with the United States and to increase the risks of nuclear use. It simply needs survivable, sophisticated, and operational nuclear weapons to provide it with a credible nuclear deterrent and warfighting capability to deter the United States from intervening in a war. China's expanding nuclear shadow should not be ignored, as it will shape the peacetime competition and any possible military confrontations that may occur.²⁶⁹ An expanding nuclear arsenal provides Beijing with coercive leverage and could allow it to pursue more assertive conventional military operations.

Similarly, nuclear weapons must figure prominently in American calculations about North Korea. There are no signs that Kim Jong Un is going to surrender his nuclear arsenal. North Korea has deployed a small but growing number of nuclear weapons and has made impressive progress in its missile technology. Focusing on North Korean “denuclearization” as the goal fuels dangerous delusions that the United States or South Korea could forcibly denuclearize North Korea. It also prevents the United States and its allies from developing realistic policies and mechanisms to manage crises, control escalation, and ultimately deter North Korean aggression. To deter North Korea, Washington needs to credibly reassure Pyongyang that the DPRK will not be attacked unless it first aggresses against South Korea, the United States, or another U.S. ally.²⁷⁰ Pyongyang has little incentive to engage in any dialogue about limiting its nuclear growth while it believes that the United States remains committed to disarming it as a prelude to destroying the Kim regime.

Russia remains the only country that has nuclear parity with the United States. It is nearly done modernizing its nuclear arsenal, and Putin threatened to use nuclear weapons against any state that intervened on the side of Ukraine or attacked Russia. Relations between the original two nuclear powers thus have deteriorated significantly, and the prospects for a bilateral arms control regime have withered. The decline began when the George W. Bush administration withdrew from the Anti-Ballistic Missile Treaty, which elevated deeply held Russian fears about U.S. missile defenses and led Moscow to seek counters to them. When the United States fielded a missile defense system in Europe intended to shoot down missiles fired by Iran, a Russian official called it a “direct threat to global and regional security” and claimed that the missile interceptors violated the Intermediate-Range Nuclear Forces (INF) Treaty.²⁷¹ Before long, the United States accused Russia of fielding missiles that were prohibited by the INF Treaty, which led to its withdrawal from the agreement in 2019, with Russia following suit shortly thereafter. Now Russia is developing an array of novel nuclear delivery systems, including several different hypersonic weapons, increasing the risk of a new arms race.

Russian-American relations will be difficult to repair even notwithstanding the 2022 war in Ukraine. But the structural factor that is likely to complicate matters and impede future arms control treaties is the emergence of China as a nuclear great power. The U.S. decision to abandon the INF Treaty was partially driven by concerns about the conventional balance of power in the

Indo-Pacific and the desire to field intermediate-range conventionally armed missiles to counter China.²⁷² Both Moscow and Washington are concerned about restricting their strategic forces while Beijing remains unconstrained. China, which has a significantly smaller nuclear arsenal than Russia and the United States, remains intensely concerned about its vulnerability as a rising power and is resistant to sharing information about its military programs.²⁷³ Beijing also believes that opacity about its strategic capabilities strengthens its nuclear deterrent and that its no-first-use policy should be sufficient to reassure other states about its intentions.²⁷⁴ These factors dim the near-term prospects for any new arms control agreements among the three powers.

The trilateral nature of the nuclear environment is shaping each side’s calculations because any decision about nuclear forces also has strategic effects on two other parties, greatly complicating expectations of consequences.²⁷⁵ Regional nuclear developments further complicate the matter as nested security dilemmas within Asia have implications for all of the great powers.²⁷⁶ In this byzantine context, the United States is focused on deterring two nuclear-armed great powers, as well as a regional nuclear power from launching conventional and nuclear attacks on itself or its allies. As the

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number of nuclear-armed states grow, so too do the risks of misperception or misunderstanding, because each action will have multiple audiences who may perceive the same act differently and create a chain of cascading responses.²⁷⁷ Although the core logics of deterrence and arms control remain the same, the current and future situation is more complex and challenging than during the Cold War. The likelihood of an all-out nuclear exchange or bolt from the blue attack have declined, but the risks of limited nuclear use in the context of a conventional war are growing. Deliberately, an adversary might employ a nuclear warning shot to deter outside intervention in a local war, to avoid imminent defeat in a conventional

conflict—as a form of asymmetric escalation²⁷⁸—or in response to conventional attacks against its nuclear arsenal.²⁷⁹ Escalation also could be inadvertent if the United States or an adversary misinterprets the other's thresholds and unwittingly crosses a red line. The risks of misperception seem particularly high with China and North Korea because of their opacity and limited contact with U.S. officials. If a nuclear weapon is used—even in a limited way—it is not well understood what would follow and how to contain further escalation. The ramifications of a multipolar nuclear world are not fully appreciated, but it is clear that the risks of nuclear use are growing.

Obama tried to move toward a world without nuclear weapons by modeling good behavior and reducing the role of nuclear weapons in American declaratory policy. This demonstration effect failed to convince other states to follow suit. Nuclear weapons play a central and, in some cases, growing role in Russian, Chinese, and North Korean strategies.

Arms control agreements have significantly reduced the size of the American and Russian strategic arsenals, enhanced transparency, and improved predictability.

A follow-on to the New START treaty thus should be pursued. But because China

is not currently prepared to enter arms control treaties, multilateral agreements do not offer a near-term option for reversing these trends.

There are two prominent ideas for changing U.S. nuclear policy and posture: shifting to a nuclear policy of sole purpose or no first use, and not modernizing all three legs of the triad. Given the trends in the strategic landscape, both changes would be imprudent and destabilizing.

Biden is reportedly considering modifying American declaratory policy to state that the sole purpose of nuclear weapons is to deter nuclear attacks on the United States and its allies.²⁸⁰ Members of Congress have urged the President to go further and adopt a policy of no first use.²⁸¹ Either change would be a mistake that will heighten nervous allies' concerns that the United States will not defend them and do little to improve relations with America's rivals who will not believe the American pledge. Making such a change in a charged strategic environment could increase the risks of proliferation on the part of American allies, a much more delicate nonproliferation challenge for Washington to navigate than when the issue was nuclear developments among "bad guys."

Additionally, there have been proposals to reduce or forgo modernization of the ground-based leg of the U.S. triad. Given the strategic shifts that are underway, this action is unwise. Moreover, the United States needs to hedge against future uncertainty, which is a central purpose of having redundant and diverse nuclear delivery systems, which provide the force with resiliency.²⁸²

Future technological developments—improvements in remote sensing, data processing, and decision support tools such as artificial intelligence, combined with highly accurate, fast, and evasive conventional or nuclear weapons—are increasing the vulnerability of nuclear forces.²⁸³ Given the long time it takes to develop and field nuclear weapons, if the United States eliminates one leg of the triad, it could not rapidly reconstitute the capability if it became necessary to do so because, for example, the SSBN force unexpectedly became more vulnerable. Because new and emerging technologies may mature unexpectedly and different technologies may work together to have unexpected effects, it is prudent to hedge against technological surprise. The United States should not necessarily give up a long-term goal of reducing the

role of nuclear weapons in U.S. strategy. But American leaders also need to be clear-eyed about

The United States needs to hedge against future uncertainty, which is a central purpose of having redundant and diverse nuclear delivery systems, which provide the force with resiliency.

the current security environment and aware of the potential repercussions of suddenly changing its nuclear policy and posture in a very dynamic and increasingly dangerous nuclear environment. Now is not the time to reduce American strategic forces or introduce uncertainty about its nuclear deterrent threats.

We have entered a new nuclear age, and the shadow of nuclear weapons now extends over the United States' relationship with three rivals. Consequently, nuclear dangers are growing. This does not suggest that the United States should expand its nuclear arsenal or try to match one-for-one its opponents' capabilities. Instead, the United States needs to urgently reinvigorate efforts to strengthen nuclear deterrence and work to understand the risks today and in the future. The United States should pursue a strategic dialogue with Russia and China and establish communication channels to help to manage crises, while tailoring its deterrence approach to account for the North Korea threat. Ignoring these trends only allows these challenges to grow. The United States should proceed cautiously, avoid significant changes to current nuclear policy or posture, and hedge against future uncertainty.

Appendix: American, Russian, Chinese, and North Korean Nuclear Missiles

U.S. Nuclear Missiles²⁸⁴

U.S. NAME	PROPEL- LANT	TYPE	MAX. RANGE (KM)	DEPLOY- MENT MODE	DEPLOYED	NUM- BER OF DELIVERY SYSTEMS	NUMBER OF WAR- HEADS	WARHEADS X YIELD (IN KILO- TONS)	CIRCULAR ERROR PROBABLE (METERS)	NOTES
LGM-30 G Minuteman III Mk-12A	Solid	ICBM	13,000 km	Silo	Yes	200	600	1-3 W78 x 335 (MIRV)	120 m	
LGM-30 G Minuteman III Mk-21/ SERV	Solid	ICBM	13,000 km	Silo	Yes	200	200	1 W87 x 300	120 m	
LGM-35A Sentinel/GBSD	Solid	ICBM			No			1 W78/ Mk12A x 355		
Trident II D5 Mk-4A	Solid	SLBM	12,000 km	Submarine	Yes	12/240	1,511	1-8 W76-1 x 90 (MIRV)	90 m	Only counts 240 SLBMs for 12 deployed Ohio-class SSBNs since two are in refueling overhaul
Trident II D5 Mk-4A	Solid	SLBM	12,000 km	Submarine	Yes		25	1-2 W76-2 x 8 (MIRV)	90 m	
Trident II D5 Mk-5	Solid	SLBM	12,000 km	Submarine	Yes		384	1-8 W88 x 455 (MIRV)	90 m	
AGM-86B ALCM	Turbofan	ALCM	2,400 km	Air	Yes	66/528	528	1 x 5-150	30 m	B-52H can carry eight ALCMs internally & 12 underwings; 66 nuclear-capable bombers
AGM-181 LRSO		ALCM			No			1 W80-4 x 5-150		

Russian Nuclear Missiles²⁸⁵

Russian Name	Western Name	Propellant	Type	Max. Range	Deployment Mode	Deployed	Number of Delivery Systems	Number of Warheads	Warheads x Yield (in kilotons)	Circular Error Probable (meters)	Notes
RS-20V	SS-18 Satan	Liquid	ICBM	16,000 km	Silo	Yes	40	400	10 x 500/800 (MIRV)	500 m	
RS-18	SS-19 M3 Stiletto	Liquid	ICBM	9,000 km	Silo	Yes	0	0	6 x 400 (MIRV)	550-900 m	
Avangard	SS-19 M4	Liquid	ICBM	<6,000 km	Silo	Yes	6	6	1 x HGV		
RS-12M (Topol)	SS-25 Sickle	Solid, post boost vehicle	ICBM	11,000 km	Mobile	Yes	9	9	1 x 800	900 m	
RS-12M1 (Topol-M)	SS-27 Mod 1	Solid	ICBM	<11,000 km	Mobile	Yes	18	18	1 x 800?	200 m	
RS-12M2 (Topol-M)	SS-27 Mod-1	Solid	ICBM	<11,000 km	Silo	Yes	60	60	1 x 800	200 m	
RS-24 (Yars)	SS-27 Mod-2	Solid	ICBM	10,500 km	Mobile	Yes	153	612	4 x 100? (MIRV)	250 m	
RS-24 (Yars)	SS-27 Mod-2	Solid	ICBM	10,500 km	Silo	Yes	20	80	4 x 100? (MIRV)	250 m	
RS-28 (Sarmat)	SS-X-30	Liquid	ICBM	10-18,000 km	Silo	No			10-16 x ?		
R-29RM (Shtil)	SS-N-23 M1	Liquid	SLBM	8,300-12,000 km	Submarine	Yes	5/80	320	4 x 100 (MIRV)	500-900 m	
RSM-56 (Bulava)	SS-N-32	Solid	SLBM	8,300 km	Submarine	Yes	5/80	480	6 x 100 (MIRV)	120-350 m	
Kh-55	AS-15A/B	Turbofan	ALCM	2,500-3,500 km	Air	Yes	68/?	580		25 m	
Kh-102	AS-23B	Turbofan	ALCM	4,500 km	Air	Yes				20 m	
9K720 Iskander M	SS-26 Stone	Solid	SRBM	500 km	Road	Yes	144	70	1 x 10-100	200 m	
R-500/9M728 Iskander M	SSC-7 Southpaw	Turbofan	GLCM	500 km	Ground	Yes				2-5 m	
9M729	SSC-8 Screwdriver	Turbofan	GLCM	2,500 km	Ground	Yes	160	20	1 x 10-100	5 m	
3M14 Kaliber	SS-N-30A	Turbofan	LACM	2500 km	Ship/submarine	Yes				-5m	Dual capable
Kh47M2 Kinzhal		Solid	ALBM	2000 km	Air	Yes			1x 5-50	20 m	Dual capable Iskander derivative carried by MiG-31B
P-800 Oniks	SS-N-26 Strobile	Turbofan	Cruise missile	300 km	Air, land, ship, sub	Yes				1.5m	Dual capable
3M-22 Tsirkon	SS-N-33	Sold & Scramjet	Hypersonic anti-ship	1000km	Ship	No					Dual capable
53T6 Gazelle	SH-08 Gazelle	Solid	Air defense	80km	Silo				1x 10		Interceptor for A-135 missile defense

Note: There is some uncertainty about Russia's nuclear weapons. We have moderately high confidence in these estimates

Chinese Nuclear Missiles²⁸⁶

CHINESE NAME	WESTERN NAME	PROPEL-LANT	TYPE	MAX RANGE	DEPLOYMENT MODE	DE-PLOYED	NUM-BER OF DELIVERY SYSTEMS	NUMBER OF WAR-HEADS	WAR-HEADS X YIELD (IN KILO-TONS)	CIRCULAR ERROR PROBABLE (METERS)	NOTES
DF-4	CSS-3	Liquid	IRBM	5,500 km	Transportable	Yes	6	6	1 x 1,000–3,000	1500 m	
DF-5A	CSS-4 Mod 2	Liquid	ICBM	12,000 km	Silo	Yes	10	10	1 x 4,000–5,000, MIRV	500-800 m	
DF-5B	CSS-4 Mod 3	Liquid	ICBM	12,000 km	Silo	Yes	10	50	5 x 200–300	500 m	
DF-5C	CSS-4 Mod 4	Liquid	ICBM	13,000 km	Silo	No			MIRV		
DF-15	CSS-6	Solid	SRBM	600 km	Road	Yes				300 m DF-15A 45 m	Unclear whether nuclear capable or ever deployed
DF-11	CSS-7	Solid	SRBM	300–600 km	Road	Yes				200–600 m	Believed to have nuclear warhead with variable yield
DF-17	CSS-22	Solid	MRBM	1,800 km	Road	Yes	18		HGV	(Highly accurate)	
DF-21A/E	CSS-5 Mods 2, 6	Solid	MRBM	2,150 km	Road	Yes	40	40	1 x 200–300	50 m	
DF-26	CSS-18	Solid	IRBM	4,000 km	Road	Yes	200	20	1 x 200–300	150–450 m	
DF-31	CSS-10 Mod 1	Solid	ICBM	7,200 km	Road	Yes	6	6	1 x 200–300	300 m	
DF-31A	CSS-10 Mod 2	Solid	ICBM	11,200 km	Road	Yes	36	36	1 x 200–300	300 m	
DF-31AG	CSS-10 Mod 2	Solid	ICBM	10,000 km	Road & Off Road	Yes	36	36	1 x 200–300	300 m	
DF-41	CSS-X-20	Solid	ICBM	11,200 km	Road	Yes	18	54	3 x 200–300	100–150 m	
DF-41	CSS-X-20 (silo)	Solid	ICBM	15,000 km	Silo	No			3 x 200–300	100–150 m	
JL-2	CSS-N-14	Solid	SLBM	7,000 km	Submarine	Yes	6/72	72	1 x 200–300	300 m	
JL-3	CSS-N-?	Solid	SLBM	<9,000 km	Submarine	No			MIRV		
ALBM	CH-AS-X-13	Solid	ALBM/MRBM	2,150 km	Air	Yes					Believed to be air-launched version of DF-21

Note: There is considerable uncertainty about Chinese nuclear weapons. We have moderate confidence in these estimates.

North Korean Missiles²⁸⁷

NORTH KOREAN NAME	WESTERN NAME	PROPEL-LANT	TYPE	MAX RANGE	DEPLOY-MENT MODE	DEPLOYED	NUM-BER OF DELIVERY SYSTEMS	WARHEADS X YIELD (IN KILOTONS)	CIRCULAR ERROR PROBABLE (METERS)	NOTES
Hwasong-11	KN-02 Toksa	Solid	CRBM	160 km	Road	Yes	100		100 m	First solid-fueled conventional missile; developed as dual capable but no known nuclear mission
Hwasong-6 (modernized)	KN-18 SCUD MaRV	Liquid	SRBM	450 km	Road				7 m	
Hwasong-5 (modernized)	KN-21	Liquid	SRBM	250 km	Road				450 m	
	KN-23	Solid	SRBM	420–600 km	Road				100–200 m	Similar to Russian Iskander-M
	KN-24	Solid	SRBM	400 km	Road				100–200 m	Similar to Army Tactical Missile System; quasi-ballistic trajectory makes it harder to intercept
	KN-25	Solid	SRBM	380 km	Road	No			100–200 m	MLRS with super large diameter
Hwasong-7	KN-05 Nodong Mod 1/2	Liquid	MRBM	1,200+ km	Road	Yes	<100	1 x 1,000	2,000–3,000 m	
Hwasong-9	SCUD ER	Liquid	MRBM	1,000 km	Road	Yes		1 x 500		
Hwasong-10	Musudan, KN-07	Liquid	IRBM	3,000+ km	Road	Yes	<50	1 x 1,000	1.6 km (1600 m)	
Pukguk-song-2	KN-15	Solid	MRBM	1,000 km	Road tracked TEL	Yes		1 x ?		
Hwasong-12	KN-17	Liquid	IRBM	4,500 km	Road	?		1 x 1,000		
Hwasong-13	KN-08	Liquid	ICBM	12,000 km	Road	No		1 x ?		Experimental ICBM, believed to be abandoned
Hwasong-14	KN-20	Liquid	ICBM	10,000+ km	Road	Yes		1 x ?		
Hwasong-15	KN-22	Liquid	ICBM	12,000+ km	Road	No		1 ?		
Hwasong 17	KN28	Liquid	ICBM	15000 km	Road	No		Possible MRV		
Taepo Dong-2	Unha-3	Liquid	ICBM	10,000 km	Silo	No		1 x 800+	Poor	Militarized version of Unha-3 satellite launch vehicle; unlikely to be produced
Pukguk-song-1	KN-11	Solid	SLBM	1,000 km	Submarine	No		1 x ?		
Pukguk-song-3	KN-26	Solid	SLBM	1,000+ km	Submarine	No		1 x ?		
Pukguk-song-4	KN?	Solid	SLBM		Submarine	No		1 x ?		
Pukguk-song-5	KN?	Solid	SLBM		Submarine	No		1 x ?		

Note: There is a high degree of uncertainty about the exact size and characteristics of North Korea's nuclear arsenal. We have low confidence in these estimates, which are the best available. Most of these missiles are not believed to be currently nuclear-armed but potentially could be as North Korea's nuclear program progresses.

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