

The Threat Environment Demands Nuclear Weapons Modernization

Dr. Adam Lowther
Michaela Dodge

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On 27 January 2017, President Donald J. Trump signed a national security presidential memorandum which said, “The Secretary shall initiate a new Nuclear Posture Review (NPR) to ensure that the United States nuclear deterrent is modern, robust, flexible, resilient, ready, and appropriately tailored to deter 21st century threats and reassure our allies.”¹ President Trump’s timing could not be more prescient for such a review. In the almost eight years since the last NPR, the threats facing the United States have changed for the worse, with the US’s nuclear-armed competitors (Russia, China, and North Korea) aggressively pursuing

developments in their weapons programs that adversely affect the credibility of American deterrence.

As the Trump administration develops the next NPR during the second half of 2017, it will be important for its authors to have a firm grasp of the technological developments of the US's nuclear competitors. Not only are they well ahead of the United States in their own modernization programs, but should Congress waiver in its commitment to replacing aging weapons systems, the United States could see itself fall behind a peer competitor like Russia. If the following analysis is correct, then simply fielding new delivery vehicles with the same warheads may be insufficient to effectively deter competitors who are actively fielding systems that are designed to outmatch those of the United States.

Understanding the modernization programs of competitors, the limitations of existing American systems, and how these variables impact the stability of deterrence is important as the United States considers its nuclear posture and the direction it will take for the remainder of the Trump administration. A brief description of the modernization efforts of North Korea, Russia, and China is an instructive place to begin.

North Korea

As recent events demonstrate, North Korea and its unpredictable leader, Kim Jong-un, pose the greatest concern to the United States as the regime focuses its effort on its ballistic missile and nuclear weapons program.² Designed to provide the regime a capability that will deter what it sees as the real possibility of an invasion by the United States and South Korea, nuclear weapons are seen by Kim Jong-un as an equalizing force that effectively counters American and South Korean conventional superiority.³ Kim Jong-un sees nuclear weapons as fundamental to his regime's survival, potentially lowering the threshold of their use in the case of a perceived threat.⁴

North Korea has demonstrated the ability to produce a spherical-lensed implosion device (based on the design that can be traced back to the Pakistani scientist A. Q. Khan)—that is believed to be in the 5–10 kiloton yield range.⁵ Pyongyang has an active ballistic missile program, although its long-range missiles are likely not capable of delivering a nuclear payload just yet. Currently, there is no open source evidence to suggest that North Korea has mated a nuclear warhead with any of its ballistic missiles.⁶ The North Korean medium-range ballistic missile, Nodong-1, is based off of a Pakistani Ghauri missile that can carry nuclear payloads. North Korea periodically conducts underground nuclear tests and reportedly cooperates with Iran. North Korean scientists and engineers are likely overcoming any existing challenges to mating their nuclear warheads with their ballistic missiles in the near future.⁷

The complete lack of transparency within the North Korean nuclear program makes it both difficult to offer much detail on delivery systems and warheads and makes the program particularly threatening despite North Korea's stated "no-first-use" policy. From what little we know of its nuclear doctrine, North Korea has claimed a no-first-use policy, as well as threatened a nuclear preemptive strike, which offers analysts little in the way of understanding North Korean red lines or predicting its

action. While Kim Jong-un is proving difficult to understand and predict, his support for a nuclear and ballistic missile program has been strong and continuous.

Russia

While less of a direct threat to the United States than North Korea, Russia is undoubtedly the single greatest strategic threat to American sovereignty.⁸ Contrary to the United States, Russia spent much of the past decade actively working to improve its tactical and strategic nuclear capabilities. At a minimum, it is accurate to say that Russia has the most diverse and formidable nuclear arsenal of any nuclear weapon state.⁹ In addition to a strategic triad of long-range bombers, which are less capable aircraft than those of the United States, Russia is armed with new nuclear cruise missiles, submarine-launched ballistic missiles (SLBM), and silo, road-mobile, and rail-mobile intercontinental ballistic missiles (ICBMs). It possesses a formidable “tactical” nuclear arsenal—estimated to be at least 2,000 weapons—that would make a North Atlantic Treaty Organization (NATO)–Russia conflict particularly dangerous and unpredictable.¹⁰

Russia is also conventionally superior to NATO on its borders. It should come as no surprise that NATO, which fields approximately 200 B61 nuclear gravity bombs, is at a distinct disadvantage, should Russia seek to engage the alliance in a limited war over the Baltics or Poland with the explicit aim of breaking up the alliance.¹¹ With a stated policy that includes “escalate to deescalate,” Russia has clearly indicated that it intends to change the direction of a conventional conflict, if it appears to be losing, by using tactical nuclear weapons.¹² The diversity of its tactical nuclear weapon arsenal creates gaps on the US ladder of escalation, potentially making the calculus to attack NATO more appealing in Russian president Vladimir Putin’s mind.

According to publicly released statements, President Putin and his military leadership believe that recent upgrades to Russia’s operationally deployed strategic nuclear forces are sufficient to deter the United States from defending NATO in a limited conflict.¹³ Because the Russian tactical nuclear arsenal is greatly superior to that of NATO in both size and delivery options, it is not unreasonable to believe that President Putin believes he has the strategic advantage and can compel the United States to negotiate from a position of weakness in the event of a conflict. Some of Russia’s modernization efforts are worth noting, particularly in the context of the US inability to come up with a flexible and timely nuclear weapons modernization plan.

The Strategic Rocket Forces, which operates Russia’s ballistic missile force, is fielding a number of new ICBMs as it seeks to replace Cold War-era weapons.¹⁴ Russia is replacing its remaining SS-18 and SS-19 (model 3) ICBMs, which are equivalent to the US’s Minuteman III ICBMs, with SS-27 Topol-M and SS-29 Yars-M ICBMs—designed in the 1990s and 2000s.¹⁵ The latter can carry multiple reentry vehicles (RVs). These ICBMs are silo-based and road- or rail-mobile. Locating and targeting mobile ICBMs is particularly difficult.

By 2020, the Russians are expected to field the RS-28 Sarmat, which is referred to as the “country killer” because it can hold 15 thermonuclear RVs. It is also reported to be equipped with advanced defensive countermeasures (decoys) designed to defeat bal-

listic missile defenses. Such a weapon would prove a distinct advantage in a potential standoff between the United States and Russia and is considered highly destabilizing.

Russia is also fielding a new and far more advanced class of ballistic missile submarines to replace its fleet of six Delfin-class (Delta IV) submarines, which were launched between 1984 and 1992. The Borei-class ballistic missile submarine—the quietest submarine Russia has ever produced—can carry up to 16 of the new SS-NX-30 Bulava SLBMs. These weapons are both more accurate and deadly than the submarines and SLBMs fielded a decade ago.¹⁶ With the first Borei-class submarine entering service in 2009, this latest class of submarines—with eight expected to be commissioned by 2020—significantly improves the effectiveness of Russia's sea-based leg of the triad. In comparison, the US strategic submarines that entered into force in the 1990s time frame are scheduled to remain operational until 2042.

The bomber leg of the Russian triad is also receiving significant attention. Its fleet of Tu-95 Bear-H and Tu-160 Blackjack bombers are believed to be receiving new radar and other upgrades while Russia designs and fields a new stealth bomber.¹⁷ The Russians are also fielding a new nuclear air-launched cruise missile. First entering service in 2014, the Kh-102 can be launched by both of Russia's bombers while in Russian airspace and reach the continental United States.¹⁸ Because of the altitude at which they fly and the size of their radar cross-section, the United States may not know these weapons have entered American airspace. The Russians have been aggressively intruding into NATO's airspace in an apparent effort to intimidate US allies and test the alliance's air defenses.

Russia is also believed to be making significant advances in the design of its nuclear warheads, reportedly working on the fourth generation of weapon warheads and nuclear warheads with new weapon effects.¹⁹ Russia is growing increasingly concerned that the United States can disable or destroy incoming warheads with defensive countermeasures like ballistic missile defenses. A desire to ensure warheads detonate on target, and at the desired yield, has been a focus of Russian designers in recent years. While open source information is limited, Russia seems to be making advances in these areas. These technical developments must be considered in the context of President Putin's behavior. Russia has acted aggressively against neighboring countries but also increased the role and salience of nuclear weapons in its national security—the opposite of what the Obama administration did. Russia also is in violation of a whole host of its international obligations, including the Intermediate-Range Nuclear Forces Treaty and the "Mixed Oxide (MOX) Fuel Treaty."²⁰ Russia currently deploys several hundred more accountable warheads than allowed under the New Strategic Arms Reduction Treaty (New START), further increasing concern that it will not meet its obligations when the implementation period hits next year. Prospects for arms control are nil at this point in time. The Russian government has repeatedly stated that it will not negotiate the size of its tactical nuclear arsenal, which presents the greatest concern to NATO. Russia routinely threatens NATO allies with what it calls "preemptive" nuclear strikes and conducts military exercises simulating nuclear attacks on Poland. The possibility of a tactical nuclear exchange in Europe is increasing.

China

Although all indications suggest China maintains a nuclear arsenal considerably smaller than the United States and Russia, consistent with its policy of minimum deterrence, our knowledge of the Chinese nuclear weapons program is limited. This is because China purposefully maintains an opaque policy.²¹ We do, however, know that China possesses a secure second-strike capability that is increasingly more robust, due to ongoing modernization efforts that are providing China a legitimate nuclear triad with advanced nuclear warheads and delivery systems.²²

China has traditionally relied on its ballistic missiles as the bedrock of its nuclear deterrent. While ballistic missiles continue to be the primary building block of the Chinese deterrent, this is changing. The DF-5 (CSS-4) is a liquid-fueled ICBM first deployed in the mid-1980s and is more akin to the American Titan II ICBM than the later Minuteman III ICBM.²³ This heavy-lift ICBM was designed for use with a single large-yield warhead—with a range of approximately 7,000 miles—and an accuracy of approximately one-quarter of a mile. As part of its modernization effort, the DF-5 is due to be replaced by the DF-41, a heavy-lift, solid-fueled ICBM, which has a considerably improved accuracy and response time—making DF-41 locations harder to destroy in time of a serious crisis.²⁴

In addition to the DF-41, China also is fielding the DF-31 (CSS-9)—a solid-fueled ICBM which was first deployed in 2006. China recently upgraded to a DF-31A variant, which can reach the United States with its three warheads—a clear technological step forward for China. An additional variant is the DF-31B—a road-mobile weapon. Part of what makes the DF-31 of great concern is China's development of advanced multiple independent reentry vehicle technology.²⁵

With an estimated 20 DF-5 and 15 DF-31 missiles on alert in China, the newly reorganized People's Liberation Army Rocket Force can deliver enough firepower to destroy the US's largest cities. If loaded with a full complement of warheads, China is capable of delivering approximately 105 megaton class weapons on the United States. Given that China has a "counter-value strategy" focused on targeting American cities, the Chinese ballistic missile force is deeply concerning and an existential threat to American society.²⁶

The People's Liberation Army Navy also is fielding a "continuous at-sea deterrent" with the introduction of the Jin-class ballistic missile submarine. The first Jin SSBN was commissioned in 2010, with a total of five expected. Open source literature describes the Jin as noisy enough to be detected and tracked by the US Navy, which makes it inferior to American and Russian ballistic missile submarines and susceptible to American antisubmarine warfare (ASW) efforts, but it is a clear step toward parity for China. Jin-class vessels will carry up to 12 JL-2 (CSS-NX-4) ballistic missiles, which have a range of approximately 5,000 miles and can strike the United States from relatively safe territory.²⁷ In 2013, China showed a map of the United States with nuclear fallout after a nuclear submarine attack.

The People's Liberation Army Air Force fields the H-6K bomber, which is a modernized version of the Soviet-era H-6 bomber.²⁸ While the H-6K is inferior to the B-52 and B-2, this bomber can carry the CJ-10K cruise missile. Although it is believed that the CJ-10K is a conventional-only weapon, China has the technical ability

to rapidly field a nuclear variant.²⁹ With China seeking regional dominance in Asia, the H6-K's 2,200-mile range provides the aircraft ample distance to hold targets in the region at risk.

Indications suggest that China is increasing the numbers of its operationally deployed strategic nuclear weapons from an estimated 200–300 to an unknown number.³⁰ Because China is not known to be actively producing additional weapons-grade uranium or plutonium, the ultimate size of its arsenal may be limited well below that of the United States and Russia. However, China's purposeful effort to obscure its nuclear weapons program and the opaque nature of Chinese nuclear strategy make it difficult for Western analysts to accurately assess the direction of the Chinese nuclear arsenal and the true nature of its use doctrine. From limited glimpses into the program, interaction with Chinese scientists, and publications by Chinese scientists, it is believed that China has a weapons development program that is of the same technical capability of the United States and Russia.³¹ This means China may be developing warheads of similar sophistication and with similar combat environment concerns as those under consideration by American and Russian designers.

Understanding the Need for American Modernization

For those that are skeptical of US nuclear weapons modernization plans, the preceding discussion of adversary capabilities may be interesting but not particularly useful. Skeptics tend to believe that as long as the United States has even a small secure second-strike capability, any additional nuclear weapons are excessive and dangerous. The problem with this view is that it attributes a set of values and attitudes to American adversaries that evidence suggests they do not hold.³² For example, American culture places a higher value on the lives of individual Americans than it places on the survival of the sitting government. This is not true of Russian culture which, for centuries, has demonstrated that the preservation of the regime is of the highest importance. Additionally, American culture also places great importance on transparency and openness. Russian culture, on the other hand, is deeply influenced by an inherent distrust of "others" and a particular paranoia when it comes to the United States.³³ Given that Russian history—for the last 600 years—is the story of one autocratic form of government replacing its predecessor, it should come as no surprise that President Putin acts as he does.

While China's culture and history have their own unique characteristics, the need to sacrifice the individual for the preservation of the state and a long history of autocracy are aspects that China shares with Russia. What separates China from Russia is opacity and ambiguity with respect to its nuclear doctrine, leaving the United States to divine the location of China's red lines.³⁴ For both Russia and China, cultural and historical norms make both countries more willing to accept casualties sooner in conflict if the sacrifice means the preservation of the regime and defeat of an adversary.

Thus, when advocates of "minimum deterrence" suggest that nuclear deterrence is stable at low numbers, and no adversary would dare use nuclear weapons against

the United States—so long as we possess a secure second strike—they are guilty of mirror imaging. Opposing US nuclear weapons modernization on the grounds of attributing American values to Russia, China, and perhaps even North Korea is misleading and can lead to making the deterrent relationships between the United States and its adversaries less stable and increasing allied doubts about US commitment to their security.³⁵ The effect is the creation of a perception—mass cognitive dissonance—that the United States lacks both the will and capability to fight and win a nuclear conflict.

Technical Challenges Facing the Arsenal

Nuclear weapon states undertake substantial efforts to better understand the capabilities of competing nuclear powers. While the intelligence efforts of the United States are highly classified, some general points are possible.

First, the primary means that the United States and other countries rely on to gather intelligence is not human intelligence. Rather than looking like a James Bond or *Mission Impossible* movie, much of the information gathered by the intelligence community is accomplished through technical means that rely on analysts with science and engineering backgrounds. These types of intelligence gathering include: electronic intelligence (ELINT), measurement and signals intelligence (MASINT), imagery intelligence, signals intelligence (SIGINT), communications intelligence, and geospatial intelligence.³⁶

After combing the analytic results of these intelligence-gathering techniques, the United States, Russia, and China are able to develop a rather strong understanding of one another's nuclear weapons capabilities. What too few analysts realize is just how important of a role intelligence plays in shaping deterrence stability. Those within the disarmament community who suggest that a small number of nuclear weapons is enough to deter US adversaries and assure American allies fundamentally misunderstand that the thinking of senior leaders (civilian and uniformed) in the United States, Russia, and China is informed by the technical picture intelligence provides as they weigh the risks of a provocative action and how a nuclear-armed competitor may respond. Thus, the assertion that numbers do not matter or that American capability does not play a central role in shaping the risk calculation of Russia and China is fundamentally incorrect. As the historical analysis of Matthew Kroenig, a professor at Georgetown University, has shown, in crises where two nuclear weapon states are involved, the state with the superior nuclear capability prevailed in every single instance. The state with the inferior arsenal ultimately backed down.³⁷

The problem for the United States is that it may soon find itself in a position where it no longer possesses a superior nuclear capability and must back down in a crisis. We can see glimpses of such a situation in Europe where Russia fields a clearly superior tactical nuclear arsenal.³⁸ If the United States does not modernize as currently planned, and perhaps beyond, it will soon see Russia and China increasingly, and aggressively, willing to challenge US interests in Europe and Asia while knowing that the American nuclear advantage no longer exists. Fortunately, the United States is not there yet, but in the next three decades this will no longer remain the case if the United States does not replace its existing weapons and delivery vehicles.

Today, the United States deploys 1,550 operationally deployed strategic nuclear warheads accountable under New START—more than a 90 percent reduction from the Cold War.³⁹ Although this may seem like a large number of nuclear weapons, the reality of warfare is that nuclear weapons, like conventional weapons, do not always reach and destroy their targets. While the specific probability of arrival and probability of kill (PK) numbers are classified for each of the US's nuclear systems, it is possible to say that the number is below one and declining. A brief description of the limitation of current systems is instructive.

Intercontinental Ballistic Missiles

The Minuteman III, designed in the 1960s and fielded in the 1970s, was built to counter Russian SS-18/19 ICBMs. According to public sources, they have a circular error probable (CEP)—the radius of a circle, centered on the mean, with a boundary expected to include the landing points of 50 percent of the rounds—of between 500–1,000 meters. While the silos in which the Minuteman III reside were built to hardness standards for earlier, and less accurate, Russian ballistic missile systems, the new SS-27 and SS-29 ICBMs are far more accurate, with much smaller CEPs, dramatically increasing the PK in an attack on American ICBM fields.⁴⁰ It is worthwhile to keep in mind that the 1980s MX Peacekeeper ICBMs were deployed partially due to concerns about the Minuteman III's survivability. American ICBMs are at a greater risk to be disabled in the first strike than ever before.

To counter a similar vulnerability, the Soviets hardened their launch facilities to counter an increased accuracy of the Minuteman III, according to a 1991 study by Irukhim Smotkin, *Hardening Soviet ICBM Silos*.⁴¹ In doing so, the PK for the Minuteman III was reduced. In the four decades since the hardening occurred, the Russians have also continued to develop advanced integrated air defenses with the S-300, S-400, and S-500, which, if Russian reports are accurate, may have the ability to kill incoming American RVs and reentry bodies (delivered by SLBMs)—further reducing the certainty of a US president that the nation's ballistic missiles will reach their designated targets.⁴²

To make matters worse, there are also open-source reports that Russia is working on enhanced radiation warheads for the Moscow region's Gazelle antiballistic missile system, which would have—if correct—further increased the probability of defeating incoming American RVs and reentry bodies.⁴³ Unlike the United States, Russia sees the utility of using nuclear weapons to defeat incoming nuclear weapons, which reduces the American confidence that it can hold Russian targets at risk and thus effectively deter Russian action.

Russia, China, North Korea, and Iran have paid close attention to American ICBM and SLBM tests and have garnered significant technical intelligence from them. In the case of Russia and China, intelligence-gathering ships are frequently deployed to gather ELINT, MASINT, and SIGINT on test shots off the California coast. The result of our adversaries' efforts is that they understand the reentry angle at which both RVs and reentry bodies attack their targets. Thus, each of our adversaries, particularly North Korea, have begun placing their most valuable command and control,

leadership, and nuclear weapons facilities in locations protected from American ballistic missiles. In the case of Russia and China, both countries understand the flight physics of ballistic missiles and have/are placing advanced integrated air defense systems in the exact locations needed to, at a minimum attempt to, defeat incoming American weapons. Nuclear conflict is not like horseshoes and hand grenades where close is good enough.

Ship, Submersible, Ballistic, Nuclear Missiles

Although the sea-based leg of the triad is often called the most secure leg, the United States, Russia, and China all have active ASW programs that are specifically designed to hunt and kill an adversary's ballistic missile submarines. According to a number of accounts of Cold War-era submarine warfare, the United States experienced a level of success in tracking Soviet ballistic missile submarines that is often unknown. Should Russia and China place an equal level of focus on not only attack submarine ASW, but sea-floor-based passive sonar and space-based systems, the world's oceans would certainly become much less opaque.⁴⁴ Additionally, ship, submersible, ballistic, nuclear missiles (SSBN) are by no means assured of reaching and destroying their targets.

If the United States were to eliminate either the bomber or ICBM leg of the triad, an adversary would be free to refocus resources on advancing its ASW capabilities rather than on hedging against all three legs of the triad. In many respects, limited resources play a critical role in preventing Russia or China from focusing on defeating American ballistic missile submarines, which can be destroyed with a conventional torpedo—making it hard for the United States to threaten the use of nuclear weapons in retaliation.

Bombers

American strategic bombers are particularly useful for two reasons. First, they are the only leg of the nuclear triad that can effectively signal an adversary American intent by increasing or decreasing their readiness levels and recalling them if necessary. Second, only bombers have the ability to strike targets our adversaries bury and harden in remote locations in an effort to shield them from an ICBM or SLBM. The problem, however, is the fact that Russia and China are both developing advanced an integrated air defense system (IADS) that not only prevent the venerable B-52 from penetrating defended airspace, but also make it difficult for stealth aircraft—like the B-2—to fly the necessary profiles required to reach the targets for which they were designed.⁴⁵ The simple fact remains that stealth aircraft are not invisible to radar. Instead, they rely on a complex flight plan that is specifically designed to minimize the radar signature of the aircraft. However, as increasingly dense IADS improve their ability to discreetly analyze ultra-high frequency, very high frequency, L-band, and X-band radar returns, stealth aircraft will find it difficult to penetrate the very airspace for which they exist.

While some maintain that the loss of a B-2 during a nuclear conflict is to be expected, the Air Force relies on its stealth bombers returning from a bombing mission so that they can regenerate and fly against additional targets due to the small number of B-2 aircraft. However, this requirement is growing increasingly unrealistic.

The AGM-86 nuclear cruise missile, which serves as the B-52's only nuclear weapon, does not fly fast enough to evade air defense missiles, lacks the necessary defense to defeat modern IADS, and does not have the reduced radar signature required to evade modern air defense networks.⁴⁶ This leaves the bomber leg of the triad facing a challenging air environment in which the probability of reaching and destroying a target is declining.

Overcoming Current Challenges

America's adversaries' aggressive modernization programs undermine the credibility of the United States' nuclear arsenal. Their actions make the technical requirements for US nuclear weapons modernization an imperative. Existing American capabilities are becoming increasingly inadequate to threats facing the country. The Cold War has long since passed, and Russia and China have spent the past decade and a half designing and fielding systems that undermine the credibility of American deterrence. Contrary to the view of many opponents of modernization in the United States, who suggest that virtually any effort to field modern systems is destabilizing, the reality is much different. Former Secretary of Defense Donald Rumsfeld's admonition that "weakness is provocative" is much more accurate than any assertion that American strength is the driver of strategic instability.

If President Trump and Congress are serious about maintaining the credibility of American strategic deterrence, the nation has no other option than modernizing each of the nuclear triad's three legs. With the bomber leg of the triad in perhaps the poorest relative condition because of the B-52's inability to penetrate defended airspace, the limited number of penetrating stealth bombers (20), and the limitations of the nuclear cruise missile, fielding the B-21 Raider (the USAF's new long-range bomber) and the long-range strike cruise missile (LRSO) is more important than ever.

According to press reports, the Air Force plans to buy at least 100 B-21 stealth bombers.⁴⁷ This will increase the number of penetrating bombers capable of delivering both nuclear cruise missiles and the B61 nuclear gravity bomb. It will also provide the United States a bomber with an unprecedented ability to integrate and employ offensive cyber-attack options and serve as a platform for gathering and disseminating real-time information. Thus, the B-21 will give the United States its best opportunity to penetrate IADS that are increasingly able to detect, track, and target aircraft and missiles at longer ranges.

While unpopular with many advocates of minimum deterrence and disarmament, a stealthy nuclear cruise missile is absolutely necessary.⁴⁸ Not only are America's adversaries building their most important facilities in locations that ballistic missiles cannot attack, but they are placing their most advanced IADS around them for additional protection. This may make it very hard, if not impossible, for even the B-21 to reach these targets and deliver a gravity bomb. The only means available for

striking these targets may very well be the LRSO, which, because it is stealthy and less than one-fiftieth the size of a B-2 or B-21, will have the greatest chance of reaching a target undetected.

Moving forward with the Ohio-class replacement program is also important for the nation's sea-based leg of the triad. The simple fact is Russia and China are investing in antisubmarine warfare and making it increasingly difficult to sail the world's oceans undetected. Not only will the SSBN be quieter, but it will not need refueling during its service life. This will allow for these submarines to play a much more effective role in providing a continuous at-sea deterrent.

Conclusion

Opponents of nuclear modernization are fundamentally misunderstanding how capability affects the stability of nuclear deterrence and how it shapes the actions of the civilian and uniformed leaders of Russia, China, and the United States. Nuclear weapons are more than simple "political weapons" that exist to deter the use of other nuclear weapons. For Russia, in particular, nuclear weapons are weapons of war and integrated into Russian warfighting doctrine. To credibly deter Russian aggression, the United States must also treat nuclear weapons as not only tools of deterrence but warfighting weapons. In this regard, Air Force Global Strike Command is correct. With a motto of "deter, assure, strike," the command is effectively conveying that the United States has the will and ability to deliver devastating effects to anyone who challenges America's core interests.

We should never forget that maintaining the capability to carry out any threat is central to the stability of deterrence. After all, our adversaries are watching. 🌟

Notes

1. Donald J. Trump, *Presidential Memorandum on Rebuilding the U.S. Armed Forces*, 27 January 2017, <https://www.whitehouse.gov/the-press-office/2017/01/27/presidential-memorandum-rebuilding-us-armed-forces>.

2. Eli Watkins, "Trump: US Will Act Unilaterally on North Korea if Necessary," *CNN*, 3 April 2017, <http://www.cnn.com/2017/04/02/politics/donald-trump-north-korea/>.

3. Joel Witt, "North Korea's Unstoppable Nuclear-Weapons Program," *The National Interest*, 22 April 2015, <http://nationalinterest.org/feature/north-koreas-unstoppable-nuclear-weapons-program-12686>.

4. *North Korea: Overview*, (Washington, DC: *Nuclear Threat Initiative*, 2017), <http://www.nti.org/learn/countries/north-korea/>.

5. Steve Almasy and Euan McKirdy, "North Korea Claims to Have Nuclear Warheads that can Fit on Missiles," *CNN*, 10 March 2016, <http://www.cnn.com/2016/03/08/asia/north-korea-nuclear-warheads/>.

6. Daniel Pinkston, *The North Korean Ballistic Missile Program*, (Carlisle Barracks, PA: US Army War College, 2008), <http://press.armywarcollege.edu/pubs/1937.pdf>; see "Daniel Pinkston."

7. "North Korea's Nuclear Programme: How Advanced is it?" *BBC*, 6 January 2017, <http://www.bbc.com/news/world-asia-pacific-11813699>.

8. *Nuclear Weapons: Who Has What at a Glance* (Washington, DC: Arms Control Association, 2017), <https://www.armscontrol.org/factsheets/Nuclearweaponswhohaswhat>.

9. Alex Lockie, "How the US's Nuclear Weapons Compare to Russia's," *Business Insider*, 28 September 2016, <http://www.businessinsider.com/us-vs-russia-nuclear-weapons-2016-9>.

10. Dave Majumdar, "5 Russian Nuclear 'Weapons' of War the West Should Fear," *The National Interest*, 31 January 2015, <http://nationalinterest.org/feature/5-russian-nuclear-weapons-war-the-west-should>

-fear-12159; Will Lowry, "Russia, US and Nuclear Modernization," *Ploughshares* Fund, 9 December 2015, <http://www.ploughshares.org/issues-analysis/article/russia-us-and-nuclear-modernization>; and Hans M. Kristensen and Robert S. Norris, "Russian Nuclear Forces, 2015" *Bulletin of the Atomic Scientist* 71, no. 3, 1 May 2015, <http://thebulletin.org/2015/may/russian-nuclear-forces-20158299>.

11. Michaela Dodge, *U.S. Nuclear Weapons in Europe: Critical for Transatlantic Security*, (Washington, DC: The Heritage Foundation, 2014, <http://www.heritage.org/defense/report/us-nuclear-weapons-europe-critical-transatlantic-security>).

12. Nikolai Sokov, "Why Russia Calls a Limited Nuclear Strike 'De-escalation,'" *Bulletin of the Atomic Scientist*, 13 March 2014, <http://thebulletin.org/why-russia-calls-limited-nuclear-strike-de-escalation>.

13. John Grady, "Arms Expert: Russia Quick to Threaten Nuclear Strikes in Regional Conflicts," *United States Naval Institute News*, 28 June 2016, <https://news.usni.org/2016/06/28/arms-expert-russia-quick-threaten-nuclear-strikes-regional-conflicts>.

14. "Russia Strategic Rocket Forces Overview," *Nuclear Threat Initiative*, 14 May 2009, <http://www.nti.org/analysis/articles/russia-strategic-rocket-forces-overview/>.

15. Savo Ukropina, "R-36 (SS-18 Satan)," *Military-Today*, 1 January 2017, http://www.military-today.com/missiles/ss18_satan.htm; "UR-100N/SS-19 Stiletto," *Federation of American Scientists (FAS)*, 29 July 2000, https://fas.org/programs/ssp/nukes/nuclearweapons/russia_nukescurrent/ss19.html; "RF-2UTTH /Topol-M/SS-27," *FAS*, 13 October 2000, <https://fas.org/nuke/guide/russia/icbm/rt-2pmu.htm>; Charles Vick, "RS-24/SS-29/Yars-M," *GlobalSecurity*, 16 April 2014, <http://www.globalsecurity.org/wmd/world/russia/rs-24.htm>; and David Reid and Alexander Smith, "Russia Unveils RS-28 Sarmat 'Satan 2' Nuclear Missile," *NBC News*, 26 October 2016, <http://www.nbcnews.com/news/world/russia-unveils-rs-28-sarmat-satan-2-nuclear-missile-n673016>.

16. Andrius Genyus, "Borei Class," *Military-Today*, 1 January 2017, http://www.military-today.com/navy/borei_class.htm.

17. Jacek Siminski, "Russia is Working to Modernize its Strategic Aviation to Maintain a Deterrence Capability," *The Aviationist*, 24 March 2015, <https://theaviationist.com/2015/03/24/russia-strategic-aviation-updates/>.

18. "Kh-101 /Kh-102," *GlobalSecurity*, 1 January 2017, <http://www.globalsecurity.org/wmd/world/russia/kh-101.htm>.

19. Ivanka Barzashka, "Technical Concerns: Why Russia Worries About Missile Defense," *Bulletin of the Atomic Scientist*, 14 May 2012, <http://thebulletin.org/technical-concerns-why-russia-worries-about-missile-defense>.

20. Andrew E. Kramer, "Vladimir Putin Exits Nuclear Security Pact, Citing 'Hostile Actions' by U.S.," *New York Times*, 3 October 2016, <https://www.nytimes.com/2016/10/04/world/europe/russia-plutonium-nuclear-treaty.html>.

21. Gregory Kulacki, *China's Nuclear Arsenal: Status and Evolution* (Washington, DC: Union of Concerned Scientists, 2011), 1-5.

22. Benjamin Schreer, "China's Development of a More Secure Nuclear Second-Strike Capability" *Asia Policy* 19 (January 2015), 14-20.

23. John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs Technologies, Strategies, Goals," *International Security* 17, no. 2 (1992), 5-40.

24. "DF-41," *GlobalSecurity*, 2 February 2017, <http://www.globalsecurity.org/wmd/world/china/df-41.htm>.

25. "DF-31, DF-31A" *GlobalSecurity*, 21 December 2015, <http://www.globalsecurity.org/wmd/world/china/df-31.htm>.

26. Gregory Kulacki, *The Chinese Military Updates China's Nuclear Strategy* (Washington, DC: Union of Concerned Scientists, 2015), 2.

27. Andrius Genyus, "Jin Class," *Military-Today*, 1 January 2017, http://www.military-today.com/navy/jin_class.htm.

28. Noam Eschel, "Chinese Air Force Gets More H-6K Strategic Bombers" *Defense Updates*, 25 June 2013, http://defense-update.com/20130625_h-6k-bombers-delivered-to-pla-air-force.html.

29. "DH-10 / CH-10 / CJ-10 Land-Attack Cruise Missiles (LACM) Hong Niao/Chang Feng/Dong Hai-10," *GlobalSecurity*, 11 November 2016, <http://www.globalsecurity.org/wmd/world/china/lacm.htm>.

30. Hans M. Kristensen and Robert S. Norris, "Chinese Nuclear Forces, 2015," *Bulletin of the Atomic Scientist*, 1 July 2015, <http://thebulletin.org/2015/july/chinese-nuclear-forces-20158459>.

31. The authors have had informal conversations with both Chinese nuclear scientists and American scientists familiar with the Chinese weapons program who have indicated that China's nuclear weapons program has, during the past three decades, actively sought to catch up to the sophistication and capability of the American and Russian weapons programs and has been successful in doing so.

32. For an excellent discussion of how Eastern and Western societies think and process information, see Richard E. Nisbett, *The Geography of Thought* (New York: Free Press, 2003). For a better understanding of President Vladimir Putin's motivations and thinking, see Marcel Van Herpen, *Putin's Wars* (Lanham, MD: Rowman and Littlefield, 2014). To better understand the values of the Kim Regime, see Victor Cha, *The Impossible State: North Korea Past and Future* (New York: Ecco, 2013).

33. Anna Arutunyan, "Russia's Politics of Paranoia," *OpenDemocracy*, 22 December 2015, <https://www.opendemocracy.net/od-russia/anna-arutunyan/russias-politics-of-paranoia>; and Jeffrey Lewis, "Russia's Nuclear Paranoia Fuels Its Nuclear Propaganda," *Foreign Policy*, 22 August 2016, <http://foreignpolicy.com/2016/08/22/russias-nuclear-paranoia-fuels-its-nuclear-propaganda/>.

34. Hui Zhang, "China's Nuclear Policy: Changing or Not?" *Harvard Kennedy School Belfer Center for Science and National Affairs Power and Policy Blog*, 31 May 2013, <https://www.belfercenter.org/publication/chinas-nuclear-policy-changing-or-not>.

35. Richard Heuer, *The Psychology of Intelligence Analysis* (Langley, VA: Center for the Study of Intelligence, 2013), 65–75.

36. Robert M. Clark, "Perspectives on Intelligence Collection," *Journal of U.S. Intelligence Collection* 20, no. 2 (Winter 2013), 47–52.

37. Matthew Kroenig and Michael Weintraub, *The Nuclear Balance and International Conflict* (Washington, DC: Mortara Center for International Studies, 2011), http://www.matthewkroenig.com/Kroenig_The%20Nuclear%20Balance%20and%20International%20Conflict.pdf; see "Matthew Kroenig."

38. Julian Borger, "US and Russia in Danger of Returning to Era of Nuclear Rivalry," *The Guardian*, 4 January 2015, <https://www.theguardian.com/world/2015/jan/04/us-russia-era-nuclear-rivalry>.

39. Hans Kristensen, "New START: Russia and the United States Increase Deployed Nuclear Arsenals," *FAS*, 2 October 2014, <https://fas.org/blogs/security/2017/04/newstart2017/>.

40. "Russia Upgrades Its Missile Arsenal," *Janes Intelligence Review* (2015), 1–15.

41. Irukhim Smotkin, *Hardening Soviet ICBM Silos* (New York: Delphic Associates, 1991).

42. Dave Majumdar, "Russia's Deadly S-500 Air-Defense System: Ready for War at 660,000 Feet," *The National Interest*, 3 May 2016, <http://nationalinterest.org/blog/russias-deadly-s-500-air-defense-system-ready-war-660000-16028>.

43. Simon Shuster, "Why Russia Is Rebuilding Its Nuclear Arsenal," *Time*, 4 April 2016, <http://time.com/4280169/russia-nuclear-security-summit/>.

44. See Norman Polmar and Edward Whitman, *Hunters and Killers* (Annapolis: Naval Institute Press, 2016).

45. At present, only the B-2 is capable of penetrating Russian IADS such as the S-300 and S-400. The B-52 must operate from a stand-off position.

46. "AGM-86 Air-Launched Cruise Missile (ALCM)," *CSIS Missile Defense Project*, 29 November 2016, <https://missilethreat.csis.org/missile/alcm/>.

47. Oriana Pawlyk, "Air Force Unveils Name of Future Stealth Bomber as B-21 'Raider,'" *Military.com*, 19 September 2016, <http://www.military.com/daily-news/2016/09/19/air-force-unveils-name-of-future-b21-bomber-as-tk.html>.

48. Adam Lowther, "Nuclear Air Launched Cruise Missiles: They Still Matter," *The National Interest*, 28 October 2015, <http://nationalinterest.org/feature/nuclear-air-launched-cruise-missiles-they-still-matter-14182>.



Dr. Adam Lowther

Dr. Lowther (PhD, University of Alabama; MA, BA, Arizona State University), serves as the director of the School of Advanced Nuclear Deterrence Studies (SANDS), Kirtland AFB, New Mexico. He leads the academic, professional development, and research effort of the school and aided in the initial stand-up of SANDS. He previously served as the director of the academic and professional journals at the Air Force Research Institute (AFRI), Maxwell AFB, Alabama, where he oversaw the publication of the Air Force's professional journals: *Strategic Studies Quarterly* (SSQ) and *Air and Space Power Journal* (English, Spanish, Chinese, Africa and Francophonie). Before assuming this position, Dr. Lowther served as a research professor at AFRI, where he led and participated in a number of Chief of Staff of the US Air Force-directed studies. His principal research interests include deterrence, airpower diplomacy, and the Asia-Pacific. Dr. Lowther is the author or editor of five books. He has published in *The New York Times*, *The Boston Globe*, *Joint Force Quarterly*, *SSQ*, and a variety of other journals and outlets. Before joining AFRI, he served on the faculty of two universities where he taught courses in international relations, political economy, security studies, and comparative politics. He also served on a variety of committees and as a mentor to student groups. Early in his career, Dr. Lowther served in the US Navy aboard the USS *Ramage* (DDG-61). He also served at Commander in Chief, US Naval Forces, Europe-London and with Naval Mobile Construction Battalion-17.



Michaela Dodge

Ms. Dodge (MS, Missouri State University; BA, Masaryk University, Czech Republic) specializes in missile defense, nuclear weapons modernization, and arms control as a senior policy analyst for defense and strategic policy in The Heritage Foundation's Allison Center for Foreign Policy Studies. She has authored and coauthored research papers and commentary for Heritage, as well as contributed defense and national security posts to the think tank's policy blog, *The Foundry*.

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