AMERICA'S NUCLEAR BACKBONE:

The Value of ICBMs and the New Ground-Based Strategic Deterrent

By Maj Gen Roger W. Burg, USAF (Ret.)

MITCHELL INSTITUTE for Aerospace Studies

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About the Author

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Burg retired from the Air Force in September 2010 after 32 years of service on Active Duty. He held numerous leadership positions in ICBM and space units, to include command at the squadron, group, wing, and numbered air force levels. He also served in senior national security and international affairs positions at the White House, the Joint Staff, the Air Staff, US Strategic Command, US Space Command, and Strategic Air Command. From 2004 to 2007, Burg was the Air Force's inaugural director of strategic security, a position that combined the nuclear, counter-proliferation, space, homeland defense, and security forces portfolios, for the first time. He served at the White House from 2003 to 2004 as the director of nuclear policy and arms control on the National Security Council.

His final Active Duty tour was as the commander of 20th Air Force, headquartered at F.E. Warren AFB, Wyoming, where he was responsible for 10,000 Airmen, three operational bases, and 500 deployed ICBMs.

Today, Burg is an active member of the San Antonio community, serving on the Chamber of Commerce Cyber Task Force. He is involved with the Masters Leadership Program Alumni Association and the Armed Forces Communications and Electronics Association. He is also a member of the US Strategic Command Advisory Group and a regular guest speaker at the US Air Force Air War College at Maxwell AFB, Alabama.

Contents

Foreword

Since the end of the Cold War, the United States has delayed and truncated much of the required modernization of the nuclear deterrent enterprise. However, given the rapid modernization of the nuclear forces of nations such as Russia and China, as well as the nuclear aspirations of North Korea and Iran, it is imperative that the nation maintains a highly credible deterrent force to balance this threat.
Today, senior US military leaders and civilian defense officials have emphasized that the cost of supporting old nuclear systems is becoming prohibitive. The new Ground Based Strategic Deterrent (GBSD) program is the proposed modernization of the Minuteman III intercontinental ballistic missile (ICBM) force, the land-based missile portion of the US nuclear triad. When completed in 2040, this capability promises to give the United States the most cost-effective and stabilizing deterrent force in its nuclear arsenal for the next half century.

This ICBM modernization program, as this study details, is highly affordable. The program accounts for only eight percent of all nuclear modernization costs over the next 25 years. Most importantly, to attack effectively the 450 ICBMs in the current US force structure is virtually impossible, due to the combination of their hardening and dispersal. Furthermore, an attack would involve unambiguous, direct aggression against the continental United States, triggering a commensurate response. This basic principle significantly heightens the barriers to an adversary nuclear attack. The combination of all these factors ensures a very high degree of strategic stability.

In this study, Maj Gen Roger W. Burg, USAF (Ret.), does a superb job in explaining and examining all the elements that go into maintaining, preserving, and strengthening the ICBM leg of the nuclear deterrent. He describes the political, economic, and military environment that demands the recapitalization of the ICBM force by the new Ground Based Strategic Deterrent, and why the nuclear triad—anchored by GBSD— will remain as relevant to US national security in the 21st century as it was in the 20th century.

Lt Gen David A. Deptula, USAF (Ret.)
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December 21, 2016

Executive Summary

Since the end of the 1950s, the United States has maintained a triad of nuclear delivery systems: strategic bombers, intercontinental ballistic missiles (ICBMs), and submarine-launched ballistic missiles (SLBMs). Although different Administrations have adjusted the triad's force mix, size, basing, and other specifics, all Presidents have maintained their fundamental reliance on the triad, believing it to offer a diverse set of options to deter adversaries and assure allies.

Even as the Obama Administration has undertaken nuclear reductions, its 2010 Nuclear Posture Review (NPR) pledged to continue to maintain a credible nuclear deterrent and assessed, "Retaining all the triad legs will best maintain strategic stability at reasonable cost, while hedging against potential technical problems or vulnerabilities. Each leg of the triad has advantages that warrant sustaining all three legs at this stage of reductions."[1] Since then, the government has committed to maintaining a credible nuclear deterrent in numerous high-level policy documents, including the 2012 Defense Strategic Guidance; 2013 Nuclear Employment Strategy; 2014 Quadrennial Defense Review (QDR); 2015 National Military Strategy; and 2015 National Security Strategy.[2]

That said, in recent years the American nuclear enterprise in general—and the triad in particular—have come under increasing criticism. Some have argued that nuclear weapons have reduced value in the 21st century global security environment; others have asserted that nuclear modernization plans are unaffordable. Broadly, nuclear critics argue that the United States can afford to decrease its reliance on nuclear weapons and reduce—or, perhaps, even completely eliminate—one or more elements of the triad. The ICBM force and the planned Long Range Standoff (LRSO) cruise missile are the components of the triad whose future critics have most consistently questioned.

In response, this study advances two interlinked arguments. First, the land-based leg of the triad provides a range of crucial capabilities that underwrite nuclear stability and deterrence. Its continuing value in the 21st century appears indisputable. Second, ICBM recapitalization must proceed without delay. The current force of Minuteman III missiles, procured in the 1970s, is aging, thereby introducing major sustainability concerns, which could catalyze reliability problems in the next decade, if unaddressed. This means the inventory is insufficient to maintain needed capabilities much beyond 2030.

After providing a brief overview of the historical development of the triad, this study surveys five characteristics of the global security environment to demonstrate the continuing relevance of nuclear weapons and the need to recapitalize the US arsenal:

- **Return to Great Power Competition:** Increasing Russian and Chinese aggressiveness demonstrates that these states seek to challenge the United States and rewrite the rules of the global order to their liking. Confronting and deterring these revisionist powers require the United States to maintain a credible nuclear deterrent to preserve leverage over these destabilizing challengers.

- **Emergence of Various Regional Challengers:** In tandem with the return of great power competition on a global level, a variety of regional antagonists, notably, Iran and North Korea, has arisen to try to defy the United States, as well as to destabilize and alter their respective regional security orders in their favor. North Korea already possesses a small nuclear weapons capability today, and seeks to grow this capability. Iran has aspirations for its own nuclear capability, and though the country signed an agreement to pause its nuclear activities in July 2015, it has carried out missile tests since then. Effective deterrence requires a capable and reliable American nuclear arsenal to counter these threats.

- **Ongoing Nuclear Modernization Programs in Other Countries:** The United States is struggling to maintain a nuclear enterprise developed and deployed decades ago. Since US competitors are engaged in ambitious programs to significantly upgrade or entirely recapitalize their nuclear forces, delays in US modernization will not merely see American nuclear advantage erode, but will, in fact, cause US capabilities to fall behind those of its adversaries, whose modernization programs are already years ahead.

- **Increasing Reliance on Nuclear Weapons in National Strategy:** Just as many competing nuclear powers are modernizing their arsenals, so too are they putting increased emphasis on nuclear weapons in their national policy and planning. The United States must maintain a viable deterrent force to counter this.

- **Hedge against an Uncertain Future:** Despite the best efforts of defense planners, it is impossible to forecast with certainty the future international security environment. Since the end of the Cold War in 1991, the world has witnessed dramatic shifts and counter-shifts. At a minimum, the complexity and variety of threats that the United States will face are likely to grow. Maintaining a strong nuclear force is critical insurance against unpredictable and unforeseen challenges, which history suggests are likely to develop and which the United States ignores at its peril.

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Overall, the ICBM force is the backbone of the nuclear triad. This force provides crucial support to the other two legs: the strategic bombers and SLBMs. This is best illustrated by five key attributes:

- **Safe, Secure, and Stabilizing:** ICBM basing contributes to effective deterrence in multiple ways. Consisting of large numbers of US-based missiles in hardened facilities spread over a wide swath of territory, this safe, secure, and stabilizing approach sets a prohibitively high threshold for enemy attack, one that a rational adversary would not consider crossing. These qualities, combined with a rapid, guaranteed retaliatory US response, demonstrate how ICBMs provide nuclear stability, ensure deterrence, and underpin America's superpower status.

- **Most Responsive and Connected:** With their high alert rates, quick targeting abilities, and assured communications channels, ICBMs can quickly respond to orders from the National Command Authority (NCA): the President and Defense Secretary or their duly-deputized successors or alternates. This capability both stabilizes the nuclear balance and deters potential attackers.

- **Penetration Assurance:** Both the nuclear bombers and submarines rely upon stealth to conduct their missions, but adversaries continue to aggressively seek technologies to detect and attack these systems. Even if opponents do not develop game-changing advances that render airborne and underwater stealth obsolete, the outcome of the offense-defense cycle remains uncertain. By contrast, ICBMs provide a huge challenge for defenses. With the newest US nuclear force structure calling for 400 deployed ICBMs, an adversary possessing a defense of a few hundred interceptor missiles could only anticipate protecting itself from some partial retaliatory capability. As such, ICBMs are not only an effective delivery system in their own right, but also an important hedge against counter-stealth advances that could erode the viability of the triad's two other legs.

- **Reliable:** ICBMs have long been valued for their reliability. Their large numbers, continually alerted status, and yearly tests ensure that they stand ready, if ever needed. Even a small, temporary disruption to the mission capability of one of the triad's other legs could significantly undermine the US deterrent posture. The maintenance of a strong ICBM force ensures that ICBMs could effectively compensate, even if that were to occur.

- **Cost-Effective:** Of the triad's three legs, ICBMs feature not only the lowest operating costs (both today and in the future), but also, by far, the lowest recapitalization costs. These qualities are highly desirable, given the current specifics of budget-sequester-era defense spending and the more general era of austerity influencing defense investments.

A full analysis of the current state of the Minuteman III force and the Air Force's plans for a next-generation Ground Based Strategic Deterrent demonstrates that the current recapitalization plan is not only necessary, but also cannot afford further delay. This is illustrated in four broad areas:

- **Consistent with Air Force Analysis:** The Air Force's rigorous analysis of alternatives (AOA), which other senior defense offices reviewed and approved, judged that the service's plan to fully replace the Minuteman III with a new missile, as well as to modernize the launch control centers (LCCs) and related command and control (C2) systems, was the best way to achieve both cost and capability effectiveness. By contrast, other modernization options, such as continued service life extension programs (SLEPs) of the existing fleet, suffered from key deficiencies.

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- **SLEPs Cannot Continue Indefinitely:** Despite the impressive efforts to sustain the Minuteman III through 2030, the system has lost its ability to undergo further cost-effective SLEPs. Its advanced age makes it difficult and costly to sustain further. If the US ICBM inventory is to remain credible, the modernized and new GBSD must replace the Minuteman III, and, in doing so, will avoid significant additional and unnecessary costs.

- **Commonality Concerns:** Proposals to develop common components for new ICBMs and SLBMs raise the possibility of making triad modernization more cost-effective. However, there are compelling strategic reasons to keep these missile programs separate, notably the need to avoid a common failure among all US ballistic missiles. History suggests that while officials should explore commonality, multi-service efforts can lead to cost growth and schedule slippage. Planned efficiency gains are possible, but officials should pursue them with a careful assessment of risks.

- **Industrial Base Concerns:** A robust nuclear enterprise and solid industrial base are mutually reinforcing; they are either both strong or weak. Worryingly, today the latter is true, particularly in the case of ICBMs. The workforce that develops, builds, sustains, and modernizes ICBMs is in danger of further and probably irreversible attrition, if there are further delays to the GBSD program or it does not go forward. If this were to occur, the United States may face a future scenario in which the industrial base would have great difficulty in developing and fielding a new missile in a timely and cost-effective manner.

Taken together, the thorough examination of these various points clearly validates this study's twin, interlinked arguments: the vital, enduring utility of ICBMs and the necessity to recapitalize the Minuteman III fleet with the GBSD without further delay. Of course, the increasing turbulence of the global security environment, particularly as many competitors carry out aggressive nuclear modernization programs, strengthens this study's dual contentions. America's nuclear capability is already losing credibility. Further erosion due to a failure to invest in ICBM recapitalization would expose the United States to far too many additional risks in an already deteriorating global security environment.

I. Introduction

The Air Force is beginning development of a new intercontinental ballistic missile (ICBM) under the Ground Based Strategic Deterrent (GBSD) program to replace its aging fleet of Minuteman III missiles. It is also pursuing modernization of the missiles' launch control centers and command and control (C2) infrastructure. The new system will enter service in the 2030 timeframe. Concurrently, the Department of Defense (DOD) is also developing replacements for the nuclear triad's other legs: a new penetrating bomber, the B-21 Raider, to replace portions of the existing bomber force, and a new fleet of ballistic missile submarines (SSBNs) to replace the aging Ohio-class inventory.

Debate over the role of nuclear weapons in US national security strategy, combined with the cost of these new weapon systems, is bound to stimulate controversy over current nuclear modernization plans. Some argue that America's nuclear arsenal is a Cold War relic that serves little purpose in today's global security environment and that recapitalization of the triad is unaffordable. Consequently, the arguments go, the country should reduce its reliance on the nuclear enterprise through a variety of measures, including the potential elimination of, or significant reduction to, elements of the triad.[3] This has included proposals to significantly reduce or eliminate ICBMs, stop funding any long-range bomber or strike capability, and delay construction of new submarines. Critics have also proposed cutbacks in the existing US fleet of nuclear-capable bombers and submarines. While they have long criticized the three components of the triad due to ideological opposition to nuclear weapons, the land-based ICBM force has been the leg whose future utility they have most consistently questioned.

The purpose of this study is to examine the case for ICBM recapitalization. It will show that there is a variety of highly compelling reasons to preserve not only the strength of the nation's nuclear triad, in general, but also to maintain—and modernize—the ICBM component, in particular. To do so, this study contains four parts. First, it provides a brief overview of the development of the US nuclear enterprise from World War II to today. Second, it surveys the global security environment the United States currently faces, including the ongoing efforts of other nations, many of which are direct competitors, to upgrade their own nuclear arsenals. Third, it presents an overview of the ICBM force's crucial contributions to deterrence. Finally, it details why the Air Force's plan to replace the existing ICBM force with a new GBSD is affordable, prudent, and necessary.

II. The Development of the American Nuclear Enterprise

World War II catalyzed multiple revolutions in military technology. The exigencies of the conflict spurred forward experimentation that had begun long before the outbreak of hostilities. In turn, this produced a breathtaking array of advancements, such as jet aircraft, miniaturized electronics, radar, rocketry, and missiles. Most significantly, of course, was the creation of nuclear weapons.

The American nuclear detonations over the Japanese cities of Hiroshima and Nagasaki in August 1945 spurred a fundamental reassessment of US national security strategy. Namely, what strategy should the country adopt when another power, notably, the Soviet Union, acquired a nuclear capability? The sheer destruction that the two atomic weapons caused, far beyond what many scientists at the time thought was possible, led American political and military leaders to reframe the rationale of "the bomb" from one of attack to deterrence. As the influential nuclear strategist Bernard Brodie described in 1946, "Thus far, the chief purpose of our military establishment has been to win wars. From now on, its chief purpose must be to avert them. It can have almost no other useful purpose."[4]

How exactly could the United States convince a future nuclear-armed opponent that a massive conventional or nuclear attack would trigger a response in kind, one that would ultimately lead to its own annihilation? Strategists determined that the United States needed to present an adversary with an array of forces that could withstand a nuclear first strike, and then inflict unacceptable damage upon the aggressor. Faced with such a prospect, this would deter an enemy from launching an attack in the first place. Of course, the critical issue was the stability of the nuclear balance. The United States needed to field nuclear deterrent forces that would reduce an attacker's incentive to seek a significant advantage, even in the case of a surprise "bolt from the blue," a first strike against US strategic forces.

In the immediate postwar environment, bombers served as the primary means to deliver the then-bulky nuclear weapons. The 1950s witnessed advances in technology and a number of catalysts, both domestic and external, that spurred US development of other delivery systems. Some of the more notable developments that led to the fielding of ICBMs and SLBMs were: managing activities among the US military services to "own" a piece of the emerging nuclear enterprise, while prioritizing investment in nuclear forces across services; President Dwight D. Eisenhower's "New Look" policy that emphasized nuclear capabilities to offset perceived Soviet conventional superiority; the Soviet Union's launch of Sputnik, the world's first man-made satellite, which shocked the American psyche and led to a major intensification of research into missile technology; and size and weight reductions of nuclear weapons. These advancements included the development of solid rocket fuel capabilities that allowed ICBMs to remain on alert safely and continuously. Over time, concern mounted that the United States faced a significant "bomber gap" and "missile gap" with the Soviet Union, a worry that then-Senator John F. Kennedy articulated during the 1960 presidential campaign.

The result of these various factors was that, by 1959, the United States possessed the components of the nuclear triad of bombers, ICBMs, and SLBMs. Plans called for each leg to be capable of independently inflicting unacceptable damage against an attacker. The triad would compel deterrence because each leg's unique characteristics made it difficult, if not impossible, for an enemy to develop a means to conduct a disarming first strike and, in turn, gave the United States a diverse array of weapons to carry out a devastating response. In this way, faced with the triad, an adversary had no incentive to launch a strike; therefore, the triad ensured deterrence.

Figure one provides an overview of the evolution of the number and type of delivery vehicles within the US nuclear triad. These include Air Force medium and heavy bombers, and Atlas, Titan I and II, Minutemen (MM) I, II, and III, and MX Peacekeeper ICBMs, and Navy Polaris, Poseidon, and Trident I and II SLBMs. From World War II until the late 1950s, the country relied on a mix of medium and heavy bombers to support deterrence. At their peak in the late 1950s, the Air Force fielded roughly 1,700 nuclear-capable bombers, split between medium types (e.g., B-47 Stratojet) and heavy variants (e.g., B-36 Peacemaker, B-52 Stratofortress).[5]

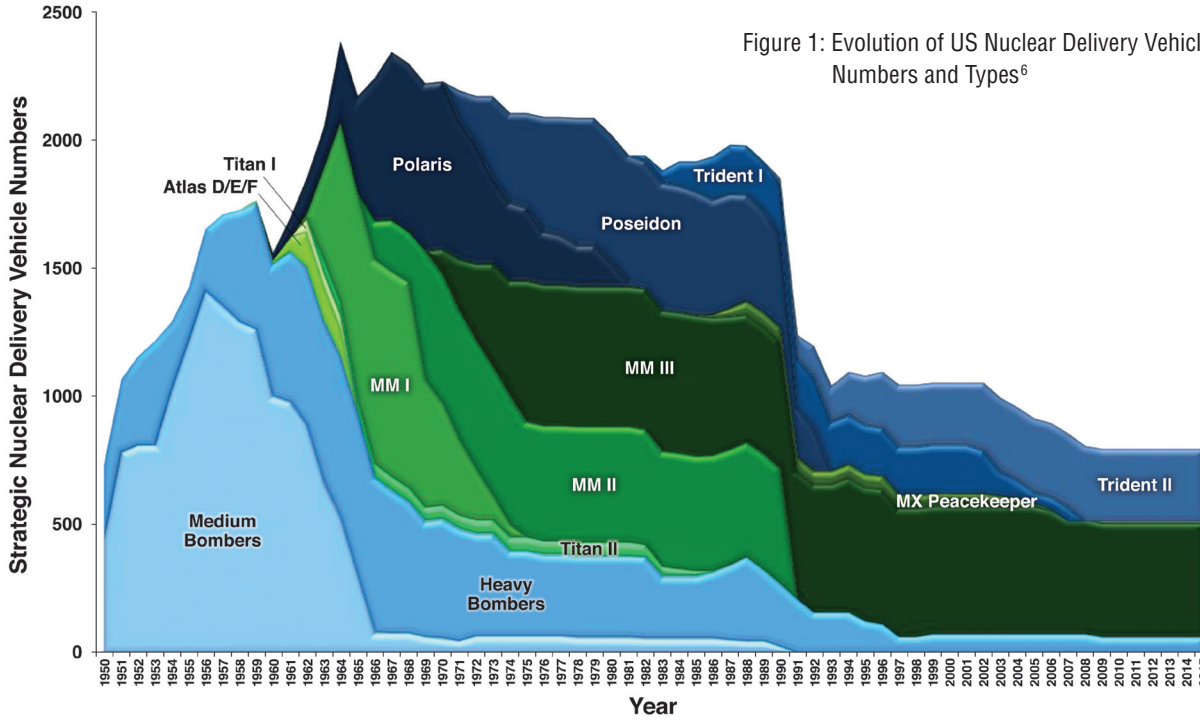

Figure 1: Evolution of US Nuclear Delivery Vehicle Numbers and Types[6]

The second leg of the triad came into being when the first liquid-fueled Atlas ICBMs became operational at Vandenberg Air Force Base in California in the fall of 1959.[7] Shortly thereafter, more ICBM sites opened across the country, and the Titan I and II missiles soon replaced the original Atlas. In turn, the solid-fueled Minuteman I, II, and III missiles followed the Titans. Since ICBM operating costs were much lower than those of manned aircraft, ICBM development enabled the Air Force to greatly reduce its medium bomber force and save money. In this respect, it was perhaps the first time that an unmanned system replaced, or significantly augmented, a manned aircraft in the Air Force.

Notably, the American ICBM inventory did not meaningfully decrease as the Cold War progressed. Instead, the Air Force still maintained roughly 1,000 ICBMs through 1991, when the Soviet Union collapsed.

The Minuteman III, which became operational in 1970, was the world's first missile to carry more than one warhead (in its case, up to three), a capability known as multiple independently targetable reentry vehicles (MIRVs). They enabled a single missile to strike multiple targets.[8] From the mid-1980s until the early 2000s, the Air Force also fielded 50 MX Peacekeepers, each of which could carry 10 MIRVs.[9] The total number of ICBMs peaked at 1,054 from 1967 to 1981.[10] Since each Minuteman III and Peacekeeper had a MIRV capability, the total number of deployed warheads exceeded the amount of missiles. Notably, the American ICBM inventory did not meaningfully decrease as the Cold War progressed. Instead, the Air Force still maintained roughly 1,000 ICBMs through 1991, when the Soviet Union collapsed.[11]

The commissioning of the USS *George Washington*, the world's first operational ballistic missile submarine, or SSBN (a hull classification acronym that denotes a nuclear submarine capable of carrying ballistic missiles), armed with 16 Polaris SLBMs, added the third leg of the triad in late 1959.[12] Over time, the Navy would replace the Polaris with the Poseidon SLBM, and then developed the more capable Trident I and II missiles. As with ICBMs, each class of SLBM featured greater range, payload, and accuracy. SLBMs also featured MIRV capability beginning with the Poseidon, which could carry up to 14 warheads.[13]

During the Cold War, the Navy completed five classes of ballistic missile submarines.[14] At their peak, between 1967 and 1979, the service fielded 41 SSBNs.[15] Each of these submarines carried 16 SLBM launchers, for a total of 656 launchers across the fleet.[16] By 1991, when the Soviet Union fell, the Navy still maintained 34 SSBNs, a mixture of older classes carrying 16 launchers and some newer Ohio-class vessels, which had 24 launchers.[17] Today, the Ohio-class SSBNs carry only 20 nuclear-armed missiles. The scheduled replacement, the Columbia-class submarine, is slated to carry 16 missiles.

Figure two examines the evolution of warhead numbers compared to launcher numbers from 1961 through the end of the Cold War. Warhead numbers rose steadily during the 1960s, increased sharply in the early 1970s, and, after a brief pause, shot up again in the early 1980s. The total number of warheads peaked at approximately 13,600 in 1987 and stood at slightly more than 12,300 in 1990, as the Cold War entered its final year.[18] The sudden increase in the early 1970s reflects the introduction of "MIRVed" Minuteman III and Poseidon missiles, while the abrupt rise in the early 1980s is due to the introduction of MIRVed Peacekeepers.

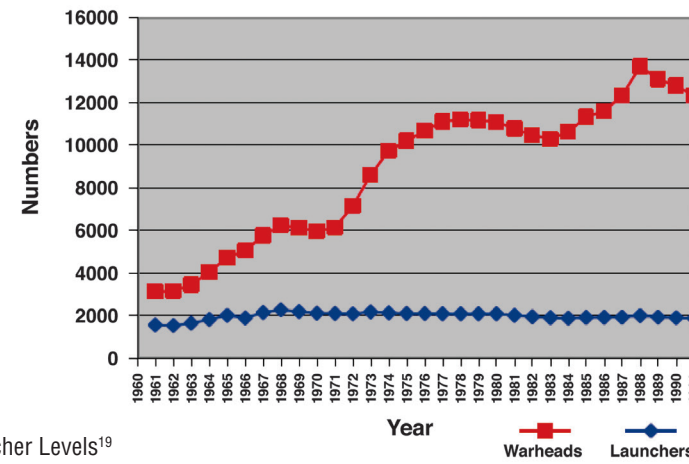

Figure 2: Evolution of US Nuclear Warhead and Launcher Levels[19]

This massive US nuclear buildup—which the Soviets matched and in many areas exceeded—catalyzed efforts by both superpowers to set limits on the growth of their deployed strategic nuclear weapons. Beginning with the 1972 Strategic Arms Limitations Talks (SALT I), negotiations over deployed nuclear weapons became a key aspect of US-Soviet relations. By the late 1970s, the process also highlighted the growing imbalance between Soviet capabilities to expand their arsenals with MIRV-capable land-based missiles. This, in turn, led to proposals to cut nuclear arsenals rather than control their growth.

While a complete history of arms control accords is beyond the scope of this study, some of the most consequential agreements included: SALT I and II in 1972 and 1979, respectively; the Anti-Ballistic Missile (ABM) Treaty in 1972; the Intermediate-Range Nuclear Forces (INF) Treaty in 1987; and the Strategic Arms Reduction Treaty (START) in 1991.

In 1991, the United States possessed roughly 9,300 warheads on 1,239 launchers, but by 2009 held just 2,200 warheads on about 850 launchers. By 2016, the United States held 1,350 warheads on around 700 launchers.

Given the nearly 50 percent reduction in deployed strategic nuclear weapons with START and with the INF treaty, which eliminated upwards of 2,600 short- and intermediate- range nuclear missiles, the subsequent collapse of the Soviet Union at the end of 1991 led many observers to believe that the world was about to enter into a period of unparalleled nuclear disarmament. Some even hoped for a completely nuclear-free planet. Momentum continued behind arms control efforts, but the pace was slow and at times haphazard, leading many to question the superpowers' commitment to disarmament. Furthermore, continued nuclear progress by states like India, Pakistan, and North Korea raised questions about the viability of the global nonproliferation regime more generally.

Even so, the United States and Russia undertook efforts to shrink their nuclear arsenals. The momentum of START stopped in 2000 when the Russian parliament turned down the START II treaty, which would have reduced nuclear weapons by an additional 40 percent from START levels. But in the next decade, strategic nuclear arms control began again. The 2002 Moscow Treaty, cutting warhead levels to 2,200 for the United States and for Russia, was followed by the 2010 New START agreement, which reduced deployed warhead levels to 1,550 for each party—a 75 percent reduction cumulatively since START I.

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As noted above, in 2010, President Barack Obama signed a major new arms control agreement, known as New START, with his then-counterpart, Russian President Dmitri Medvedev. The treaty established three

upper limits on strategic nuclear forces.[21] First, it permits each country to keep no more than 800 deployed and non-deployed ICBMs, SLBMs, and nuclear-capable bombers. Second, within that total, it allows each side to maintain no more than 700 deployed ICBMs, SLBMs, and nuclear-capable bombers. Third, it limits each nation to no more than 1,550 total deployed warheads on those various delivery vehicles (each bomber counts as having a single warhead). Each government may choose the mix of forces as long as it stays within the treaty's constraints.

As shown in Figure three, to meet the February 5, 2018, New START deadline for these requirements, the United States plans to enact the following changes to its nuclear force structure:

- Reduce the number of Minuteman III launchers to 454. Of these, the Air Force will convert 50 launchers (i.e., silos) to non-deployed status by removing the missiles from the silos; it will also maintain four other silos in non-deployed status for use as launchers in Minuteman III tests. This will leave 400 deployed Minuteman III missiles in their launchers with 400 warheads to match. In 2014, the Air Force completed the process to "de-MIRV" the Minuteman III inventory.[22] A heavily MIRVed missile force is widely seen as destabilizing because it can provide a potential first strike advantage.

- Reduce the number of Trident II SLBMs to 280, spread across 14 SSBNs, each of which will utilize 20 launchers. As two of these submarines are always in port for maintenance at any one time, this leaves 12 deployed SSBNs with 240 SLBM launchers. Unlike the Air Force, the Navy has kept MIRV capability on its SLBMs, so its 240 SLBM launchers will be able to carry upwards of 1,090 total warheads under New START limits.

- Reduce the number of B-2A Spirit and B-52H aircraft to 66. Given that the Air Force will not deploy six of these platforms at any given time, this will result in 60 deployed strategic bombers (18 B-2s and 42 B-52s), each of which counts as having one warhead under New START's rules. Bombers are viewed as stabilizing forces because of their slow flight times. Thus, if both Russia and the United States sought to bring greater stability to the nuclear balance, they could significantly increase bomber force levels even as they decreased ballistic missile deployments.

	Total Launchers	Deployed Launchers	Total Warheads
Minuteman III ICBMs	454	400	400
Trident II SLBMs	280	240	1,090
B-2 Bombers	20	18	18
B-52 Bombers	46	42	42
Total	800	700	1,550

Figure 3:
US Nuclear Force Structure
Under The New START Treaty[23]

III. The Current Global Security Environment

As a result of the reductions described in the previous section, the American and Russian strategic nuclear arsenals will be dramatically smaller by the beginning of 2018 than they were at the height of the Cold War. However, even a cursory look at the deteriorating global security landscape illustrates that nuclear weapons and all forms of deterrence will continue to play a crucial role in underwriting US national security in the coming decades.

Return to Great Power Competition:

In January 2016, the Chief of Naval Operations, Adm John M. Richardson, wrote that for "the first time in 25 years, the United States is facing a return to great power competition. Russia and China both have advanced their military capabilities to act as global powers. Their goals are backed by a growing arsenal of high-end warfighting capabilities, many of which are focused specifically on our vulnerabilities."[24] Similar statements have come from a long list of senior civilian defense officials and uniformed military officers, including: Defense Secretary Ashton B. Carter; Deputy Defense Secretary Robert O. Work; Air Force Secretary Deborah Lee James; Chairman of the Joint Chiefs of Staff Marine Corps Gen Joseph F. Dunford Jr.; Army Chief of Staff Gen Mark A. Milley; Navy Adm Cecil D, Haney, former head of US Strategic Command (STRATCOM); Navy Adm Harry B. Harris Jr., head of US Pacific Command; and Gen Philip M. Breedlove, USAF (Ret.), former head of US European Command.[25] In recognition of this widespread assessment, Pentagon officials designed the Fiscal Year 2017 defense budget to respond specifically to renewed great power competition with Russia and China.[26]

The Russian intervention in Ukraine and annexation of Crimea in 2014 are the clearest expressions of Russia's renewed belligerence; however, these military moves are merely the most obvious in a long list of provocations that flout global norms, stretching back to the 2008 invasion of Georgia. Other recent Russian actions raising great power strains include: extensive military modernization; deepening defense cooperation with rogue states like Iran; dramatically increased incursions into European waters and airspace; scores of provocative flights near US military ships and jets operating in international territory; and, most recently, the violent and destabilizing intervention in Syria to support the Syrian dictatorship of President Bashar Bashar al-Assad.[27] Of course, added to this long list are the actions of Russian officials, including President Vladimir Putin himself, whose anti-American rhetoric, scaremongering, and scapegoating have been strident enough to amplify tensions on their own.[28]

China has also done more than its fair share to raise frictions. Broadly, its actions have belied its claim to a so-called "peaceful rise." To begin, its aggressive land reclamation and island building in the South China Sea threaten freedom of navigation and pose a major threat to nearby states, including many US allies. Although China denies that it is militarizing the strategic waters, its deployment of fighter jets, air defenses, advanced radar, and other strategic assets contradicts this claim.[29] Moreover, its massive internal military modernization program, largely shrouded in secrecy, raises major concerns about its future intentions.[30] China's continued external support for rogue states like North Korea—a country which continues to be a

serial nuclear weapons technology proliferator—as well as the active promotion of anti-Western propaganda domestically, have also contributed to a steady intensification of great power tensions.[31]

Together, the advent of great power competition with Russia and China places a renewed importance on US nuclear strategy and capabilities to deter these nuclear-armed adversaries that seek to challenge both the United States specifically and global norms more generally. Moscow's bold resurgence and Beijing's increasing assertiveness demonstrate that these are not status quo powers, but rather revisionist states determined to alter the international order to their liking. Deterring their ambitions requires Washington to invest in nuclear modernization. Without a robust and credible arsenal, the United States foregoes a key part of its leverage against these competitors, whose self-confidence only continues to grow, as they perceive American power to be waning.

Emergence of Regional Challengers:

The United States also faces a variety of regional challengers, most notably Iran and North Korea. Although these states cannot compete with Washington on the scale of Russia and China, they still pose immense challenges to regional stability and American interests. In fact, in addition to addressing the return to great power competition with Moscow and Beijing, Pentagon officials deliberately crafted the Fiscal Year 2017 defense budget to confront threatening regional challenges from Tehran and Pyongyang.[32]

For its part, Iran remains a destabilizing force in the Middle East. Despite Iran signing the Joint Comprehensive Plan of Action—the nuclear accord with Britain, China, France, Germany, Russia, the United States, and the European Union—in July 2015, it is far from clear that Tehran's nuclear ambitions are satiated. Worryingly, its history of nuclear deception and continued, provocative testing of ballistic missiles raises major questions over its long-term commitment to nuclear limits.[33] Moreover, the relaxation of global sanctions since the nuclear deal has allowed Iran to begin upgrading its military capabilities; already, it has acquired an advanced Russian air defense system to protect its airspace and has indicated plans to modernize other capabilities.[34] It also remains the largest state sponsor of terrorism, including support to insurgent groups in places like Syria and Yemen, and it continues to make incendiary threats to close the Strait of Hormuz and attack the United States, its overseas assets, and its allies.[35]

As for North Korea, the brutal police state has grown even more defiant. Since the start of 2016, it has, among other actions, carried out a fourth nuclear test, launched multiple volleys of ballistic missiles in tests, and made advances in warhead miniaturization, reentry vehicle (RV) technology, and rocket engines. In short, these are the steps needed to achieve its stated goal of attacking the United States and its allies.[36] Other actions, including aggressive money laundering and cyberattacks, raise further concerns.[37] In fact, its constant saber-rattling and ever-more-belligerent rhetoric make North Korea, according to Defense Secretary Carter, the one country against which the United States could find itself in a ground war overnight.[38]

In sum, just as a strong American nuclear deterrent is necessary against great power competitors like China and Russia, these capabilities are vital to confront the challenges posed by regional aggressors like Iran and

North Korea. In fact, given North Korea's continued quest to increase its existing nuclear capabilities, as well as Iran's latent ability—and desire—to acquire the bomb, a robust American arsenal is particularly important to deter these incipient nuclear states from mistakenly thinking they could challenge the United States and its allies. Without a reinvigorated triad, the United States will have far fewer options and influence over these regional antagonists.

Ongoing Nuclear Modernization Programs in Other Countries:

While the United States maintains a nuclear infrastructure that it acquired in the 1980s, its competitors are in the midst of extensive upgrades to, and complete recapitalization of, their arsenals. A broad survey of the most notable developments in other nations demonstrates a clear need to modernize American nuclear forces to keep pace with US adversaries. Without doing so, the United States will see its nuclear edge erode to the point that its deterrent forces will be less credible than required.

Russia: Russia's modernization is the most significant and most concerning. As Admiral Haney commented in March 2016, "Russia poses an existential threat to the [United States] by virtue of the size of its nuclear arsenal, which it continues to modernize."[39] Even as Russia appears set to meet its New START commitments, the United States charged the country with violating its INF treaty obligations in 2014, a dispute that threatens the future of the agreement. In addition, Russia's pace of nuclear reductions has slowed and its ambitious modernization plan, underway for many years, "will present the international arms control community with new challenges," wrote analysts Hans M. Kristensen and Robert S. Norris in April 2016 in the *Bulletin of the Atomic Scientists*.[40] Overall, Russia will soon field systems that are at parity with, and in many cases superior to, American nuclear forces.

Russia's nuclear modernization is most evident in its ICBM force. Observers estimate that the complete replacement of Soviet-era ICBMs is already halfway done and Russia will finish this task by 2022, years before the expected US Minuteman III replacement enters service.[41] Notably, while the United States has de-MIRVed all of its ICBMs, Russia has taken the opposite, destabilizing approach of adding MIRVs to a variety of its new missiles.[42] They include the world's largest ICBM, which is in development and which the Russian strategic missile force commander boasted Russia specifically designed to penetrate US missile defenses.[43] They also include new silo-based and road-mobile missiles that Russia already is deploying.[44] Finally, the United States continues to accuse Russia of violating the INF treaty as recently as the fall of 2015, thus seriously calling into question the Russian government's commitment to existing arms control limits.[45]

Simultaneously, Russia is improving its nuclear bombers by upgrading its existing heavy bombers and restarting production on at least one variant.[46] It is also developing a new stealth bomber that could carry not only nuclear missiles—of which Russia is developing a modernized version—but also reportedly next-generation hypersonic missiles.[47] These weapons fly at high speeds and can maneuver in flight to avoid defenses. While the United States has declared its hypersonic program to be for conventional weapons only, Russia reportedly intends to field hypersonic missiles with a nuclear capability.[48] Further, while US versions are still in early development, Russia is set to begin production in 2018.[49]

Concurrently, Russia is also modernizing its submarine fleet. The nation has already improved its SSBNs by deploying an upgraded version of its existing SLBMs and is in the process of fielding an entirely new, even-more-advanced SLBM.[50] This new MIRVed missile will increase the warhead capacity by more than 50 percent.[51] Finally, Russia is also recapitalizing the submarines themselves. To date, three new SSBNs are in service, with another five in various stages of production, all of which will carry the newest SLBM.[52]

China: China is fast becoming a major new nuclear power. While the United States is decreasing its nuclear stockpile, China has actually expanded its arsenal in recent years, raising questions about its future intentions.[53] In addition, as the Pentagon recently assessed, China has also prioritized upgrades of existing nuclear systems and appears to be taking steps towards developing a triad of delivery platforms, meaning it could soon join Russia and the United States as the only states with that capability.[54]

As with Russia, China's most aggressive modernization has been in its ICBM force. While its inventory is small, DOD has said China continues "to modernize its nuclear forces by enhancing its silo-based intercontinental ballistic missiles and adding more survivable, mobile delivery systems."[55] This ambitious program includes the deployment of a powerful new, potentially MIRVed, silo-based ICBM, and the development of a road-mobile ICBM with MIRVs is confirmed.[56] China recently conducted a test of this new mobile missile, its first to be capable of striking the entire US mainland.[57] Worryingly, China can hide such mobile missiles in the country's extensive underground tunnel network.[58] In addition, like Russia, China is also building advanced hypersonic missiles that could one day carry nuclear warheads.[59]

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Simultaneously, China is modernizing its nuclear submarines. According to the Pentagon, China "places a high priority on the modernization of its submarine force," which contains four operational SSBNs, with a fifth under construction.[60] These assets, which will carry an advanced new SLBM, will give China "its first credible long-range sea-based nuclear capability."[61] China is also building a new class of submarines, which will eventually host an even more sophisticated SLBM.[62] Although there is disagreement over whether China's current SLBMs can carry multiple warheads, there is widespread suspicion that its most advanced SLBM will be MIRVed.[63] In the summer of 2016, China also signaled that it would soon send an SSBN to sea on an operational patrol with live nuclear missiles, a demonstration of its growing nuclear prowess and confidence.[64]

Finally, China is taking steps to develop an airborne delivery system. While it does not have a specifically designated nuclear bomber, it continues to produce and upgrade its existing bombers, some of which serve the nuclear mission.[65] Many reports suggest that China plans to build a long-range "strategic" stealth bomber, which would portend a future nuclear capability.[66] Even if the development of a full nuclear

bomber is years away, China is already converting one of its bombers to carry new cruise missiles, which gives its military "a long-range standoff offensive air capability with precision-guided munitions capable of striking Guam," the site of important regional US military bases.[67]

North Korea: Since the beginning of 2016, North Korea has carried out significant nuclear activity, reminding the world that, while its arsenal is relatively small, its ambitions are large, and it continues to invest in its nuclear capabilities. As DOD judged even before North Korea's latest nuclear provocations, the country "remains one of the most critical security challenges for the United States and the broader international community"; specifically, its "continued pursuit of nuclear technology and capabilities and development of intermediate- and long-range ballistic missile programs underscore the growing threat it poses to regional stability and US national security."[68]

Since the start of 2016, North Korea has carried out its fourth, most advanced nuclear test; furthered its ICBM program through a long-range missile test in the guise of a satellite launch; made major progress in RV technology needed for a warhead to survive breaching the earth's atmosphere; reportedly acquired the ability to use solid fuel, rather than liquid fuel, in its rocket engines, thereby greatly reducing the time needed to prepare for a missile launch and increasing ground mobility; conducted a number of SLBM tests, further diversifying its missile force; and, as South Korea confirmed, acquired the miniaturization capability to mount a nuclear warhead on a medium-range missile.[69]

While the 2015 nuclear deal seems to have temporarily slowed Iran's nuclear program, it retains a strong nuclear industrial capability and has continued, if not grown, its pace of ballistic missile development...

Even if some of these tests were less successful than North Korea's typical boasting suggests, the missile test program is producing results and it represents a dangerous acceleration of the country's nuclear prowess. Added to these destabilizing moves is DOD's assessment that North Korea is upping its uranium enrichment, allowing it to produce more weapons. This is coupled with what DOD calls "an ambitious ballistic missile development program."[70] The Pentagon notes that "North Korea is committed to developing a long-range, nuclear-armed missile that is capable of posing a direct threat to the United States," and judges that the country is capable of fielding a powerful new road-mobile ICBM.[71] Even before the flurry of activity in 2016, now-retired Navy Adm William Gortney stated in April 2015 when he led US Northern Command that he operated under the assumption that North Korea was capable of attaching a nuclear warhead to a mobile ICBM that could hit the United States.[72]

Iran: While the 2015 nuclear deal seems to have temporarily slowed Iran's nuclear program, it retains a strong nuclear industrial capability and has continued, if not grown, its pace of ballistic missile development, including work on more-accurate warhead delivery. As Admiral Haney stated in a January 2016 speech when he was STRATCOM chief, "Even with the Joint Comprehensive Plan of Action, we must remain vigilant of any shift of the Iranian actions regarding nuclear weapon ambitions and their ballistic missile programs."[73]

Notably, as former Secretaries of State Henry A. Kissinger and George P. Shultz have written, the nuclear deal simply means that, "for 10 years, Iran will never be further than one year from a nuclear weapon and, after a decade, will be significantly closer."[74] Even if Iran adheres to the pact—an open question given its history of nuclear obfuscation and deceit—it retains robust nuclear industrial capabilities that it could restart at any time. Indeed, while debate over the accord involved heated rhetoric from all sides, some media observers like the *Washington Post* editorial board noted that, "In effect, Iran's nuclear infrastructure will remain intact, though some of it will be mothballed for 10 years. When the accord lapses, the Islamic Republic will instantly become a threshold nuclear state."[75] As Director of National Intelligence James R. Clapper testified to Congress in February 2016:

> *Iran probably views the Joint Comprehensive Plan of Action … as a means to remove sanctions while preserving some of its nuclear capabilities, as well as the option to eventually expand its nuclear infrastructure. … We also continue to assess that Iran does not face any insurmountable technical barriers to producing a nuclear weapon, making Iran's political will the central issue.*[76]

In short, Iran has the ability to join the nuclear weapons club on short notice, aided by its increasing ballistic missile capabilities. According to Clapper:

> *We judge that Tehran would choose ballistic missiles as its preferred method of delivering nuclear weapons, if it builds them. Iran's ballistic missiles are inherently capable of delivering WMD [weapons of mass destruction], and Tehran already has the largest inventory of ballistic missiles in the Middle East. Iran's progress on space launch vehicles, along with its desire to deter the United States and its allies, provides Tehran with the means and motivation to develop longer range missiles, including ICBMs.*[77]

Iran's recent actions conform to Clapper's assessment. In March 2016, it test-fired a series of ballistic missiles, including some marked with the statement "Israel must be wiped off the Earth." The Iranians launched them as Vice President Joseph R. Biden Jr. visited Jerusalem.[78] Iran's repeated missile advances suggest a clear trajectory; in fact, Defense Secretary Carter in mid-2015 stated, "I wouldn't rule out that in 10 years, Iran could progress to an ICBM."[79] Given that Iran's leaders have ordered the intensification of the country's missile program, it could come even sooner.[80]

Other Countries: While these four states constitute the greatest nuclear threats, a brief summary of other nations' nuclear development efforts illustrates the increasing pace of nuclear modernization efforts around the globe.

Most notably, in South Asia, fierce rivals Pakistan and India are engaged in major modernization programs. Like China, both have increased their weapons total in recent years by boosting their uranium and plutonium enrichment.[81] More specifically, to add to its six operational variants, Islamabad is developing at least two more nuclear-capable ballistic missiles—although it does not yet possess an ICBM—as well as two new cruise missiles.[82] Pakistan is also adding an aerial refueling capability to support its nuclear-capable fighters, which would boost their range for strike missions.[83] For its part, to add to its four operational

variants, New Delhi is developing at least two new types of long-range ICBMs and reportedly working on a nuclear-capable cruise missile.[84] In addition, India is upgrading its existing fighter-bombers and searching for a new model to recapitalize the fleet. It has also made impressive strides to field a nuclear submarine and has developed at least two types of SLBMs.[85] In fact, India's first SSBN began sea trials in April 2016; the country has plans to acquire between three and six of them in total.[86]

Elsewhere, US allies are also modernizing. Britain has committed to recapitalizing its nuclear submarine fleet, the only delivery platform is operates, by building four new SSBNs based on the US Navy Ohio-class replacement.[87] Meanwhile, France, which maintains both sea- and air-based delivery systems, is updating both. Of particular note, France is upgrading its SSBNs to carry improved SLBMs, replacing its entire fighter-bomber fleet with new jets that will carry upgraded cruise missiles, and studying plans for next-generation ballistic and cruise missiles.[88] Even Israel, widely acknowledged to have weapons despite its lack of confirmation, seems to be upgrading its systems. It appears to be developing a new ballistic missile that analysts have called a dramatic leap in its missile capabilities, and some analysts believe it has developed an SLBM.[89] Beyond that, rumors abound that its version of the F-35 Lightning II may be nuclear-capable.[90]

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Finally, there are multiple threshold nuclear states, as well as others that could begin crash development programs at any time. In terms of the former, aside from many North Atlantic Treaty Organization (NATO) states, the most obvious cases include the East Asian nations of South Korea and Japan, as well as, some argue, Taiwan, which are widely recognized as having the capabilities to develop a bomb on short order if so desired.[91] As for the latter group, Middle Eastern states including Egypt, Jordan, Saudi Arabia, Turkey, and the United Arab Emirates have all started down the road to developing civilian nuclear power; many experts warn that, given sufficient motivation and resources, some of them could easily transition to building a nuclear bomb.[92]

Although these states may never decide to acquire the bomb, their latent ability to do so is a stark reminder of the complexity of the global security landscape and the enduring need for a strong nuclear deterrent. As the 2010 NPR noted, "US nuclear weapons have played an essential role in extending deterrence to US allies and partners against nuclear attacks or nuclear-backed coercion by states in their region that possess or are seeking nuclear weapons," thus helping to prevent indigenous weapons development in many countries.[93] In this way, US nuclear modernization is necessary not only to deter adversaries, but also to reassure allies that they do not need their own nuclear forces. If allies do not trust the credibility of the aging US nuclear deterrent, especially when compared to other countries' modernization plans, they could decide to join the nuclear weapons club on their own, thereby unleashing a highly destabilizing cascade of nuclear proliferation.

Increasing Reliance on Nuclear Weapons in National Strategy:

Not only are other nuclear states modernizing their arsenals, they are also increasing the role that their nuclear weapons play in their strategic planning. A survey of other countries' nuclear strategies reveals a major discrepancy between their aggressive actions—especially the procurement and deployment of new nuclear systems—and the relative restraint that the United States and its allies exercise. This incongruity raises questions about the American ability to deter threats and assure allies going forward in the 21st century.

Russia: Again, Russia tops the list of threats. As Defense Secretary Carter told Congress in April 2016, the Kremlin's "nuclear saber-rattling raises serious questions about Russia's leaders' commitment to strategic stability, their respect for norms against the use of nuclear weapons, and whether they respect the profound caution that nuclear-age leaders showed with regard to brandishing nuclear weapons."[94]

Given President Putin's determination to remake Russia into a great power, and his clear belief that nuclear weapons are critical to this goal, it is unsurprising that he has prioritized them in political and military strategy.[95] Among other recent moves, Russia has held extensive nuclear exercises; forward-deployed nuclear-capable missiles; conducted mock attacks against the United States and its allies; violated multiple states' territory using nuclear-capable aircraft and ships; and threatened others with nuclear coercion.[96]

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At the same time, Russia has placed nuclear weapons at the center of its military strategy through its "escalate to de-escalate" concept. This calls for employing tactical, smaller yield nuclear weapons to raise the stakes of further conflict to such a level that an adversary would have to back down.[97] This logic reveals that Russia has shifted away from its stated "no-first-use" (NFU) position.[98] Further, it contradicts Russia's formal policy to employ nuclear weapons only if state survival is in question. In fact, noted Elbridge Colby, senior fellow at the Center for a New American Security (CNAS) in Washington, D.C.:

> *[M]any experts believe that Russia's actual nuclear doctrine … provides for a more elastic understanding of how such a doctrine could be applied, and recent rhetoric by Russian leaders, including President Putin himself, suggests such a broader gambit for the doctrine may have considerable purchase at the highest levels of the Russian government. Perhaps more to the point, Russian policy on the subject is vague, and any statements on the subject, especially by a government clearly not wedded to a strict policy of avoiding dissimulation and even outright falsehood, cannot be accepted at face value.*[99]

These concerns are not merely theoretical, but have major real-world implications. After all, as Colby commented, Putin and other Russian leaders "have been strongly suggesting—if not loudly stating—Russia's willingness to introduce nuclear weapons into a conflict with NATO."[100] Russian nuclear threats

have soared in recent years. To demonstrate how commonplace they have become, consider that the Russian ambassador to Denmark in 2015 threatened to target Danish ships with nuclear weapons if the country took the mere step of supporting a European missile defense shield.[101]

China: China's nuclear doctrine has also begun to evolve in unsettling ways. First, its rhetorical commitment to a NFU policy has been met with increasing skepticism. In 2013, the country released a defense white paper that notably omitted its historic, explicit NFU promise; that omission, combined with a speech by Xi Jinping, China's then-recently elected president, in which he signaled a major rhetorical shift in describing the role and value of nuclear weapons, created significant concerns over China's nuclear doctrine.[102]

To be sure, China's 2015 defense white paper update once again included a formal NFU pledge, but, according to the Pentagon, there remained "ambiguity over the conditions under which China's NFU policy would apply."[103] Security studies scholars Keir A. Lieber of Georgetown University and Daryl G. Press of Dartmouth College confirmed this perception in a 2013 report. In it, they noted that several US government officials with knowledge of China and its nuclear doctrine said the following at a 2012 security conference in Washington, D.C.:

> *China's 'no-first-use' pledges should not be interpreted literally. … [D]iscussions with official Chinese delegates about these issues reinforced the impression that China's actual nuclear policy is more nuanced than 'no first use,' and that China's representatives indicated that a range of non-nuclear US military actions might trigger Chinese nuclear response.*[104]

For instance, observers often suggest that China, in a strategy reminiscent of Russia's "escalate to de-escalate," could threaten nuclear strikes to deter or stop US support for Taiwan during a crisis.[105] Such a concern is not just theoretical; multiple senior Chinese leaders have raised this exact scenario, including the former ambassador to the United Nations, who as far back as two decades ago stated, "As far as Taiwan is concerned, it is a province of China, not a state. So, the policy of no first use does not apply."[106] While government officials later walked back this comment, the fact that a senior representative felt comfortable saying it at all is concerning, not to mention that similar comments have been made since then.[107] Even if one takes such remarks out of context and later dismisses them, they appear to represent the thinking of at least a part of the Chinese leadership.[108]

The disturbing implication, therefore, is that China's deliberate ambiguity over its NFU policy has served a similar strategic end to Russia's more explicit nuclear saber-rattling. Scholars Fiona S. Cunningham and M. Taylor Fravel noted in a December 2015 policy brief from the Belfer Center for Science and International Affairs at Harvard University that:

> *China is allowing limited ambiguity over the application of its no-first-use policy. Debate among Chinese strategists over the definition of 'first use' has created uncertainty over how China would respond to attacks with conventional weapons on its nuclear forces and infrastructure. The main purpose of such limited ambiguity is to deter the United States from conducting such conventional counterforce attacks.*[109]

Such ambiguity, however, could easily backfire by leading to miscommunication and misunderstanding, thereby in reality raising the chances of nuclear escalation.

North Korea: No state has placed nuclear weapons more at the heart of its national strategy than North Korea. According to the Pentagon, the country's "military-first" approach, which puts the armed forces at the center of the decision-making process, "bolsters the centrality of nuclear weapons to the regime's survival."[110] Specifically, North Korea's leadership sees nuclear weapons—and ballistic missiles—"as necessary for a credible deterrent capability essential to its survival, sovereignty, and relevance, and supportive of its coercive military threats."[111] In short, nuclear capabilities underpin the state's rule.

As with Russia, North Korea loudly trumpets its nuclear weapons capability to exhibit the prime place it receives in its strategic planning. Most obviously, the rogue state routinely issues nuclear threats against the United States and its allies.[112] While they used to treat these threats as mere bluster, the stunning pace of North Korea's recent nuclear and missile developments has made analysts pay much more attention. The North Korean activity has raised fears that the country's erratic leader, Kim Jong Un, could soon be able to actually follow through on his threats, which could likely involve aggression against South Korea and the use of North Korea's nuclear capability to deter a US response.[113]

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In fact, in a potential conflict, North Korea's leadership would have little to lose and every reason to try to prevent its collapse at all costs. According to CNAS's Colby, the country's conventional military inferiority could easily "incentivize Pyongyang to reach earlier and more brazenly for its nuclear arsenal to ward off US conventional might and even to attempt to blackmail the United States and its allies into backing off in the event of war."[114] Put in even starker terms, argued Lieber and Press, if conflict broke out, the North Korean leadership would have "powerful reasons to use nuclear weapons coercively, rather than permit its enemies to prevail in a war."[115]

Iran: Even though it does not possess nuclear weapons, Iran seems to have prioritized its ability to acquire them on short order, if desired. As noted previously, the 2015 nuclear accord allows Iran to maintain its nuclear infrastructure, effectively giving it a future breakout option that analysis indicates could require as little as a few months. To this end, Iran's national policy appears to be one of "nuclear hedging," that is, "retain[ing] a low level of latency and the ability to acquire nuclear weapons relatively quickly should it decide to do so," according to a 2015 report by security studies scholars Wyn Bowen and Matthew Moran of King's College London.[116] As such, Iran has kept the pathway to a bomb open by conducting extensive missile tests and retaining the industrial capability to produce nuclear weapons, all while being able to claim that it is notionally adhering to the terms of the nuclear deal.[117] In these respects, Iran clearly continues to prioritize its nuclear program, even as it supposedly keeps its work under the official weapons threshold.

If Iran one day acquires the bomb, it would undoubtedly form the basis of its military strategy—and Iran could very well use it. In a hypothetical standoff with superior US conventional forces, Iranian officials could feel incentivized to threaten or actually use a nuclear weapon to coerce an end to the confrontation.[118] As Lieber and Press argued, in such a scenario, "Nuclear escalation—directed against US facilities in the region, or the facilities or cities of US regional allies—would be one of Iran's main options."[119] In this respect, Iranian incentives for nuclear escalation mirror those of North Korea. Furthermore, Tehran's provocative threats often match those emanating from Pyongyang, suggesting that Iran's radical leadership is also risk-acceptant.[120] Even if Iran's leaders are rational and do not seek nuclear war, their continued saber-rattling and acute feelings of insecurity reinforce fears that they could fall prey to "use it or lose it" pressures, common in the first few years after acquiring the bomb, leading them to engage in destabilizing actions and rhetoric that could catalyze actual nuclear use.[121]

India and Pakistan: The South Asian arch-rivals again emerge as major concerns due to their increasing reliance on nuclear weapons in strategic planning. On the Indian side, anxieties first arise from India's wavering NFU commitment; while it issued an NFU policy after its 1998 nuclear tests, it has relaxed it multiple times, including by warning that it could use nuclear arms to respond to a "major attack" with unconventional weapons like chemicals or biologics.[122] To this end, there are serious concerns over how India would respond to another large Pakistani-backed terrorist attack, such as the 2008 Mumbai assault, especially if the militants used unconventional weapons.[123] Back then, only through intense US pressure and extreme Indian restraint was a retaliatory strike averted; now, however, India's more nationalist government is more predisposed to action, particularly since Indian public opinion would demand retribution.[124] Any type of forceful reprisal, even one with conventional arms, could easily spiral into nuclear escalation, given the historic distrust and the lack of direct communication between the two sides.

Nuclear weapons are also at the heart of India's state-based strategy, which is built on "massive retaliation" involving nuclear attacks on Pakistani population centers. By definition, this would be "a war with unlimited means for unlimited ends," noted analyst Shashank Joshi.[125] To be sure, there is debate over whether this is a prudent—or even credible—policy, and whether India should introduce more "ambiguity" or "flexibility" into its doctrine.[126] However, rather than easing tensions, doing so could easily raise them by making India's position less clear, thus causing Pakistani misunderstanding and miscalculation.

Although concerns about India's reliance on nuclear weapons are alarming on their own, they do not come close to the main regional threat, which emanates from Pakistan, as noted by Oliver Thränert of the Center for Security Studies in Zurich:

> *The most worrying development however is that India's arch rival Pakistan perceives Delhi's existing conventional superiority, and potential future nuclear superiority, as a growing threat that might result in escalation dominance over Pakistan. As a result, Islamabad is relying more upon the early first use of nuclear weapons in its own strategy and is emphasizing the deployment of tactical nuclear forces.*[127]

As Lieber and Press argued, knowing it is the weaker side, "Pakistan may have powerful, rational reasons to use nuclear weapons if it is losing a conventional war to India."[128] After all, unlike India, which at least notionally has an NFU policy, "Pakistani leaders have repeatedly declined to adopt a similar stance, saying they might be forced to resort to nuclear weapons should India invade Pakistan with conventional forces."[129] This is not mere rhetoric; Pakistan has built a mobile missile that can hit all of India and is seeking to equip it with MIRVs.[130] To this end, US intelligence officials anticipate that Pakistan will continue to prioritize development of such "battlefield" nuclear weapons.[131] Furthermore, this is not just a case of an aggressive military establishment. In October 2015, even Pakistan's Foreign Secretary Aizaz Chaudhry said his government "was in the process of formalizing plans to use low-yield nuclear weapons in the event of an Indian invasion."[132]

Most threatening, however, is the widespread fear that, in a crisis, Pakistan would cede nuclear C2 to local field commanders, who would have the authority to use the weapons on their own initiative.[133] Doing so would be extremely destabilizing and, rather than coerce an opponent, could easily backfire and lead to further nuclear escalation. Of course, the threat of a bomb falling into the hands of a terrorist group during the chaos, either deliberately or otherwise, remains a major concern.[134] During the 1999 Kargil War with India, the Pakistani military allegedly readied its nuclear arms without the knowledge of the prime minister and asked the then-ruling Afghan Taliban if it could store some of these weapons in Afghanistan; while the Taliban agreed, Pakistan thankfully never followed through.[135] What differentiates then from now, however, is that today both India and Pakistan have far more nuclear weapons and delivery platforms, thereby significantly increasing the potential for nuclear escalation or miscalculation.

...today, US strategic planning documents routinely refer to the sheer complexity and diversity of threats the United States faces, noting that the military must be prepared to confront a wide variety of challenges, including those that strategists may not accurately foresee at the present moment.

Hedge against an Uncertain Future:

Surveying the future geopolitical environment following the collapse of the Soviet Union at the end of 1991, no one would have guessed that, a decade later, the United States would be fighting a counterinsurgency campaign in Afghanistan, the very country where the mighty Red Army had suffered a costly and embarrassing defeat. Likewise, even if there were skeptics of President Obama's "reset" with Russia in early 2009, few, if any, believed that tensions in the following years would grow to such an extreme that some observers now regularly employ the term "new Cold War."[136] Furthermore, today, US strategic planning documents routinely refer to the sheer complexity and diversity of threats the United States faces, noting that the military must be prepared to confront a wide variety of challenges, including those that strategists may not accurately foresee at the present moment.[137]

The key takeaway from these observations is that it is exceedingly difficult to predict the future geopolitical environment. In fact, attempts to do so, and to shape the US force posture in tandem, often backfire. As merely one example, many people argued just last decade, as US soldiers confronted messy urban

counterinsurgencies, that the US military needed to transition from a Cold War-era, state-based force to a leaner, more flexible 21st century force designed to fight non-state actors.[138] While such thinking made sense at the time, the Pentagon now finds itself in a situation where it must confront a return to great power competition with Russia in Eastern Europe, hence the large boost in funding to the European Reassurance Initiative in the Pentagon's Fiscal Year 2017 budget; the previous funding was woefully inadequate.[139] Worryingly, however, this neglect has raised significant concerns about the military's ability to confront a hybrid Russian threat like that seen in Ukraine.[140] As Army Chief of Staff Milley has stated, "Today, a major in the Army knows nothing but fighting terrorists and guerrillas, because he came into the Army after 9/11. But as we get into the higher end threats, our skills have atrophied over 15 years."[141]

With these considerations in mind, letting the nuclear triad deteriorate would raise serious risks to US national security. By arguing that the current American nuclear force will remain adequate, critics of nuclear modernization make the faulty assumption that the future security environment will resemble today's. However, the conditions that have allowed the United States to forego modernization over the past two decades, such as the lack of superpower competition and conventional military superiority, are already unraveling. Even if they did persist, US military leaders have readily acknowledged in recent years that they have a poor track record of predicting future conflicts. Speaking with cadets at West Point in 2011, then-Defense Secretary Robert M. Gates noted that since the Vietnam War, the United States has a perfect record of predicting the nature and location of its next military engagement. "We have never once gotten it right," he said.[142]

With this in mind, a strong nuclear deterrent is critical insurance against an uncertain future. Indeed, in March 2016 when Haney was still STRATCOM chief, he argued that nuclear modernization "is not only necessary to maintain capabilities for today's threats; it is necessary to ensure we have flexibility and options to address future uncertainty. Failure to modernize and maintain readiness will limit our strategic options in dealing with the span of crises we can expect and those we don't anticipate."[143] Furthermore, as Gates stated back in 2008, when the global security environment looked almost sanguine by comparison to today:

> *Our nuclear arsenal is vital for a final reason I mentioned earlier: we simply cannot predict the future. Who can tell what the world will look like in 10 to 20 years? As someone who spent most of his career in the intelligence business, I can assure you that our track record for long-term guesswork hasn't been all that great. We have to know our limitations. We have to acknowledge that the fundamental nature of man hasn't changed and their adversaries and other nations will always seek whatever advantages they can find. Knowing that, we have to be prepared for contingencies we haven't even considered.*[144]

In short, modernizing the nuclear triad is the most effective hedge against unforeseen threats, which history shows are likely to develop. A limited nuclear strike against the United States would dramatically transform the country, while a massive one could destroy it altogether. Deterring such attacks is the fundamental US national security goal. Accordingly, the United States must maintain a strong, credible, and reliable deterrent force.

IV. The Value of ICBMs

Each leg of the triad offers unique capabilities that together present an adversary with a dual assurance: it cannot carry out a decapitating nuclear first strike, and the United States will have a sufficient mix of forces to respond to an attack and inflict unacceptable levels of damage.

Strategic bombers are the most flexible leg. As the United States has done many times, it can forward-deploy them to signal concern. In a crisis, it can put bombers on alert and/or disperse them for a visible signal of resolve. The combination of penetrating stealth bombers and bombers firing cruise missiles also presents an adversary with a unique set of defensive problems that requires a much different array of defensive forces compared to ICBMs or SLBMs. Furthermore, nuclear-capable bombers also offer important conventional capabilities, as proven in combat operations since World War II.

SSBNs are typically viewed as the most survivable leg of the triad. Submarines use stealth and maneuver to minimize the chances that an adversary locates them. Unlike US-based ICBMs, SLBMs have launch flexibility, meaning they can strike along different axes of attack, thus complicating an adversary's defensive problem. Although expensive to procure and sustain, the SSBN force is often seen as the leg that ensures retaliation.

For their part, ICBMs continue to serve many vital functions and possess numerous characteristics that are unique to their portion of the triad. In fact, their impressive capabilities essentially make them the triad's proverbial backbone, supporting the other two legs. The following examines the ICBM force's many strengths in the context of the triad to illustrate the importance of retaining this capability.

Safe, Secure, and Stabilizing—Favorable Basing Strategy:

The United States maintains its inventory of 450 Minuteman III ICBMs at three different air bases that are spread over 30,000 square miles of territory in five states: Minot Air Force Base in North Dakota; Malmstrom Air Force Base in Montana; and F.E. Warren Air Force Base in Wyoming (with additional sites in Nebraska and Colorado).[145] Each base hosts 150 missiles. The Minuteman IIIs are housed in hardened launch facilities spaced at least three miles apart to prevent a single enemy warhead from destroying more than one ICBM. There are then 45 hardened LCCs—one for every 10 missiles—that provide C2 functions for the missiles.[146] This deliberate basing strategy sets a prohibitively high threshold for attack, which ensures stable deterrence in a number of ways.

First, by virtue of being US-based, ICBMs have a clear deterrent value; namely, there is no way to strike them without directly attacking the United States, a choice no rational adversary would make. Indeed, as the Pentagon has noted, disabling the country's ICBMs would require "a massive and unambiguous nuclear attack against the US homeland, with unmistakable consequences for the attacker."[147] A strike on the US ICBM force would require an adversary to generate strategic forces by putting them on alert and would demand a large number of warheads. To take out all US ICBMs and associated launch control

centers would necessitate upwards of 900 warheads, which would require two-thirds of Russia's total known missile inventory, for example. Also, US satellites would detect any attempt by Russia, or another capable adversary, to "flush," or move its mobile nuclear forces from shelters, like Russia's rail garrisoned land based missiles. This warning from the satellites would allow the United States to place American strategic forces on higher alert, making US forces more survivable. By preparing to attack the US ICBM force, an adversary would be helping the United States to generate its own forces, thereby enabling the United States to prepare a greater retaliatory capability to use subsequent to a first strike. An adversary could only conclude that such an attack would be suicidal. US satellites would easily attribute responsibility, the attack's origin would be obvious, and the US response would be overwhelming.

The design and stationing of the 450 ICBM silos and 45 LCCs also present an opponent with a major targeting problem. Since the silos and centers are hardened facilities, an enemy would have great difficulty using conventional weapons to strike them; instead, it would have to use nuclear arms, a step that further increases the threshold for attack.[148] In order to maximize the probability of destroying all targets, an aggressor would have to expend multiple nuclear warheads against each silo and LCC (typical planning assumes a 2:1 warhead-to-facility ratio to ensure a high probability of destruction), meaning an enemy would have to use roughly 900 to 1,000 weapons to destroy all the sites, as noted earlier.[149] This requirement raises the threshold for attack to such a degree that no country, even Russia, has a large-enough stockpile even to contemplate this scenario today. Even then, it would still need to expend the majority of its arsenal to execute such an attack. Today, the large number of targets that the ICBM force presents eliminates the possibility that any power except Russia could seek to effectively attack US land-based missile systems. Even in a generated posture, any Russian attack would still be suicidal. The large US ICBM force is in many ways the factor that helps to sustain the United States as a global superpower, by making any attack on the sovereign United States and its nuclear assets simply incredible.

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By contrast, as Northrop Grumman engineer Mitch Bott noted in an April 2010 paper for the Center for Strategic and International Studies, a conventional attack on an Ohio-class submarine "does not necessarily have the same ramifications on the aggressor as does an attack on the ICBM force, as striking the ICBM force is a direct attack on sovereign US territory."[150] Indeed, an aggressor could even conduct such a strike, especially a covert one that could attrite the submarine fleet over time, "with plausible deniability" or even "without attribution" entirely," stated the Pentagon's Defense Science Board (DSB) in a 2008 report.[151] These concerns are absent from the ICBM force. There is simply no way to strike US land-based missile silos without a direct, massive attack on the United States itself—and the adversary would have to know that overwhelming retaliation would ensue.

Further consider that, without ICBMs, an adversary would only need to strike five US targets (three air bases that house nuclear bombers and two ports where SSBNs are stationed) in order to disable a significant

percentage of the US nuclear force with the expenditure of only a handful of nuclear warheads.[152] Navy submarines at sea at the time of such an attack would survive, but they would be left as the only surviving part of the triad. As the DSB concluded, "Without the ICBMs, surprise attacks against a handful of bomber bases and SSBN facilities … could drastically alter the correlation of forces."[153] Even absent such a massive attack, unlike ICBMs, the triad's bomber and, especially, the submarine leg "could be quietly attrited over time or drastically depleted with very limited attacks on just a handful of aimpoints."[154] Lest one think such concerns are hypothetical, here is an example from a 1998 report by National Defense University's Center for Counterproliferation Research of how just such a scenario could play out in reality:

> *[I]f there were no US ICBMs, an adversary might, during time of great crisis, be tempted to conduct a limited surprise attack (for example, from a single ship at sea) against the small number of US bomber bases and submarine support facilities. Such an attack—which could be portrayed as the work of a rogue crew even if it were not—would have a devastating effect for an extended period on the US ability to respond. The decision to retaliate might be difficult, given the ambiguity of the attack and the forces remaining to the adversary. The existence of significant numbers of single-warhead ICBMs greatly reduces the potential gain from such a small, ambiguous attack.*[155]

As another example, view the problem from an adversary's perspective. Without ICBMs, a decapitating first strike is relatively simple. An enemy could virtually cripple US nuclear forces by shadowing SSBNs from their bases, eliminating them at sea, and then striking the remaining bomber and submarine bases with just a few weapons. The enemy could even strike these submarines with non-nuclear weapons, and could deliver the weapons surreptitiously as a way to camouflage or obfuscate its identity.

ICBMs avoid these potential scenarios. As summarized in 2009 by Lt Gen Frank G. Klotz, USAF (Ret.), then-head of Air Force Global Strike Command:

> *Continuously on alert and deployed in 450 widely dispersed locations, the overall size and characteristics of the Minuteman III force presents any potential adversary with an almost insurmountable challenge should he contemplate an attack. He cannot disarm the ICBM force without using up almost all of his own forces and, in the process, leaving himself vulnerable to the remaining two legs of the triad. Therefore, he has no incentive to strike in the first place. That's the point. In this way, the ICBM contributes immeasurably to both deterrence and stability in a crisis.*[156]

Finally, mounting such a massive attack could be essentially pointless. During much of the Cold War, the United States maintained the capability to be able to "launch on warning," meaning if the NCA had clear evidence of an incoming nuclear attack, and proof of the detonation of enemy warheads on US soil, it would give the order to launch US missiles.[157] It is true that American ICBMs are designed to fly through such an environment. And such a capability acted as a disincentive then and still does today; the consequences for an attacker would be the commitment of significant nuclear resources for no gain—and with the guarantee of their own destruction. In the words of the US Senate ICBM Coalition, "Since there is no feasible scenario under which an adversary can threaten the entire ICBM force, the ICBM force compels deterrence."[158]

Most Responsive and Connected—Highest Alert Rate:

Another key attribute of the nation's ICBM force is that it is highly responsive. As Center for Strategic and Budgetary Assessments (CSBA) senior fellow Evan B. Montgomery explained in a 2013 study, with "approximately 99 percent of missiles on constant alert and redundant command and control systems in place, ICBMs provide the capability to execute an immediate and massive retaliatory strike in the wake of an attack..."[159] The Pentagon itself has acknowledged this unique capability, noting, "The ICBM force provides a responsive capability of almost unimaginable magnitude that is continuously at a full state of readiness… Potential adversaries clearly understand and respect this capability."[160] To this end, as Air Force scholars Mel Deaile and Al Mauroni argued:

> *Alerted nuclear forces are actually a stabilizing force in international relations because they force diplomats and national leaders to carefully consider their next escalatory step. There has to be a credible belief that a nation cannot avoid a violent response if it attacks the United States (deterrence by punishment), or that its goals will not be met even if it attacks the United States (deterrence by denial). If the US nuclear posture is to deter a nuclear or WMD attack by a peer nation-state, there is no better asset position for that mission than the intercontinental ballistic missile (ICBM) on alert.*[161]

In fact, in the expert view of Maj Gen Timothy J. McMahon, USAF (Ret.), the former commander of the nation's ICBM force:

> *[N]o component of our strategic deterrent capability has contributed as decisively to the daily success of the mission of deterrence since the end of the Cold War than the ICBM force. Retained on continuous alert here in the homeland, the ICBM force represents America's ability to defend ourselves under the most desperate circumstances, and if necessary, to impose our national will by projecting devastating power over near-global distances, and with a promptness unmatched by any other military force on the planet.*[162]

Bombers and submarines provide lower levels of readiness. The United States took bombers off alert in 1991.[163] Today, they are not loaded with nuclear warheads on a day-to-day basis, meaning that there is a lag between bomber crews receiving an order and taking flight.[164] Moreover, bombers also take hours to travel to their target, not minutes, as is the case with ICBMs. (Though their slower speed does mean that they cannot pose a first strike threat, thereby providing a stabilizing contribution to the nuclear balance). At the same time, open-source information suggests that the Navy keeps only four SSBNs on "hard alert," ready to fire at the President's order.[165] Moreover, getting ready to launch submarine-based missiles takes some additional time as the submarines must travel to their firing position, spin up the missile guidance systems, adjust their depth to the correct position, and then launch. Those SSBNs on patrol, but not on "hard alert," would take even longer to launch their SLBMs, once they received orders from the President to do so.[166]

Finally, the ICBM force, like the bomber, has multiple assured communications channels (e.g. landlines, radio, satellite) with the NCA; this secure connectivity is a highly prized attribute compared to submarines. As Keith B. Payne, former deputy assistant defense secretary, observed in a 2013 study on minimum deterrence that he directed for the National Institute for Public Policy:

> *In contrast, the SSBN fleet must rely on the accurate receipt of securely transmitted messages to submerged submarines. In the contemporary environment, cyber attacks, communications disruption (including, but not limited to, anti-satellite operations), insider threats, and data contamination are becoming increasingly potent. … If an adversary discovered a method to interfere with and prevent receipt of messages transmitted to SSBNs at sea, the deployed SSBNs could be of little value. In that case, ICBMs with secure communications could become particularly important for deterrence.*[167]

Overall, therefore, ICBMs' alerted posture gives them unique capabilities compared to nuclear bombers and submarines. In fact, the removal of the bomber force from on-alert status and the reduction in the number of submarines from Cold War highs make the nation's continually alerted ICBMs even more strategically important today. As the Air Force Nuclear Task Force succinctly summarized in a 2008 review of its nuclear capabilities, "Ready, capable, and secure ICBMs provide the unique, sovereign-based, stabilizing, and responsive capability to hold any target on the globe at risk 24/7."[168]

Penetration Assurance—Insurance Against Adversary Advances:

Presenting an adversary with multiple methods of attack notably complicates its ability to establish effective defenses. Even with research and forces focused on defending against one leg of the triad, the other two legs present a different set of challenges.

ICBMs, along with SLBMs, present an extremely difficult defensive challenge, at least to current missile defense systems. Their high rate of speed, combined with countermeasures (e.g., decoys, chaff), makes defense against a large attack extremely difficult. Missile defenses against more limited attacks, however, can serve as an important stabilizing and complimentary deterrent.[169] An additional factor to consider when examining the need for the triad is that the Minuteman III (and Trident II) missiles are completely autonomous once launched, and are invulnerable to enemy jamming or spoofing.[170] Indeed, as analysts Kingston Reif and Travis Sharp wrote in 2013, "the odds are vanishingly small that an adversary could ever deploy a missile defense system robust enough to stop 100 percent of incoming long-range missiles."[171] While effective defenses exist for short- and medium-range missiles, currently no country possesses anything close to an effective ballistic missile shield to defend against significant numbers of ICBMs (or SLBMs).[172] Even as countries develop more-capable missile defenses, the bomber leg would still require an adversary to develop a different set of capabilities and forces. This again illustrates the value of the triad's diversity in ensuring a US retaliatory strike will achieve deterrent objectives.

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ICBMs also offer insurance against advances in anti-submarine and air defenses. SSBNs rely on stealth, maneuver, and the ever-changing environment of the seas to hide from enemy forces. Similarly, stealth bombers employ reduced radar, acoustic, visual, emissions, and infrared signatures to maintain survivability. For example, the B-2, developed in the early 1980s, features the radar signature of an insect.[173] To date,

advances in stealth have outpaced progress in detection technologies, but numerous senior military leaders have warned against the long-term erosion of stealth.[174] Even if a revolutionary advancement does not appear in the near future, it is clear that potential adversaries are progressively challenging stealth. In fact, the Pentagon's 2014 QDR stated, "Counter-stealth technology is just one example of how highly advanced weapons systems—previously available only to those with significant research and development capabilities and large acquisition budgets—could proliferate and change warfighting equations."[175] Consider this evaluation in June 2015 from former Undersecretary of Defense for Policy James N. Miller:

> *The case for keeping at least a few hundred ICBMs, in my view, is also compelling. First and foremost, and perhaps ironically, as a hedge against any future problem with SSBN security or reliability. The Ohio-class replacement is supposed to last out to 2070 and beyond. We today have extraordinary confidence that it will be survivable over that timeframe. But as I noted at the start of my remarks, we are often surprised. And while we don't expect to be surprised and will work hard not to be surprised on this issue, given the stakes involved having at least a second leg of the triad as a hedge makes a lot of sense. We know that stuff happens. … [I]f we didn't have ICBMs a small number of warheads—any number of states, several states potentially, could take out our bomber and submarine bases and effectively eliminate our deterrent.*[176]

Given such concerns, it is not merely prudent, but in fact incumbent, to retain ICBMs as a hedge against the potential erosion of stealth as a major advantage. After all, without ICBMs, not only would the United States be far more vulnerable to begin with—and forego a crucial penetrating strike power—but adversaries would see benefit in aggressively pursuing transformative anti-submarine and air defense technologies.[177]

Reliable—Insurance Against Development, Sustainment, and Capability Problems:

With the triad's three independent legs, one can maintain deterrence if another faces unanticipated development, sustainment, or capability problems. For instance, as the military procures new bombers and submarines to replace aging fleets, an unexpected design flaw, funding reduction, or other issue could delay their introduction into service. As a concrete example, consider that, as a result of cancelations, delays, and funding cuts, the B-1, although first conceived in the 1960s, did not enter service until the mid-1980s, and even then, multiple developmental issues delayed its use in combat until 1998.[178]

At the same time, bombers and submarines could be subject to fleet-wide moratoriums on their use. For example, after a February 2008 B-2 crash, the Air Force instituted a "safety pause"—not an official "grounding," but action which, in effect, suspended all flight operations—that the service did not lift for a month and a half.[179] Similar problems have occurred in other aircraft as varied as the KB-50, KC-135 Stratotanker, and F-15 Eagle. Of particular worry, as B-52s age, it becomes increasingly likely that an unforeseen problem could ground that fleet.

Even a small, temporary disruption to the availability of the bombers or SLBMs runs the risk of undermining deterrence. Maintaining a strong ICBM force that can compensate for unanticipated problems in another leg is a sensible and prudent policy. As previously noted, defense officials view ICBMs as the most reliable leg; the missiles have retained a historic 99 percent alert rate, proving their ability to be ready, if needed.[180]

Moreover, ICBMs undergo multiple test launches per year in order to validate their reliability.[181] Finally, the simple fact that they exist in such large numbers means that there are plenty of backups if certain missiles unexpectedly failed. Even ICBM skeptics acknowledge these points, as researcher Lauren Kobor noted in a 2013 article for the *Journal of Politics and Society*:

> *[T]he ICBM leg of the triad has been most valued for two capabilities: immediacy, which has been addressed thoroughly, and permanence. An ICBM, once built, can last for decades with minimal maintenance. Bombers and submarines require more frequent upkeep in order to remain at operational capacity. These systems are more complex and more dynamic, which give the bomber and the submarine an advantage in terms of technology and survivability, but serve as a disadvantage to permanence.*[182]

In sum, therefore, ICBMs act as an essential hedge against various mission capability challenges in the other two legs, whether such complications come from design flaws, sustainment issues, or something else entirely. In the same way, the availability of the other two legs provides a backstop should ICBMs experience unanticipated problems or delays in the acquisition process, again illustrating the value of diversity in the triad.

Cost-Effective—Lowest Operating and Recapitalization Costs

Using Fiscal Year 2014 constant dollars, Figure four summarizes current triad forces, each leg's planned modernization program, the estimated cost of each modernization program, and the current annual operating costs for each leg. As one can see, ICBMs offer both the lowest annual operating and recapitalization costs. In terms of modernization, expenditures for the ICBM force are roughly half that of bombers and one-third that of submarines. A similar story is reflected in ICBM annual operating costs, which will remain the lowest in the future.

	Current Force	Modernization Program	Modernization Cost (25-year Dev./Prod. Cycle) in FY14 Dollars	Annual Cost (Operations & Sustainment) in FY14 Dollars
ICBMs	450 Minuteman IIIs w/single warheads	Procure 642 new missiles w/single warheads & modernize infrastructure	$44 billion	$1.4 billion
Bombers	20 B-2s, each carrying 16 B-61 bombs & 40 B-52s, each carrying 20 ALCMs	Procure 100 B-21s (payload classified)	$77 billion	$1.8 billion
Submarines	14 Ohio-class submarines, each carrying 20-24 Trident II missiles with MIRVs	Procure 12 submarines, each carrying 16 Trident II missiles with MIRVs	$110 billion	$3.8 billion

Figure 4: Triad Modernization Overview[183]

The total estimated cost of modernizing the three deployed legs of the triad is approximately $235 billion in Fiscal Year 2014 dollars, spread over the next 25 years; that's roughly $10 billion per year over that period.[184] It is important to view such outlays in context. For instance, a 2015 government report estimated that the nation loses $60 billion worth of Medicare payments each year—more than 10 percent of the Medicare budget—to fraud, waste, and abuse.[185] On this score, the GBSD's entire $44 billion acquisition cost equals about two-thirds of the improper Medicare payments in just one year. Moreover, the most recent analysis of the "tax gap"—the difference between taxes paid and taxes owed—put lost revenue at $458 billion per year.[186] In this respect, the United States could completely recapitalize the entire triad if the government collected merely half of what the US Treasury is due each year, but not paid. To note is that these costs do not include Energy Department/National Nuclear Security Administration expenditures, nor C2 modernization, and are in Fiscal Year 2014 dollars and not then-year dollars.

According to the Air Force, the new GBSD will cost $44 billion in Fiscal Year 2014 dollars. More recently, the Pentagon's Cost Assessment and Program Evaluation (CAPE) office pegged the GBSD program cost at $60.5 billion, also in Fiscal Year 2014 dollars. This places the program at roughly $30 million more per missile on a buy of more than 600 missiles. What is unanswered is the extent to which the cost of producing 60 missiles a year, an optimum rate, is more cost-effective.[187]

... the United States could completely recapitalize the entire triad if the government collected merely half of what the US Treasury is due each year.

Also, there are three additional perspectives on the cost of a new land-based system to help inform decision-makers. First, procuring 500 small ICBMs (SICBMs), such as the Cold War-era road-mobile Midgetman, and 500 Trident II missiles would cost $54 billion and $50 billion in Fiscal Year 2014 dollars, respectively. The now-retired and much larger MIRV-equipped Peacekeeper ICBM would have cost $36 billion in Fiscal Year 2014 dollars for 120 missiles. These estimates are consistent with the $44 billion estimate that the Air Force cites for the GBSD. Second, expressed as a unit cost per missile, the Peacekeeper cost around $300 million, the mobile SICBM was around $110 million, the Trident II was $110 million, and Minuteman III was $60 million, all in Fiscal Year 2014 dollars. Third, when comparing 24 of the major missile and aircraft acquisition programs since 1945, particularly those related to the nuclear deterrent, GBSD as a percentage of gross domestic product (GDP) comes in at less than 0.2 percent. In comparison, the B-52 was more than 1.9 percent, the F-111 Aardvark was 1.6 percent, the B-1 was 1.1 percent, and the Peacekeeper came in at 0.5 percent. GBSD, at $44 billion, is the lowest of all 24 of the major acquisition programs. This is the case when expressed in terms of the cost of the programs when entering Milestone B, the official start of engineering and manufacturing development, and when compared to the GDP of the year each program achieved this goal.[188]

Another way of putting nuclear modernization costs in context is to compare them to defense spending more broadly. As Admiral Haney noted in April 2016, "Today, maintaining our strategic nuclear capability costs about three percent of our defense total obligation authority. In the 2020s and 2030s, when recapitalization begins in earnest, that figure will grow to between six and seven percent."[189] This is hardly a crippling

percentage, especially considering that, during the Cold War, DOD spent an average of 9.8 percent of its budget on procuring nuclear systems.[190] In fact, respected outside defense budget analyst Todd Harrison has argued, together with CSBA's Montgomery, that only a small increase in defense spending—perhaps just two percent, a figure not out of line with historic patterns—above the limits imposed by the current budget sequester could fund nuclear modernization during the 2020s without offsetting defense cuts.[191] This is when the Pentagon's budget is most at risk of a "bow wave," meaning that the bills for much-needed defense acquisition programs come due at around the same time.

An additional perspective on cost is to view the US nuclear arsenal as an insurance policy, effectively, its true purpose. Consider that in 2013, the average car owner paid $841 for annual insurance.[192] By contrast, assuming an average nuclear platform modernization spending rate of $10 billion per year, the average taxpayer—in 2015, 137.3 million individuals filed—would spend just around $72 per year to rejuvenate the nuclear triad. That amount is nearly one-twelfth what the average car owner pays for car insurance each year.[193] Of course, since the nuclear arsenal protects not just taxpayers, but rather all Americans, each person would pay even less if the costs were spread among the entire population.

While these points demonstrate that nuclear modernization is far from the budget-killer that some critics make it out to be, the even-more-important consideration is that the need more than justifies the cost. To this end, as Haney forcefully and persuasively argued:

> *Our budget has a deterrent value all of its own, and the President's budget reflects our nation's commitment to our deterrence strategy. … If we are to meet future challenges, we must have a synchronized campaign of investments supporting the range of military operations that secure our national security objectives. … Similar to how the US analyzes the budgets of others, our adversaries pay close attention to how we back up our words with resources. To that end, budget stability is integral to our strategic stability.*[194]

Further, as he testified in February 2016, "Our allies and adversaries are observing and assessing the fiscal emphasis placed on our nation's strategic deterrence and assurance capabilities. We cannot afford to send them mixed message on their importance by underfunding them."[195] Sen John Hoeven (R-N.D.) has made similar statements, arguing in April 2015 that walking away from "any one of the capabilities in the triad would send the wrong signal to the rest of the world about our overall commitment to deterrence."[196] In short, reducing or eliminating triad investments emboldens US adversaries and weakens the confidence of US allies, thereby undermining deterrence.

Even skeptics of ICBM recapitalization acknowledge such risks. As Kobor wrote, "such a policy decision could signal to the rest of the world that the United States' economic woes are so great that they have impacted the very core of US strength—the nuclear arsenal. … Controlling the perceptions of enemy and possible enemy actors is crucial in maintaining deterrence as a strategic doctrine."[197]

Finally, as retired General McMahon has said, when evaluating cost, it is crucial to note that the nuclear arsenal, particularly the ICBM inventory, involves an inherent paradox:

> *The utility of the ICBM force is often questioned because of the faulty assertion that it has not 'been employed operationally.' That's the paradox, but that's also the point. The political objective and military effect of deterrence is to make our capability so overwhelmingly clear to potential adversaries that the mere presence of an alert, reliable ICBM force is by definition an 'employment' of the force. Some have difficulty understanding that the deterrence of violence, at all levels, transcends warfighting in both national security and moral terms. The extent to which the ICBM force achieves this effect is again a sufficient purpose to justify its existence.*[198]

Put another way, as CSBA senior fellow Mark Gunzinger has argued:

> *[Modernization] will be expensive, but maintaining our nation's strategic deterrence posture is well worth the investment. I would never try to evaluate the cost-effectiveness of our nuclear triad from the 'will it be used in combat' perspective. Rather, we should ask what is needed to ensure that it is never used and our enemies understand that a nuclear act of aggression against the United States risks a devastating response.*[199]

Finally, as retired Gen Larry D. Welch, USAF (Ret.), former Air Force Chief of Staff, put it:

> *The primary role of US nuclear weapons for well over half a century has been to prevent their use. To that end, we have used them every second of every day since the first deterrent systems were deployed. They have worked perfectly. The nuclear deterrent is the only weapons system I know of that has worked perfectly without fail, exactly as intended, for their entire life span. And because they have been so successful, then there may be some who have forgotten why we need them.*[200]

To be fair, such arguments may raise thoughts of the Cold War-era film *Dr. Strangelove*, yet they still remain correct. While the United States may not visibly employ ICBMs in the same way as one thinks of employing tanks, airplanes, or other hardware, they continually serve the most vital national defense mission, on which it is difficult, if not impossible, to place a dollar amount. The nation is continually "using" them to assure allies, deter opponents, and, in turn, maintain effective deterrence.

In this respect, the US nuclear arsenal, and, in particular, the ICBMs, which are on alert every hour of every day, are cost-effective investments in underwriting US national security. Committing to the GBSD program not only means investing in the lowest cost modernization program out of the triad's three legs, but also serves an important deterrence function on its own by demonstrating that the United States strongly values its nuclear capabilities and is prepared to spend what is required to keep them current.

Rather than asking how the nation can afford these investments, surveying the global security landscape suggests that the better question is: How can the nation afford not to? Americans must consider not just upfront costs, but also the value derived from long-term investment in the nation's ultimate insurance policy. For a capability to deter existential threats, nuclear modernization costs—of which those for GBSD are the least expensive—are well worth the investment. In the words of Adam B. Lowther, director of the Air Force's School of Advanced Nuclear Deterrence Studies, "dollar for dollar, no weapon system the United States maintains in its arsenal provides the nation greater security."[201]

V. The Need for GBSD

Clearly, ICBMs continue to play a crucial role in the strength and efficacy of the nation's nuclear triad. As already outlined, they are: safe, secure, and stabilizing; responsive and connected; capable of assured penetration; reliable; and cost-effective. Given these attributes, the clear need to keep the ground-based leg viable over the long term has led to the Air Force's plan to develop a next-generation ICBM, formally known as the Ground Based Strategic Deterrent program, to replace the Minuteman III missile and related infrastructure.

The Air Force is beginning the process to procure the new ICBM, 400 of which it would deploy, in line with New START commitments, while it would keep 242 others in non-deployed status for test launches and as spares.[202] The service plans to deploy the new missile in modernized Minuteman silos, and also to modernize the launch control centers and associated command and control infrastructure. One must view the new missile and the infrastructure as a complete weapon system. There are numerous interfaces between the missile, LCCs, and supporting C2 apparatus to consider together in order to develop an effective system. The goal is for the first part of the new system to become operational around 2030, and for the GBSD to last into the 2070s.[203]

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The Air Force estimates the costs of the new system to be $44 billion in Fiscal Year 2014 dollars: $35 billion for development and procurement of the new missiles, $4.5 billion for upgrades to the missile silos, and $4.5 billion for modernization of the C2 infrastructure.[204] If expressed in "then-year" dollars, the Air Force's estimated cost total would be $62 billion, while the CAPE cost estimate is $85 billion.[205] This is primarily due to different views on the actual cost of building a new ballistic missile, and whether the Air Force could gain significant efficiencies with building missiles at a higher rate of production.

Utilizing increased missile reliability, along with upgrades to the infrastructure that will enable reductions in security and maintenance personnel, the Air Force anticipates savings in annual operating and sustainment costs compared to today. Further, despite outside talk of potentially giving the GBSD a mobile capability, which would increase costs, the Air Force has made it clear that it is not examining this option.[206] The following section illustrates how the Air Force came to its decision to proceed with its proposed plan.

Consistent with Air Force Analysis:

Before proceeding with its acquisition strategy, the Air Force conducted a rigorous analysis of alternatives, which concluded that the current recapitalization plan is the most appropriate path forward to modernize the Minuteman III system. Gen Robin Rand, head of Air Force Global Strike Command, testified before Congress in March 2016 that:

The Minuteman flight system, currently on its third model, has been on continuous alert since the early 1960s and has proven its value in deterring our adversaries and assuring our allies well beyond the system's initial 10-year lifespan. ICBM capability gaps were identified and validated by the Joint Requirements Oversight Council, and subsequently approved in August 2012 by the Air Force Chief of Staff, resulting in an AOA. The AOA was completed in 2014 and concluded that an integrated replacement to the Minuteman III weapon system was the most cost-effective approach to filling capability gaps.[207]

In the AOA, the Air Force considered five possible options:

- A "baseline" option to extend the life of the Minuteman III through 2075 without seeking to close gaps in the missiles' capabilities;
- An "incremental" option to incorporate incremental changes into the current Minuteman III system to close capability gaps;
- A "replacement" option to design a new ICBM to replace the Minuteman III;
- A "mobile" option to create a new mobile ICBM system; and
- A "tunnel" option to build a new tunnel-based system.[208]

After initial examination, and in consultation with officials in the Office of the Secretary of Defense, Air Force officials eventually narrowed the focus of the AOA from five alternatives to just three: the baseline option; the replacement option, which would utilize the existing Minuteman III silo infrastructure with a redesigned missile; and a "hybrid" option mixing the current silo infrastructure with new mobile ICBMs.[209]

While the AOA's specifics are classified, the Air Force did publicly discuss some findings. It concluded that the replacement option was the most cost-effective approach to fill capability gaps. In fact, the Air Force estimated this option's total life-cycle cost (i.e., the complete cost of designing, building, operating, and sustaining the new system) from 2016 to 2075 at $159 billion in Fiscal Year 2014 dollars.[210] In contrast, the estimated cost of the baseline option is $160 billion, while the "hybrid" option is pegged at $242 billion.[211] Notably, multiple senior officials, both inside and outside the Air Force, validated this plan. According to Rand's March 2016 testimony:

The Office of the Secretary of Defense (OSD) Cost Assessment and Program Evaluation [office] reviewed the AOA report and validated it as 'sufficient to support a Milestone A decision and initiate a program of record.' SAF/AQ [The Air Force Secretariat's acquisition office] approved the Ground Based Strategic Deterrent (GBSD) acquisition strategy in December of last year [2015] and directed the program to proceed to the Milestone A Defense Acquisition Board.[212]

The Air Force's rigorous AOA concluded that replacement was the best option. Over the long-term, GBSD procurement will provide a system with sufficient capabilities and reduced annual operating costs: an unbeatable combination.

SLEPs Cannot Continue Indefinitely:

In contrast to the AOA's conclusions, a 2014 RAND Corporation study recommended an "incremental modernization" strategy as a better alternative. According to RAND, in this scenario, the Air Force

would continue to sustain the Minuteman III through various service life extensions (e.g., re-pour rocket propellant, replace aging sub-systems) and gradual upgrades to retain current ICBM capabilities. RAND said this would be the most cost-effective option.[213]

Nonetheless, RAND noted that this option suffered from two key deficiencies. First, the service will run out of Minuteman III test missiles toward the end of the 2030s based on the current testing pace and with the assumption that the Air Force maintains a deployed ICBM force of 400 missiles per the US nuclear force structure to comply with New START.[214] This is no small problem. As RAND admitted, "Tests are critical to the longevity, readiness, and reliability of the system."[215] Moreover, they serve an important signaling function to both allies and adversaries. As Deputy Defense Secretary Work commented before an ICBM test in February 2016, "That's exactly why we do this. … We and the Russians and the Chinese routinely do test shots to prove that the operational missiles that we have are reliable. And that is a signal … that we are prepared to use nuclear weapons in defense of our country, if necessary."[216]

...SLEPs simply cannot continue forever. Already, the average age of the ICBM inventory is more than 40 years. Since production ceased in 1978, this means that the youngest Minuteman III missile is about 38 years old.

Second, as RAND noted, if the Air Force set new requirements for the GBSD program, then incremental modernization would be insufficient.[217] This is precisely what has happened. The Air Force clearly desires improved capabilities (e.g., better accuracy, payload, range, countermeasures) in order to keep the ICBM force effective over the coming decades. As General Rand testified, "The Minuteman III, with each year, becomes more and more obsolete, and I am concerned that if we don't replace it … we will not be able to provide the capabilities that are needed."[218]

Aside from these critiques, the Air Force has already carried out many SLEPs to keep the Minuteman III viable beyond its originally planned lifespan of 10 years. They have included programs to replace missile propellants, extend and improve the reliability of guidance sets, and upgrade parts of missile's post-boost propulsion system.[219] Including past and current SLEPs, the Air Force will have spent some $7 billion extending the life of Minuteman III missiles so they can operate through 2030.[220]

Nonetheless, SLEPs simply cannot continue forever. Already, the average age of the ICBM inventory is more than 40 years.[221] Since production ceased in 1978, this means that the youngest Minuteman III missile is about 38 years old.[222] To borrow an instructive analogy from Admiral Haney, imagine the state of a car after that much time; even if the owner never missed a scheduled service, the car would need an ever-increasing amount of maintenance, would likely be subject to a number of recalls and defect investigations, and, ultimately, would require replacement for the owner to remain safe while driving.[223]

With this analogy in mind, trying to push the Minuteman III beyond its planned service life merely invites decreased reliability and credibility, thereby undercutting deterrence. The need to acquire exotic and expensive replacement materials often presents challenges to sustainment; steep declines in the skilled

workforce required to complete the work exacerbate this.[224] Furthermore, some existing components require a complete overhaul since modern health and safety rules preclude their continued production.[225] For a missile system that is meant to be the ultimate deterrent and national insurance policy, these are major credibility concerns, particularly as potential adversaries modernize their own nuclear forces.

Even if SLEPs could continue, the ICBM force is based on 1960s technology. A first-generation iPhone reportedly possesses more computing power than a Minuteman III.[226] In fact, the missile inventory is so old that many of the contractors that made the original parts are no longer in business.[227] As a result, as one former ICBM launch officer has written, "Simple day-to-day tasks, routine during the peak of the Cold War, now take hours of wrench-turning, just to keep the deterrent on its feet."[228] In short, existing SLEPs are already overburdened, and will merely grow more so in the future.

Historically, in order to preserve a secure second strike retaliatory capability, the United States has deliberately sought to minimize commonality among the triad's legs to avoid the potential for a failure that could affect more than one leg.

The key takeaway, therefore, is that the older the Minuteman III gets, the more difficult it will be for the Air Force to sustain it and the more the service will have to spend to keep it viable. By this point, it is more cost-effective to proceed with the GBSD replacement option than to continue with indefinite SLEPs, which also do not deliver needed capability upgrades. As Gen John A. Shaud, USAF (Ret.), the former director of the Air Force Research Institute, has written, "the system does not have an indefinite life span. At some point, the nation will be faced with the decision to retire or modernize the current fleet."[229] Admiral Haney put this in starker terms, saying, "We are out of time. Sustainment is a must. Recapitalization is a requirement. … Our choice is not between keeping the current forces or replacing them. Rather the choice is between replacing those forces or risk not having them at all."[230]

Commonality Concerns:

The Navy has proposed increasing the level of commonality between land- and sea-based missiles to save money. In particular, Vice Adm Terry J. Benedict, the Navy's director of strategic systems programs, has said developing a joint fusing firing circuit for ICBMs and SLBMs would save the Air Force $600 million in unique development costs.[231] This proposal raises a key issue for the Air Force to consider in its GBSD procurement: What, if any, level of commonality is acceptable in the nuclear triad?

Historically, in order to preserve a secure second strike retaliatory capability, the United States has deliberately sought to minimize commonality among the triad's legs to avoid the potential for a failure that could affect more than one leg. If a critical common element in the land- and sea-based legs failed, it is entirely possible that only the 66 bombers out of the 800 total delivery vehicles—a tiny fraction of the strategic forces allowed under New START—could be available as effective systems, greatly undermining deterrence.

However, while previous attempts to gain benefits from multi-service commonality have typically proven less fruitful than the promise, there is reason to believe a joint Air Force-Navy effort to adopt production

efficiencies could work.[232] There are caveats to note. Broadly, difficulties in coordinating the competing requirements of individual services and other factors have reduced the attractiveness of pursuing joint programs. Consider the V-22 Osprey tiltrotor aircraft, which began as a joint effort among all the services before the Army exited the program due to competing priorities. The program took more than two decades to reach initial operating capability and a suffered a development cost overrun of more than $9 billion in today's dollars.[233] In contrast, successful aircraft, such as the A-10 Thunderbolt II, F-14 Tomcat, F-16 Fighting Falcon, and F/A-18 Hornet were all single-service programs borne out of ineffective multi-service efforts due to difficulties reconciling requirements.[234]

Officials must also harmonize the promise of commonality with possible risks to program schedules. The Navy needs to release the technical designs of its proposed common elements, for one. However, it may well be that a subsequent technical review, concomitant reevaluation of requirements, and refining of the acquisition strategy would force the Air Force to slip the acquisition timetable further. Of course, compounding these challenges is the fact that the GBSD schedule is already tight in light of the expected age-out of existing Minuteman III components beginning around 2030. As a result, officials must balance commonality's hoped-for cost savings with the possible acquisition and operational risks that commonality may introduce to the GBSD effort.

Industrial Base Concerns:

The Air Force and DOD have long understood the need for a robust defense industrial base in order to develop, build, sustain, and modernize military hardware, particularly nuclear weapons, which often require an even more specialized skill set than do conventional systems. For instance, in 2008 then-Defense Secretary Gates co-published a report with then-Energy Secretary Samuel W. Bodman stating, "To maintain a credible deterrent at these lower levels, the United States requires … a responsive defense industrial infrastructure that can maintain existing capabilities and manufacture new or replacement components as needed."[235] Moreover, as the 2010 NPR noted, "industrial base activities that support the nuclear enterprise also remain critical to the nation's deterrence posture."[236] These are just two of many similar official policy statements.

> ...in 2009 the Congressional Commission on the Strategic Posture of the United States, led by former Defense Secretary William J. Perry, wrote bluntly, "The infrastructure that supports two-thirds of the strategic deterrent triad—the SLBMs and ICBMs—is not being sustained."

Unfortunately, desires do not match reality. For instance, in both 2006 and 2008, the Defense Science Board published reports signaling its alarm over the erosion of the industrial talent base, particularly in the nuclear enterprise.[237] Furthermore, in 2009 the Congressional Commission on the Strategic Posture of the United States, led by former Defense Secretary William J. Perry, wrote bluntly, "The infrastructure that supports two-thirds of the strategic deterrent triad—the SLBMs and ICBMs—is not being sustained."[238] Again, these are merely two of many official statements warning of an impending crisis.

Concerns over current and future capacity in the defense industrial base have arisen from a number of causes, many of which the DSB explicitly identified in 2006. First, the workforce is rapidly aging as the baby boomer generation retires. As the DSB argued, the "skills necessary to maintain and modernize the country's strategic nuclear strike systems are endangered due to the imminent retirement of critical personnel."[239] The DSB particularly worried about the ICBM industrial base, writing, "Current ICBM-related industry personnel distributions show substantial fractions nearing retirement. Recruitment in most strategic-strike-unique areas is not taking place at a rate that will allow adequate training to replace the skills of retiring workers before they have left."[240] A decade on, the problem has only gotten worse. The United States is fast approaching a time when vital skills will take a long time to regenerate.

...spending on nuclear procurement is roughly one-fourth what it was during the Cold War. ...The Air Force has not developed and fielded a new ICBM since the Peacekeeper program first began in the mid-1970s, eventually fielding it in 1986.

Underpinning this aging workforce has been a host of factors stymieing effective labor force replacement: insufficient numbers of graduating engineers; of those, fewer desiring a career in the defense industry, particularly compared to opportunities at technology startups; and, even of those who are interested, challenges obtaining security clearances.[241] Worryingly, since the DSB's 2006 report, many of these negative trends have continued and, in some cases, become more severe.[242]

Corporate consolidation has also contributed to the erosion of the defense industrial base. According to the 2008 DSB report, 50 major contractors worked DOD contracts at the beginning of the 1990s, yet now, the industry is made up of only six primes.[243] This wave of consolidation has led to an entirely predictable problem: a smaller talent pool. Absent major recapitalization programs, consolidation has created business incentives for the remaining primes to focus on sustaining legacy platforms rather than investing in new systems.[244] If recapitalization is delayed, the situation will only become worse. As the DSB concluded in 2008, "today the nation has a consolidated 20th century defense industry, not the transformed national security industry needed for the 21st century."[245]

Despite these various contributing causes, by far the largest is that the country took a "procurement holiday" for the past quarter century.[246] As previously noted, spending on nuclear procurement is roughly one-fourth what it was during the Cold War.[247] In the 1960s, the United States recapitalized all three triad legs in short, regular intervals. In the 1980s, the Air Force pursued nuclear modernization through the B-1 Lancer and the B-2 programs (although DOD severely truncated the latter at just 21 airplanes in the 1990s).[248] The Navy also fielded the new Ohio-class SSBN and two generations of new missiles, the Trident I and II.[249] By contrast, ICBM modernization has lagged far behind. The Air Force has not developed and fielded a new ICBM since the Peacekeeper program first began in the mid-1970s, eventually fielding it in 1986.[250]

The result of this post-Cold War procurement holiday is that the defense industrial base has had no incentive to invest in next-generation capabilities to modernize the nuclear enterprise, meaning that its

nuclear expertise has dramatically declined—with major national security implications. Industry has been warning of this precise problem for some time. For example, in 2008. the DSB wrote, "Management and the workforce in the defense industry and in nuclear weapon contractors believe that 'sustainment' (e.g., life-extension programs) will not retain the skills necessary to competently solve major problems with existing systems or to initiate new programs should the need arise."[251]

Similarly, the 2009 Congressional Commission on the Strategic Posture of the United States wrote:

> *Industry uniformly and understandably emphasizes that expertise can only be maintained with active programs. The skills being exercised today for nuclear deterrent forces are almost exclusively related to the less-demanding sustainment of systems first deployed many years ago. … On the present path, in the not too distant future, the infrastructure unique to strategic missiles will not be available for any new programs or to respond to major problems, should they develop, in deployed systems. Any reconstitution of capability (both facilities and people) will take many years.*[252]

As this statement references, losses to the industrial base have been particularly acute in regards to ICBMs. For example, the DSB warned in 2006:

> *The skills base needed to assure the success of the current systems over the long term, however, is thin. The ICBM Program Office has conducted an assessment of the skills viewed to be critical for success in implementing the current program and concluded that guidance skills, reentry systems critical systems, and propulsion critical skills are, in the aggregate 'marginal' at present and moving toward untenable 'below critical mass' workforce within five years. … [O]nly a handful of those who comprise the current industrial base were involved in MM [Minuteman], Peacekeeper, or Small ICBM design and development. … No one who designed the original MM III components in the late 1960s is actively engaged in the program, so root causes of design failure, should one occur, could be difficult to determine and correct.*[253]

Clearly, therefore, the procurement holiday, along with the many other factors listed beforehand, has negatively affected all three legs of the triad, but particularly the ICBM force. This has caused a significant decline in defense industrial base capability, which, in turn, will make future modernization even more difficult. With an already weakened ICBM contracting workforce, further delays to GBSD development—or, worse, its complete cancellation—would catalyze further decay, perhaps to the point of being irreversible. Indeed, as Admiral Haney starkly warned:

> *We are fast approaching the point where we will put at risk our safe, secure, effective, and ready nuclear deterrent, potentially jeopardizing strategic stability. We must not let our deterrence capabilities be determined by failure to sustain and modernize our forces. … In much the same way as we sustain and modernize our platforms and weapons, we must also sustain and modernize our workforce. We must invest in the future of professionals, both civilian and military, who operate and maintain, secure, engineer, and support our nuclear enterprise.*[254]

We cannot allow this major threat to US national security to become a reality.

Conclusion

The evidence presented in this study clearly demonstrates that the nuclear triad will remain as relevant to US national security in the 21st century as it was in the preceding one. In particular, this study has clearly proven that ICBMs continue to provide critical capabilities, but, for them to endure, recapitalization of the Minuteman III fleet with the new GBSD program must move forward without delay. ICBMs are crucial to deterring competitors, assuring allies, and, if necessary, defeating opponents. Through ICBMs' unique attributes, they act as the backbone of the triad, supporting the other two legs.

Contrary to the arguments of ICBM opponents, these strategic assets have always played a crucial role in US national security. Indeed, reflecting on the Cuban Missile Crisis, President John F. Kennedy called the original Minuteman his "ace in the hole" for the essential deterrent role it served during the tense standoff.[255] ICBMs can continue to provide that crucial service to future Commanders-in-Chief, but only if the nation prioritizes the GBSD plan. In this respect, comments that Assistant Secretary of Defense for Strategy, Plans, and Capabilities Robert M. Scher made in May 2016 are particularly instructive:

> *The need for nuclear modernization is particularly simple. It is clear that other countries will continue to possess nuclear weapons well past the service lives of our existing systems, which have already been in use decades longer than originally planned. Modernization is thus essential to the President's commitment to sustain a safe, secure, and effective nuclear arsenal for as long as nuclear weapons exist. … To be clear, our choice is not between keeping the current forces or replacing them. Rather, the choice we face is between replacing those forces or watching a slow and unacceptable degradation in our ability to deter.*[256]

While that is, ultimately, a choice for citizens to make through their elected officials, this study has proved the point that investing in ICBM recapitalization through the GBSD program is the best way to ensure necessary capabilities at the lowest cost. This is the case for three key reasons: First, proposals to reduce or even eliminate the country's ICBM force disregard the missiles' many unique contributions to national defense that other capabilities cannot duplicate. Second, the increasingly unstable global security environment calls for the nation's leaders to have the most flexible and capable nuclear deterrent force as possible, which the nation cannot have without a modern ICBM force. And third, the extensive nuclear modernization programs of potential adversary nations require US recapitalization to avoid a serious erosion of American nuclear deterrent capability. Failing to invest in the recapitalization of the nuclear deterrent, especially in the ICBM force, will merely clear a path to obsolescence and eventual dissolution. ✪

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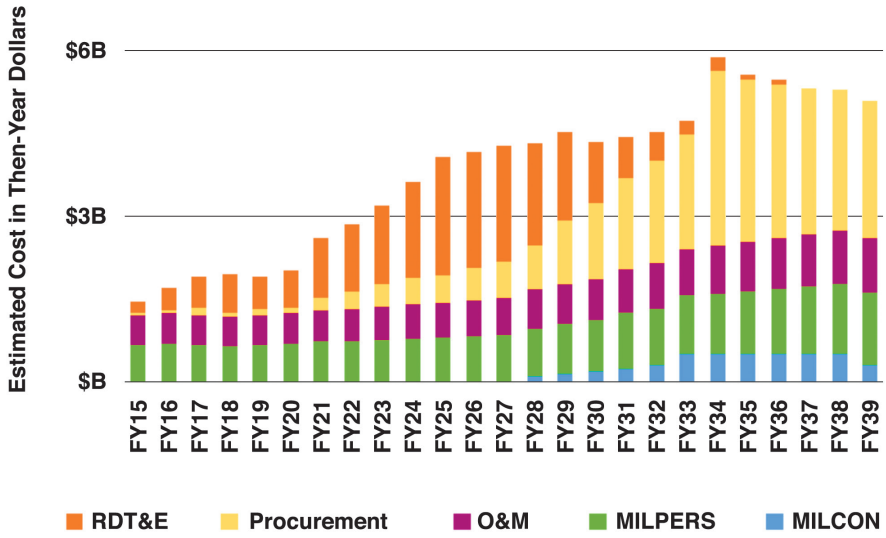

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