# The End of Nuclear Warfighting: Moving to a Deterrence-Only Posture

## AN ALTERNATIVE U.S. NUCLEAR POSTURE REVIEW

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# *Contents*

# *Abstract*

The United States should adopt a deterrence-only policy based on **no first use** of nuclear weapons, **no counterforce against opposing nuclear forces** in second use, and **no hair-trigger response.** This policy requires only a **small highly survivable second-strike force** and **resilient nuclear command, control, and communications (C3). Five new strategic submarines (SSBNs)** backed by a small reserve fleet of 40 strategic bombers would fully support the policy, which requires a robust capability to destroy a nuclear aggressor's key elements of state control and sources of its power and wealth. All other existing U.S. nuclear forces, including silo-based missiles (ICBMs), should be phased out and all other planned U.S. nuclear force programs should be canceled.

The top priority of the U.S. nuclear modernization program should be strengthening the vulnerable U.S. C3 system. A larger menu of de-escalatory conventional options to replace escalatory nuclear responses is needed. Achieving these force and C3 objectives would ensure nuclear deterrence vis-a-vis Russia, China, and North Korea while greatly reducing the volatility of a crisis, the pressure to initiate a preemptive strike, the risk of launch on false warning, and the likelihood of rapid escalation to all-out nuclear war. A deterrence-only policy would also cut the U.S. stockpile of operationally deployed weapons by two-thirds to 650, put the "nuclear complex" responsible for nuclear weapons maintenance and production on a sustainable footing, and advance the goals of nuclear non-proliferation and phased, verifiable disarmament. The United States should champion a global treaty to prohibit the first use of nuclear weapons and devise and implement an action plan detailing the technical and diplomatic steps needed to achieve a nuclear-free world.

# *Executive Summary*

The United States should adopt a deterrence-only nuclear strategy that recognizes neither Russia nor China has strong intrinsic reason to initiate a nuclear attack on the United States and that deterring such attacks can be assured by a relatively small number of survivable U.S. nuclear weapons capable of responding to the immediate circumstances of enemy aggression. This shift would allow the United States to halve the size of its nuclear arsenal and the number of targets in its war plans. It would also pave the way to even deeper reductions and facilitate progress toward a nuclear-weapon-free world.

The primary targets of a deterrence-only strategy would consist of key elements of state control and the economic-industrial base that is the source of its power and wealth: leadership facilities; banking, communications, and transportation networks; oil pipeline and shipping infrastructure used in petroleum exporting; and oil refineries, metal works plants and electric power plants. The destruction of this infrastructure is not time sensitive and therefore would not require prompt or preemptive strikes to disable it. Additionally, an estimated 30 to 50 percent of these targets are vulnerable to conventional and cyberattacks, allowing U.S. non-nuclear forces to be substituted for nuclear weapons in substantial numbers and de-escalatory non-nuclear choices added to the president's menu of wartime strategic options.

U.S. conventional capabilities could destroy the vast bulk of these vulnerable targets in response to enemy attack. Conventional forces are sufficiently survivable across a broad spectrum of conflict scenarios to perform this mission. In addition, advanced offensive cyber capabilities have been developed to provide a means of non-nuclear attack against many of the key elements of an adversary's state control, power, and wealth. Cyberwarfare capabilities are more vulnerable than conventional forces in high-intensity conflict but they offer an effective alternative to nuclear weapons for disabling or disrupting an adversary's critical infrastructure and command, control, and communications (C3) facilities during earlier stages of conflict.

A shift to a deterrence-only nuclear strategy with its commitment to retaliation implies that the top priority in modernizing the U.S. nuclear arsenal should be strengthening the resilience and survivability of C3 networks. Elements of these vulnerable networks still use 1950s technology and are in desperate need of upgrades. Care must be taken to ensure that the president can order nuclear use reliably in response to enemy nuclear attack (positive control) and that such forces cannot be used without direct presidential authorization or through a series of accidents, C3 disruption, or other circumstances (negative control). The risks of a failure of either type of control remain unnecessarily high due to the chronic neglect of C3 networks and the strong operational inclination of current strategy toward preemptive strikes and prompt launch on warning. C3 modernization strengthening the "connectivity" of the leadership and the far-flung nuclear forces is crucial to ensuring the credibility of a deterrence-only strategy that requires the ability to respond after absorbing a large-scale enemy strike. This is an immense but surmountable challenge.

Another major benefit of adopting this strategy is that it would afford the opportunity to scale down current plans for U.S. nuclear modernization. The United States could fully support the strategy with a monad composed of nuclear-powered ballistic-missile submarines (SSBNs). Five new submarines would suffice if, as would be certain in any real conflict, conventional and cyber forces were mixed with nuclear forces in programming attack assignments. This transition would also entail a reduction in U.S. deployed nuclear warheads from the current level of 2,000 on multiple different platforms to less than 700 warheads on the five SSBNs (see Table 1).

| | Deterrence Only | Deterrence-Plus-Warfighting |
|---|---|---|
| Aimpoints | 445 | 905 |
| Total Sea-Based Force | 5 Columbia-class submarines | 7 Columbia-class submarines |
| Total Deployed Warheads | 640 | 896 |
| SSBNs at Sea | 3 Columbia-class submarines | 5 Columbia-class submarines |
| Warheads at Sea | 384 | 640 |

Table 1: Active Forces Under Deterrence-Only and Deterrence-Plus-Warfighting Strategies. (Assumes U.S. conventional and cyber forces cover 30 percent of the aimpoints.) SSBNs at Sea: The remaining Columbia-class submarines (two in both the deterrence-plus-warfighting and deterrence-only strategy) would normally remain in port in peacetime and could be sent to sea during a crisis. Each SSBN at sea would carry 16 missiles with eight warheads each for a total of 128 warheads per SSBN.

Almost all of the existing forces and the rest of the new nuclear-weapon programs in the modernization pipeline—including seven additional new SSBNs beyond the five called for by this report, the existing 400 silo-based intercontinental-range missiles slated for

replacement, 100 new and 75 old heavy long-range bombers, and the tactical nuclear weapons delivered by dual-capable aircraft—would become superfluous and subject to cancellation.

A transition to a deterrence-only strategy would thus vastly reduce the scope of current modernization plans, promote building a more robust and reliable C3 system to support post-attack operations, and allow substantial sums of money to be re-allocated to more pressing non-nuclear defense and security needs.

A deterrence-only strategy would replace the existing deterrence-plus-warfighting strategy which no longer fits the security environment and increasingly diverges from the security needs of the United States in the 21st century. The current U.S. nuclear posture is a vestige of the Cold War that reflects the following long-standing and anachronistic operational practices:

- methodically programmed massive nuclear-strike plans independent of any immediate circumstance;
- directed mainly against Russian and Chinese nuclear forces and their supporting launch and C3 systems;
- continuously and immediately enabled by alert U.S. nuclear forces capable of covering primary targets in several categories—nuclear forces, war-sustaining industries, and leadership facilities; and
- technically configured and operationally inclined for rapid reaction in preemptive or launch-on-warning modes despite a commitment in theory and doctrine to second-strike retaliation only in response to enemy nuclear aggression.

A recent official review by the Trump administration reaffirmed these practices. By contrast, this study concludes a deterrence-only approach would provide greater stability and security at lower cost.

Although the target set of a deterrence-only strategy would largely overlap two of the three target categories (leadership and war-sustaining industries) in the existing U.S. strategy, it would exclude opposing nuclear forces. The U.S. nuclear posture, force structure, and planning would be de-coupled from the size of opposing nuclear forces and no longer geared to the immediate destruction of those forces. The existing warfighting posture, often referred to as a counterforce strategy, coupled to the additional traditional requirement to cover leadership and war-sustaining industrial targets, portends a magnitude of destruction far beyond any reasonable judgment of actual deterrent requirements. It also rationalizes maintenance of an arsenal far larger than needed for deterrence. And most importantly, because warfighting seeks the rapid destruction of opposing nuclear

forces, it places a premium on early first use and thereby encourages a rushed decision to initiate an attack. With "use or lose" forces operationally inclined toward preemption and launch on warning, warfighting also runs an inherent and unacceptably high risk of an inadvertent, accidental, or unauthorized triggering of the operational attack plans. These instabilities and risks are compounded by Russia's equally strong inclination toward early and rapid employment of nuclear weapons during a confrontation.

If the United States continues to field its risky strategy of deterrence-plus-warfighting, against the advice of this report, the official U.S. nuclear modernization plan currently underway would still produce a vastly oversized and extravagantly expensive arsenal. U.S. planners are building an arsenal that is much larger than necessary to cover all the priority aimpoints in the current strategic war plan, including all known nuclear weapon deployments in Russia, China, and North Korea. The current modernization plan envisions the construction of 12 new SSBNs, when in reality seven to 10 would suffice to meet extant target objectives. No additional forces are needed even under today's deterrence-plus-warfighting strategy and hence there is no reason to keep, let alone replace, the aging U.S. bomber and silo-based missile forces. Not only are these surplus forces expensive to maintain and replace, they also provide incentives and possible justification for potential U.S. adversaries to maintain unnecessarily large nuclear forces of their own, a self-perpetuating dynamic that fuels nuclear arms competition.

Under either the current or proposed strategy, the forward-deployed dual-capable aircraft assigned to deliver nonstrategic nuclear weapons (which, if used, would be considered strategic on the receiving end) should also be eliminated. Like the Minuteman III silo-based force, these aircraft are highly vulnerable and have negligible military utility. Also, no valid requirement exists to acquire new "low-yield" nuclear weapons. Many hundreds of "low-yield" weapons already exist in the U.S. stockpile, but they can be mostly eliminated and their assignments given to modern conventional weapons whose accuracy makes them as lethal as tactical nuclear weapons.

As noted above, plans to equip a new generation of stealthy, long-range strategic nuclear bombers could also be scrapped under either strategy. However, should military and intelligence planners obtain strong evidence to doubt the long-term invulnerability of America's SSBN fleet due to anti-submarine-warfare threats or other "black swan" contingencies, then prudence dictates modernizing the bomber force and its weapons payloads as a nuclear reserve hedge force.

The cost of this insurance policy would be far lower than the cur-

rent bomber modernization program, however. While the official program envisions a fleet of 75 older B-52H and 100 brand new B-21A stealth bombers, a much smaller fleet would suffice. A fleet of only 40 bombers armed with 450 warheads is needed under a deterrence-only strategy, and only 70 bombers armed with 900 warheads under a deterrence-plus-warfighting strategy (see Table 2). Their payloads would consist of a mix of nuclear gravity bombs and cruise missiles. Additional conventional cruise missiles capable of destroying most types of enemy targets would be added to the mix. The bomber mission would probably remain viable without building and deploying a new standoff nuclear cruise missile (known as LRSO, for "long-range standoff") carrying a modified version of the existing W80 warhead, but an analysis of alternatives is needed to define the optimal mix of payloads.

| | Deterrence Only | Deterrence-Plus-Warfighting |
|---|---|---|
| Aimpoints | 445 | 905 |
| Air-Based Force | 40 bombers | 70 bombers |
| Reserve Warheads | 450 | 900 |

Table 2: Reserve Forces Under Deterrence-Only and Deterrence-Plus-Warfighting Strategies. The air-based force consists of B-52H, B-2A, and B21 Raiders equipped with gravity bombs and cruise missiles. The bomber force would be kept off alert in peacetime, with its nuclear warheads kept in central storage, except in an emergency that grounded some or all of the Columbia-class submarine fleet.

As is the case today, the future strategic nuclear bomber force would remain off alert in peacetime unless and until the SSBN fleet encountered a critical threat to its effectiveness arising from new anti-submarine-warfare capabilities or from unexpected technical flaws in its propulsion reactor or other components. A plausible judgment that an enemy breakthrough in anti-submarine warfare might not be detected in time to take effective countervailing action might also justify alerting all or a portion of the hedge bomber force in peacetime. Depending upon the circumstances, this increase in readiness from reserve to full-alert status would be maintained until the SSBN issues were resolved.

This modernization road map would transform U.S. nuclear posture and save hundreds of billions of dollars over 30 years otherwise spent on force modernization, maintenance and operations, and warhead work by the Department of Energy's nuclear facilities. These savings could finance increased investment in C3 modernization. The net savings after this reallocation could amount to tens of billions of dollars.

More importantly, a deterrence-only strategy would enable the United States to address the root source of existing nuclear danger: the large number of nuclear weapons around the world at risk of misuse. It would light the way toward reducing the role of nuclear

weapons, cutting their numbers and hastening their elimination. These are fundamentally legitimate and long-standing U.S. national security aspirations.

By contrast, the current strategy strives to enable nuclear warfighting and exploit any opportunity to gain the capacity to physically prevent Russian or Chinese nuclear attack on the home territory of the United States through preemptive offensive strikes, possibly in combination with missile defenses. This quest for "counterforce" superiority goes far beyond the stated purpose of deploying nuclear weapons for deterrence and embraces aims that today are not widely regarded as fundamentally legitimate goals for American military or security policy. It is also self-defeating as this anachronistic strategy only works to stimulate countervailing measures and arms racing by potential adversaries.

By adopting the alternative strategy of deterrence-only, the United States could dampen these warfighting dynamics and foster deep reductions or caps by other nuclear weapon countries. This would open up a credible pathway to the complete elimination of nuclear weapons.

To advance this goal of "global zero," one of the key first steps is convincing Russia that matching the near-term U.S. cuts proposed by this report serves Russia's own national security interest. This will not be easy but the goal is feasible if an effort is made to address the wider panoply of nuclear and conventional security concerns in the spirit of equal security for both sides. Although the goal is to reduce reciprocally and equally to 650 nuclear warheads apiece, the United States should not make its adoption of a deterrence-only strategy and the associated cuts to 650 weapons contingent upon negotiated cuts with Russia. A deterrence-only strategy is preferable to deterrence-plus-warfighting in part because it allows the United States to delink its forces from the size of the Russian arsenal. The size and composition of the U.S. arsenal should be keyed only to the intrinsic need to deter, and not to engaging opposing forces in nuclear warfighting.

If progress can be made toward shrinking the Russian nuclear arsenal to the U.S. level of roughly 650 total warheads, the stage would be set for deeper bilateral cuts and the imposition of constraints such as caps on the stockpiles of other nuclear-armed states. One important aim would be garnering a multilateral agreement among all the nuclear-armed states to reduce to or cap their arsenals at 300 weapons. If that goal can be reached, then the next and final stage would be negotiating a comprehensive multilateral agreement among all the nuclear-armed states setting the terms for complete elimination. These provisions would include a timetable and set of security

and verification conditions for implementing phased, proportional, and verifiable reductions culminating in total elimination.

In addition to phased bilateral and multilateral reductions in the size of nuclear stockpiles, a reasonable list of other intermediate measures on a credible path to complete elimination would include:

- adopting a policy of "no first use," which categorically prohibits any initial use or threat of use of nuclear weapons for any purpose;
- de-alerting nuclear forces, which removes weapons from operational status to secure storage separated from delivery systems and placed under monitoring;
- creating an international monitoring program that, when fully evolved, would provide the basis for accurate accounting and reliable security of all weapons and weapon-usable materials (plutonium and highly enriched uranium) on a continuing basis while maintaining invulnerability to disarming attack; and
- ending all testing of nuclear devices, all production of weapon-usable fissile materials, and all fabrication of new weapons out of preexisting fissile-material stocks.

Because the United States and Russia possess the lion's share of the world inventory of nuclear weapons, they have a particular obligation to be responsible stewards. This stewardship implies responsibility to refrain from threatening to use nuclear weapons first and avoid brinkmanship, and engage in serious discussions of the steps listed above as well as other steps that would reduce the risk of nuclear-weapon use and advance the cause of their eventual elimination. The United States and Russia should broaden their talks on strategic arms to consider all categories of nuclear weapons, including tactical weapons. Besides aiming to shrink the total arsenals, these talks should also address key operational matters such as the dangerous "hair-trigger" alert status of the two countries' nuclear missiles and find ways to reduce the risks of misperception of each other's military intentions, including the risks of a missile launch based on a false warning. Other key subjects for discussion include key non-nuclear strategic capabilities such as missile defenses and precision long-range conventional weapons. These strategic-stability talks should be open to discussion of any concerns that may increase the danger of nuclear escalation and conflict. It is hard to imagine a scenario where the United States and Russia can pursue deep reductions unless both sides are willing to engage and compromise with each other on military and political activities that are relevant to their national security concerns.

These stewards also bear responsibility for pursuing dialogue with the other nuclear-armed nations. Toward this end, they should convene a first-in-history multilateral nuclear-weapons summit to consider proposals from the five nuclear-armed members of the Nuclear Non-Proliferation Treaty (NPT), other nuclear-armed countries, and key non-nuclear-armed stakeholders on ways to reduce nuclear danger. These proposals should consider bold steps for advancing global strategic-arms control leading to the worldwide reduction and eventual elimination of nuclear weapons. The United States and Russia need to listen to third-party views on the incremental process needed to achieve greater security with fewer nuclear weapons in the world.

This summit should also seek the commitment of all nuclear-armed nations never to initiate the use of nuclear weapons. "No first use" is an idea whose time has come. Adopting this policy and, ideally, codifying it in a treaty or agreement prohibiting the first use of nuclear weapons would lend stability to crises and advance the cause of global nuclear disarmament.

Together with progress on nuclear arms control, it would also roundly affirm U.S. support for the NPT, an indispensable tool in staving off and rolling back proliferation. The United States must pay far more than lip service to its Article VI treaty obligation to pursue good-faith negotiations for nuclear disarmament if this fundamental agreement is to be preserved and strengthened. By following this road map, the United States would pay serious heed to the disarmament aspirations of the vast majority of the treaty's 189 signatories and recapture global nonproliferation leadership. In return, the United States could expect the other signatories to support other key U.S. national security objectives, including preserving the NPT, keeping Iran from developing a nuclear weapon, pressuring North Korea to freeze and eventually dismantle its nuclear and ballistic-missile programs, preventing a new nuclear arms race, and reducing the risks of nuclear weapon use.

# *I.*
# *Introduction*

In a world brimming with nuclear weapons, in which just one nuclear device out of the 15,000 held by the nine nuclear-armed nations can destroy a large city, preventing their use is of paramount importance (for global stockpile estimates, see Figure 1). Deterring a deliberate nuclear attack against the United States and its allies is one of the keys to prevention and is the fundamental purpose of U.S. nuclear forces.[1] These forces exist to ensure that the costs of aggression by potential adversaries will far outweigh any political or military gain. Any rational adversary facing the prospect of such costs should be deterred, and by the same token, U.S. allies should be reassured. These dual outcomes have been the main objectives of U.S. military power for seven decades.

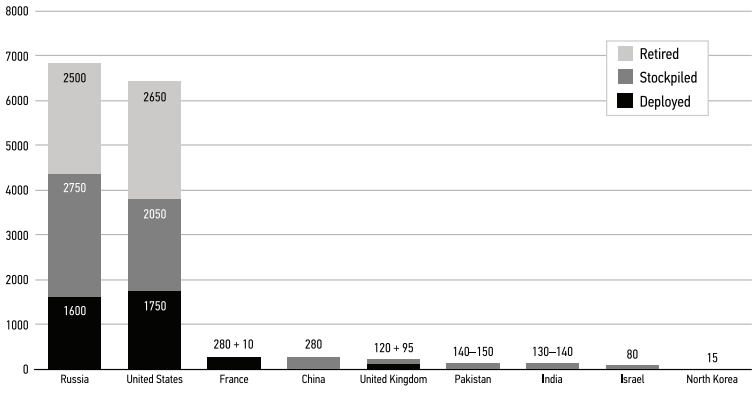


Figure 1: Estimated Global Nuclear Warhead Inventories, 2018. Chart from Hans M. Kristensen and Robert S. Norris, "Status of World Nuclear Forces," Federation of American Scientists, June 2018, fas.org.

While nuclear deterrence remains a pillar of U.S. national security and a security umbrella for U.S. allies, its central organizing principle of threatening massive destruction in response to nuclear aggression was more suited to the Cold War confrontation with the Soviet Union and China than to the modern rivalry among the United States, Russia, and China. But despite the anachronistic nature of today's nuclear postures, these competitors have been unable to replace the

[1] This report's description of the U.S. nuclear posture draws heavily on conversations and collaborations over many years with the author's close colleague, John Steinbruner, who passed away in 2015. See, for example, John Steinbruner, "Security Policy and the Question of Fundamental Change," Center for International and Security Studies at Maryland, November 2010, cissmdev.devcloud.acquia-sites.com.

paradigm of nuclear deterrence with a new security architecture. They remain under its yoke, seemingly condemned to maintain and rebuild vast arsenals in perpetuity.

Among the deleterious consequences are an increased risk of nuclear conflict and massive investments in weapons of diminishing relevance to the biggest global security dangers facing the world in the 21st century—nuclear proliferation, terrorism, cyberwarfare, climate change, mass refugee migrations, and a multitude of dangers stemming from the diffusion of power around the world.

China and Russia are not U.S. allies, but they are indispensable partners in the resolution of these vexing challenges. Preserving reciprocal nuclear terror as the central organizing principle of mutual security contributes to central and extended deterrence—wherein U.S. nuclear forces serve to deter an attack on the United States (central) and its allies (extended)—but fear-based relationships stunt cooperation in grappling with these complex problems. And their adversarial nuclear postures carry an inherent risk that nuclear weapons will be used, intentionally or not. Today there are a multitude of scenarios of use by one of the nine states that possess them, or by terrorists seeking to acquire them. The number of possible scenarios is much higher than existed at the height of the Cold War, and consequently the likelihood of intentional or unintentional use may well be higher.

Wisdom in imagining a new direction and shaping a more suitable nuclear posture for the early 21st century begins with an honest reckoning of the shortcomings of current policy. Nine key points underlie most of the findings and recommendations of this analysis.

First, the long-standing operational U.S. (and Russian) practice of programming massive-attack options directed against opposing nuclear forces, war-sustaining industries, and leadership facilities produces an egregious discrepancy between the scale of destruction enabled by the nuclear forces and any reasonable judgment of what scale would actually deter an adversary. The legacy U.S. posture of deterrence-plus-warfighting directed against roughly 1,500 total aimpoints in Russia, China, North Korea, and Iran goes well beyond intrinsic requirements of a deterrence-only posture. The capacity to deliver a very small number of nuclear weapons in a measured and flexible manner in response to immediate circumstances should suffice. It is reasonable to judge that such a capability would serve to repress any impulse by a legitimate state under rational leadership to initiate a nuclear attack against the United States or U.S. allies.

Second, the legacy posture rests precariously on the core assumption of deterrence that national leaders as individuals are rational actors and perform logical calculations of costs and benefits. Gen-

eral John E. Hyten, head of U.S. Strategic Command (STRATCOM), recently testified that "a rational actor is the basis of all deterrent policy."[2] But a posture enabled by high-alert nuclear forces configured and inclined toward preemptive or prompt "launch on warning" does not support a deliberative process. Even the most level-headed U.S. (or Russian) leader could buckle under the immense time pressure imposed by current nuclear postures. Aggravating factors include the likelihood of inadequate information, misperception, political pressure, and fear. Decision-making in crises and under uncertainty often leads seemingly rational leaders to make mistakes or misinterpret an adversary's behavior or intentions.

[2] U.S. Congress, Senate, Committee on Armed Services, Hearing to Receive Testimony on United States Strategic Command in Review of the Defense Authorization Request for Fiscal Year 2019 and the Future Years Defense Program, 115th Cong., 2nd sess., 2018, 62, www.armed-services.senate.gov (hereinafter SASC Hearing on U.S. STRATCOM).

The assumption of rationality may not be tenable for another reason. Doubts have arisen as nuclear weapons proliferate to more actors and as traditional norms of international behavior yield to idiosyncratic interpretations of acceptable conduct on the world stage. The lineup of world leaders in command of nuclear forces today includes more than one outlier whose grasp of reality appears in doubt at times and whose advisers and institutions appear unwilling or unable to rein in their impulses. Hinging national and world security on the assumption of human rationality seems a dubious wisdom.

Third, deterrence's core message that nuclear weapons offer their possessors a security blanket runs counter to the plea to non-nuclear nations to forgo such weapons permanently. This contradiction, dripping in hypocrisy, engenders cynicism among the non-nuclear-weapon countries and erodes the nonproliferation regime.

Fourth, the extensive "modernization" of nuclear forces underway in the United States, Russia, and China does not comport with the treaty obligations of the five nuclear-armed members of the Nuclear Non-Proliferation Treaty (NPT). Their pledges to negotiate disarmament in good faith and reduce the salience of nuclear weapons in international affairs ring disingenuous in light of their nuclear upgrades. This discordance harms the nonproliferation cause.

Fifth, the U.S. nuclear posture works at cross-purposes with crisis stability. The United States (along with Russia, France, and the United Kingdom, but not China) refuses to rule out the first use of nuclear weapons. This weakens restraint during a crisis. The mutual anticipation of nuclear first use by the belligerents would exert pressure on them to go first, or "preempt." In the case of the United States and Russia, this pressure is greatly aggravated by the long-standing operational practice of programming massive-attack plans directed primarily against the opposing nuclear forces (many of which are vulnerable) and enabling these plans by alert forces poised for immediate launch.

Sixth, the U.S. posture has an Achilles' heel: vulnerable command,

control, and communications (C3) and early-warning networks. The fear that these networks would collapse under attack all but compels national leaders to authorize the release of U.S. nuclear forces during a crisis regardless of the survivability of the triad of U.S. land-based Minuteman missiles, Ohio-class ballistic-missile submarines, and heavy long-range B-52H and B-2A bombers. Having the ability to absorb an attack and retaliate is the essence of deterrence, and yet the United States has failed to ensure presidential survival and robust communications—both vital to executing a retaliatory attack. This deficiency far outweighs concerns about the number, reliability, and survivability of warheads, bombs, and delivery vehicles. If command and control fails, nothing else matters.

Seventh, the existing nuclear posture stands apart from powerful U.S. conventional forces and other non-nuclear military capabilities. It neglects both the positive and negative contributions of these capabilities. On the positive side, exponential advances in information processing—the driving force behind the "revolution in military affairs"—have allowed for the mass substitution by conventional precision-guided forces directed by space navigation and laser targeting for nuclear forces in mission planning and accelerated the 80 percent drawdown in the nuclear inventories of the United States and Russia since their Cold War peak.[3] But the U.S. nuclear posture has still not fully exploited this revolution. Strategic planners have not adequately grasped the need and opportunity for providing the president with strategic non-nuclear options involving conventional forces for de-escalating the early phase of conflict, even one marked by enemy nuclear strikes. The recent Pentagon push to develop new "low-yield" nuclear weapons for purposes of conflict de-escalation fails to grasp the fact that any use of nuclear weapons is inherently escalatory and unnecessary given the availability of powerful non-nuclear capabilities.[4] On the negative side, high-performing non-nuclear U.S. capabilities have not only widened the U.S. conventional advantage over its potential adversaries and driven these countries to rely more on nuclear weapons and their early first use to compensate, but also increasingly put those opposing nuclear forces at risk. The growing lethality of U.S. conventional weapons has thus undermined nuclear crisis stability at the same time that they provide tools for de-escalation. This double-edged sword complicates all aspects of nuclear planning, operations, and arms control.

Eighth, the U.S. posture saddles strategic-arms control with a perspective that focuses on nuclear weapons and looks past non-nuclear capabilities. This downplays real or perceived U.S. advantages in those capabilities, particularly in the areas of precision-guided conventional weapons and missile defenses. Thus, it was U.S.-led con-

[3] The thaw in U.S.-Russian relations during the post-Cold War years was fundamentally responsible for this drawdown, but changes in doctrine and tactics enabled by the revolution in military affairs strongly reinforced this trend.

[4] According to the author's analysis, numerous conventional cruise missile and gravity bombs in the current U.S. arsenal are capable of destroying almost all enemy targets except for superhard targets (hardened to a level above 1,000 pounds per square inch) like most underground missile silos and some command posts.

ventional precision bombing during the Balkans conflict in 1999 and U.S. withdrawal from the Anti-Ballistic Missile Treaty in 2002, coupled with the deployment of missile defenses that spurred Russia's modernization of its nuclear weapons and its reluctance to negotiate a follow-on treaty to replace the New Strategic Arms Reduction Treaty (New START). Progress in U.S.-Russian strategic-stability talks and in drawing other nuclear-armed countries into multilateral discussions of strategic arms has also suffered as a consequence. The narrow compass of such talks needs to be widened.

Ninth, and last, the U.S. posture seems to float in a geopolitical vacuum. It is understood almost entirely in military terms, divorced from broader connections to political relationships, diplomacy, economic sanctions, and other nonmilitary dimensions. This decoupling magnifies the role of the nuclear force in international relations and in managing crises. An ordinary strain in relations can bring nuclear weapons into the foreground of the relationship. Thus, the end of the Cold War did not end the practice of programming massive-attack options and keeping thousands of nuclear warheads on hair-trigger alert, notwithstanding a symbolic and operationally meaningless "detargeting" agreement between the United States and Russia signed in 1994. In 2014, the Russian incursion into Ukraine was a sufficient strain in U.S.-Russian relations to initiate a phase of nuclear signaling and brinkmanship between them.

These shortcomings, amplified by an equally myopic posture in Moscow, led to an almost unfathomable amount of nuclear overkill during the Cold War. Soviet and U.S. arsenals grew well beyond any reasonable deterrent requirement—13,000 U.S. strategic weapons aimed at 16,000 Soviet targets in the 1980s. Present-day arsenals still exceed any reasonable judgment of actual deterrent requirements. In their continuing pursuit of warfighting capabilities if not decisive nuclear superiority, both sides are undertaking outsized modernization programs that will continue to hold each other and the world hostage to incomprehensible levels of violence and destruction.

Breaking the nuclear grip of this long-standing pursuit on U.S.-Russian relations and on U.S. capital investments will be very difficult, but the United States has a historic opportunity to leverage its other strengths and chart a new course in reducing the role and salience of nuclear weapons. It should pursue an ambitious agenda whose lead items should be negotiating deep U.S.-Russian nuclear cuts and eliciting formal pledges from all the nuclear-armed states not to use nuclear weapons first in conflict. The United States should also immediately transition to a deterrence-only strategy. Backed by powerful non-nuclear capabilities designed for second-strike responses, this posture would provide adequate deterrence while

changing the strategic culture of nuclear warfighting, restraining the nuclear arms competition, and setting the stage for multilateral nuclear negotiations aimed at making progress toward a world free of nuclear weapons.

The United States ought to acknowledge the use of nuclear weapons is unacceptable because of the grave humanitarian consequences of such use—the driving motivation behind the 2017 Treaty on the Prohibition of Nuclear Weapons. The humanitarian consequences movement argues persuasively, based on scientific analysis (and a dollop of common sense), that nuclear conflict cannot be confined strictly to the territories and interests of the warring parties. Radioactive fallout, cooling temperatures caused by soot in the stratosphere blocking out the sun, and other environmental and human consequences of a nuclear war would spread far beyond the parties' national boundaries. The scourge would be global. The global externalities of such conflict could even exceed the devastation suffered by the belligerents themselves. Borders offer no safety from the folly of nations that blunder into a nuclear conflict.

Engaging constructively with Russia and China begins with establishing a dialogue. Talks are key to managing nuclear competition and resolving the misperceptions and misunderstandings that could fan the embers of conflict. They are also essential to increasing transparency, resolving allegations of treaty cheating, and rejuvenating strategic-arms negotiations.

Dialogue can also help clarify each nation's view of the value and purpose of its nuclear capabilities and find solutions to the dangers they pose. It behooves the United States and Russia to initiate such dialogue with all the nuclear-armed states in a first-in-history nuclear-weapons summit convened and led by the two former Cold War antagonists.

# *II.*
# *The Value of U.S. Nuclear Capabilities and Enduring National Objectives*

Many observers claim that U.S. nuclear capabilities deserve partial or full credit for deterring nuclear aggression during the Cold War. Although fear of nuclear war ironically stimulated a massive buildup of nuclear arms that only further magnified the fear, it was widely argued, somewhat counterintuitively, that mutual nuclear terror deterred their use. A taboo against their use simultaneously gained strength.

Some of the most astute observers of the Cold War beg to differ, or at least to remain agnostic on the question of whether nuclear weapons deterred nuclear aggression. For example, McGeorge Bundy, who had a front-row seat at the White House during the Cuban Missile Crisis of 1962 as President John F. Kennedy's national security adviser, wrote in retrospect:

> *The nuclear competition contributed powerfully if intermittently to fear, suspicion, and search for advantage (political or military or both) on both sides. Nuclear capabilities on 'the other side' also contributed formidably to caution on both sides in handling crisis and confrontation . . . ['But] there is no way to decide for certain whether nuclear fears helped keep the peace more than they helped to endanger it.*[5]

Far from being a salvation, nuclear weapons themselves often drove the great powers to the brink of a nuclear conflagration during the Cold War. The Soviet Union's desire to offset its numerical inferiority in globe-spanning nuclear missiles by emplacing intermediate-range nuclear-armed missiles within range of U.S. territory precipitated the Cuban Missile Crisis.[6] In 1983, Soviet fear of a surprise nuclear strike against it (the "evil empire" in the words of President Ronald Reagan) led Soviet General Secretary Yuri Andropov to seriously consider launching a preemptive nuclear strike against the United States and NATO to beat them to the punch.[7] Also, both na-

[5] McGeorge Bundy, *Some Thoughts on the Prospects for Disengaging Nuclear Weapons from International Politics,* unpublished memo to the author, June 1992.

[6] See Graham Allison and Philip D. Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis,* 2nd ed. (Reading, MA: Longman, January 1999).

[7] See Marc Ambinder, *The Brink: President Reagan and the Nuclear War Scare of 1983* (New York: Simon and Schuster, 2018); Christopher M. Andrew and Oleg Gordievsky, *Comrade Kryuchkov's Instructions: Top Secret Files on KGB Foreign Operations, 1975–1985* (Palo Alto, CA: Stanford University Press, 1991).

tions on numerous occasions experienced terrifying alarms indicating that incoming enemy nuclear warheads were streaking over the poles at 4 miles per second.[8] Luckily, these indications were assessed to be false, but only just minutes before panic-stricken advisers had to inform their top leaders of the need to immediately render a decision whether and how to "retaliate."[9]

Some observers go further and posit that nuclear weapons also deserve credit for preventing conventional world wars between the great powers after 1945.[10] So does the latest Nuclear Posture Review, released by the Pentagon in February 2018.[11] That document tries to make the broader case that nuclear weapons have deterred not only nuclear but also conventional aggression. It says:

> *During the first half of the 20th century and just prior to the introduction of U.S. nuclear deterrence, the world suffered 80–100 million fatalities over the relatively short war years of World Wars I and II, averaging over 30,000 fatalities per day. Since the introduction of U.S. nuclear deterrence, U.S. nuclear capabilities have made essential contributions to the deterrence of nuclear and non-nuclear aggression. The subsequent absence of Great Power conflict has coincided with a dramatic and sustained reduction in the number of lives lost to war globally . . .*[12]

This claim is nearly impossible to prove or disprove. There are myriad alternatives that must be rejected if one is going to accept that nuclear weapons were an essential cause of the absence of major conventional war. But if the question cannot be scientifically resolved, the views of key witnesses to the Cold War such as McGeorge Bundy ought to be heard. He wrote:

> *I myself would argue, with Professor John Mueller (Retreat from Doomsday), that the peacekeeping role of the bomb is easy to exaggerate, and that there would not have been a large hot war between the Soviet Union and the West if there had been no bomb at all.*[13]

Whatever deterrent benefits accrue from the possession of nuclear weapons, the sobering lessons of history underscore the apocalyptic risks they also carry. These dangers have to be carefully weighed against the putative benefits. Counterfactual historical speculation muddies more than clarifies the balance sheet.

For the United States, this debate is largely academic today because U.S. nuclear weapons are not needed to deter or defeat a large-scale conventional invasion along the lines of previous world wars. U.S. and allied non-nuclear military power is so formidable that it can effectively parry and thus deter such aggression by any nation-state without invoking the nuclear threat.

[8] "Close Calls with Nuclear Weapons," Union of Concerned Scientists, Fact Sheet, April 2015, www.ucsusa.org.

[9] Ibid.

[10] For a recent articulation of this view, see Robert Spalding, "Nuclear weapons are the U.S.'s instruments of peace," *Washington Post*, October 4, 2013, www.washingtonpost.com.

[11] U.S. Department of Defense, Office of the Secretary of Defense, *Nuclear Posture Review* (Washington, DC, February 2018), 17, defense.gov (hereinafter NPR).

[12] Ibid.

[13] Bundy, "Some Thoughts."

# *III.*
# *Maximizing Strategic Stability*

Maximizing strategic stability seeks to strengthen barriers to the outbreak of nuclear conflict between the United States and its potential adversaries.

## *A. Russia and China*

The primary aim of U.S. nuclear strategy is to deter a nuclear attack against the United States or its allies while also ensuring stability in U.S. relations with Russia and China. Through its official declaratory policy, the United States strives to convey to both countries that it does not intend to acquire the capability to negate their nuclear forces, introduce new threats, or in any way destabilize its military relations with Moscow and Beijing.

The message is beset by contradictions, however. If deterrence fails, or failure is imminent, U.S. nuclear strategy today tends toward warfighting aimed at promptly inflicting severe damage on an adversary's nuclear forces. In peacetime, Washington makes strenuous efforts to improve its technical capability to find and destroy Russian mobile strategic ballistic missiles, for example, creating incentives for preemptive operations on both sides during a crisis or conflict. Such planning for wartime operations seems difficult to square with the proclaimed lack of intent to nullify Russian or Chinese nuclear capabilities. A transition to a deterrence-only strategy would align better with such assurances.

The United States, Russia, and China, but especially the United States and Russia, have ample leeway to disengage nuclear weapons from their bilateral politics and adopt operational practices that reduce—and eventually eliminate—nuclear weapons as a source of tension, threat, fear and confrontation.

In the near-term future, the United States and Russia could reduce the size of their arsenals, remove all but a fraction of them from launch-ready alert status, and shorten their wartime target lists. They

could also eliminate plans to launch on warning—launching on the basis of indications from early-warning sensors or other intelligence that an enemy nuclear strike is imminent or underway—from their repertoire of options and limit their capabilities to initiate surprise or preemptive strikes. These steps would thicken firewalls against both deliberate and unintended strikes.

Over a longer time horizon, they could further buttress crisis stability by eliminating their silo-based strategic missiles. These forces reside at fixed and known locations and are mutually vulnerable. For its part, the United States should phase out the Minuteman leg of the U.S. strategic triad over the next 10 years. The almost exclusive mission of these missiles is to engage Russia, or Russia and China simultaneously, in large-scale nuclear conflict. Such wartime scenarios have become unthinkable. Waging war against both countries simultaneously is a contingency so improbable that U.S. planners can safely ignore it. In any event, any nuclear crisis between the United States and Russia would be more stable if their "use or lose" fixed-position strategic forces had been previously dismantled.

Strategic stability rests on rational cost-benefit calculations indicating that no political or military gain would justify initiating the use of nuclear weapons.[14] This determination must remain robust under all conditions, including worst-case scenarios in which massive surprise strikes succeed in comprehensively destroying the opposing strategic forces in their underground silos, submarine pens, and air bases.

[14] Andrei Kokoshkin, *Ensuring Strategic Stability in the Past and Present: Theoretical and Applied Questions* (Cambridge, MA: Belfer Center for Science and International Affairs, Harvard University, 2011).

Although such scenarios strain credulity, the United States would be prudent to hedge against them in deploying and modernizing its nuclear forces and their supporting C3 and early-warning networks. The modernization recommendations presented below in the section "Nuclear Modernization Program" derive from these calculations. Forces and command systems that can perform under the stress of such severe hypothetical conditions can be expected to function under more-realistic wartime scenarios.

Stability would be further strengthened if the nuclear rivals eschewed the first use of nuclear weapons. A no-first-use (NFU) policy would reduce the risk of decision makers misconstruing intentions and striking preemptively or launching missiles immediately upon receiving initial indications of a strike in progress. NFU would encourage restraint and reinforce the taboo against using nuclear weapons in conflict.

The United States has good reason to embrace NFU. It would gain no military or political advantage from using nuclear weapons first in response to attacks of any kind—cyber, conventional, chemical, or biological. First use would only invite nuclear retaliation and carry

a risk of spiraling into a vast conflagration. Furthermore, the United States would have other tools at its disposal. Ample conventional means would be available to deter and respond to non-nuclear aggression.

NFU enjoys growing support among U.S. leaders. The Obama presidency laid the groundwork for its formal adoption.[15] In January 2017, Vice President Joe Biden articulated the position that

> *"given our non-nuclear capabilities and the nature of today's threats—it's hard to envision a plausible scenario in which the first use of nuclear weapons by the United States would be necessary. Or make sense. President [Barack] Obama and I are confident we can deter—and defend ourselves and our Allies against—non-nuclear threats through other means."*[16]

[15] Bruce Blair, "The Flimsy Case Against No-First-Use of Nuclear Weapons," *Politico,* September 28, 2016, www.politico.com.

[16] The White House, Office of the Vice President, "Remarks by the Vice President on Nuclear Security," Washington, DC, January 11, 2017, obamawhitehouse.archives.gov.

This view rejects the contention that taking first use off the table weakens deterrence and allies' confidence in U.S. security guarantees. A clear and credible U.S. position on NFU would have the opposite effect. It would reduce ambiguity and uncertainty and would increase predictability. It would thus tend to be calming and stabilizing during a confrontation. NFU might not remove all suspicion and anxiety about U.S. intentions, but it could substantially allay an adversary's apprehension of a sudden first strike, thus relieving pressure to preempt.

A universal NFU commitment by all of the nuclear-armed states would multiply these salutary effects. Getting as many of these states as possible to agree to renounce first use should be a high priority for U.S. nuclear diplomacy.

Some discontent with this agenda remains to be addressed. A few leaders within the U.S. alliance network have voiced reservations on the grounds that NFU may embolden Russia, China, or North Korea to carry out regional conventional aggression.[17] This concern throws a spotlight on the credibility of the U.S. guarantee of extended deterrence and places a burden on the United States to reassure its allies that it is ready to employ whatever means are necessary to respond effectively to aggression. But nuclear weapons simply are not needed to respond to non-nuclear aggression. The United States can offer credible assurance to allies that conventional capabilities are adequate to repel and defeat such aggression.

[17] Josh Rogin, "U.S. allies unite to block Obama's nuclear 'legacy,'" *Washington Post,* August 14, 2016, www.washingtonpost.com.

In the past, some allies correctly assumed that the United States was prepared to initiate nuclear strikes if necessary to blunt or defeat an adversary's nuclear or conventional capabilities.[18] But today, no ally should expect a U.S. president to employ nuclear weapons first when effective non-nuclear options are available. Nuclear first use would not look credible to either adversaries or allies under such circumstances.

[18] Scott D. Sagan, "The Case for No First Use," *Survival* 51:3 (2009): 167, doi:10.1080/00396330903011545.

This same argument can be generalized to the case of an immi-

nent or actual attack with biological weapons. Some argue that the United States should not let an enemy think it can use bioweapons and escape a nuclear response. The 2018 Nuclear Posture Review thus leaves open the possibility of responding with nuclear weapons to a biological attack from a nuclear state.[19] However, the situations in which this might make sense are highly speculative, highly conditional, and very narrowly circumscribed. Only if a state were conducting ongoing attacks using a short-action biological agent stored in a secure location that could be eliminated only with nuclear weapons, and only if the United States were working with very reliable intelligence on those points, could a case for a first nuclear strike possibly exist.[20] Such a situation is very unlikely.

[19] NPR, 38.

[20] Scenario based on correspondence between the author and Jon Wolfsthal, March 2018.

Given the extremely limited possibility that this situation might occur, a more applicable, credible, and effective deterrent for the risks of biological attacks on the United States or its allies would be to make clear that the United States possesses the means and the will to respond to such an attack with some of its immense capabilities beyond its nuclear arsenal, and would hold accountable those responsible for ordering and executing such an attack. Relying on conventional strikes against the offending regime, in some circumstances with the aim of destroying it, and other non-nuclear means, including international legal prosecution for war crimes, remains a far more credible option for responding to a biological attack.

Some defenders of threatening first use of nuclear weapons see continued value in the ambiguity of such threats in response to the use of other weapons of mass destruction.[21] In the minds of these advocates, it does not make sense to reduce the ambiguity a potential adversary might see as it contemplates the possibility of unleashing such weapons on the United States.

[21] For an example of this view, see Al Mauroni and David Jonas, "All Cards on the Table: First-Use of Nuclear Weapons," *War on the Rocks,* Texas National Security Network, University of Texas, July 25, 2016, warontherocks.com.

The value of making this exception, however, does not come close to equaling the myriad benefits of adopting an NFU policy. Among those benefits is the value of NFU in strengthening the NPT by endorsing a clean negative security guarantee that assures non-nuclear nations that they will never be attacked by U.S. nuclear weapons.

Under NFU, the United States still retains the option of responding to an adversary's nuclear strike with U.S. nuclear force if necessary. In sum, extended deterrence does not necessarily require the employment of U.S. nuclear weapons, and insofar as it does, such use would only occur in response to an adversary's nuclear attack.

NFU appeals to some U.S. allies and partners for a completely different reason: they worry that the United States might prematurely resort to the first use of nuclear weapons and provoke nuclear retaliation that inflicts great harm and possibly threatens their very survival. A NFU policy that removes this danger would be welcomed

by these allies.

NFU is often dismissed as empty rhetoric that could easily be overturned if the parties changed their minds.[22] But the operating systems of nuclear postures can be modified in ways that show a genuine commitment to the policy. To reinforce the credibility of a U.S. pledge not to strike first and assure adversaries that such a strike would not negate their ability to respond, the United States could greatly reduce the number of warheads on launch-ready alert. The number should be kept well below the threshold at which a sudden decapitating strike is possible; about 270 warheads pose such a first-strike threat to Russia. The U.S. delivery vehicles carrying the deployed warheads—submarines only, after the elimination of silo-based missiles—could incorporate this principle by adopting a "modified alert" posture that requires 24–72 hours of preparations to reach launch-ready status. Russia would be called upon to return to its pre-1993 commitment to NFU and adopt comparable confidence-building measures that align operations with it. China already keeps its strategic forces at a low level of readiness in keeping with its longstanding NFU pledge.

[22] See Lewis A. Dunn, "The Strategic Elimination of Nuclear Weapons: an Alternative Global Agenda for Nuclear Disarmament," *Non-proliferation Review* 24 (2018): 405, doi:10.1080/10736700.2018.1440733.

In signaling U.S. intent not to negate Chinese or Russian nuclear forces, the United States could take additional steps. It could refrain from tracking and targeting their relocatable land- and sea-based nuclear delivery systems that have dispersed—mobile intercontinental ballistic missiles (ICBMs) that have left their garrisons to go into the field and ballistic-missile submarine (SSBNs) that have left their submarine pens for the oceans. U.S. surveillance planes and vessels operating close to Chinese and Russian borders and other intrusive intelligence-gathering activities carried out in support of nuclear-employment planning (for example, finding weaknesses in air defenses through which penetrating strategic bombers or other warplanes would fly in wartime) could be curtailed in peacetime. And U.S. missile defenses could be deployed in configurations that do not put their strategic deterrent capabilities at risk. (See the "U.S. Missile Defenses" section below.)

## *B. North Korea*

Current U.S. policy toward North Korea is a work in progress now that President Donald Trump and North Korean leader Kim Jong Un have begun a negotiation process with uncertain milestones and timelines, but several underlying objectives appear to be foundational. The policy aims to deter Pyongyang from using nuclear weapons against the United States or its allies and to nullify the North's weapons of mass destruction (WMD) if deterrence fails. It

aims to prevent a conventional as well as nuclear conflict between North Korea and the United States or its allies. The policy also seeks to induce North Korea to cap or freeze and eventually relinquish its nuclear arsenal and fissile-material stockpile, minimize its ballistic-missile capabilities, rejoin the NPT in good standing, and prevent its nuclear program from stimulating proliferation among neighboring non-nuclear states that feel threatened by it, particularly South Korea and Japan.

Other than deterring North Korean nuclear attack and reassuring allies—Japan and South Korea in particular—of the dependability of U.S. extended deterrence, U.S. nuclear weapons play little role in achieving these aims. The primary tools are diplomatic, economic, and financial sanctions and non-nuclear military capabilities. The latter includes global and regional missile defenses—the Ground-Based Interceptor (GBI) missile defenses meant to protect U.S. territory from attack by long-range ballistic missiles, and Terminal High Altitude Area Defense, Patriot, and Aegis regional missile defenses designed to protect allies against short- to medium-range ballistic missiles. The effectiveness of these missile defenses is marginal today, and future investment in existing technologies may well drop as North Korea equips its ballistic missiles and reentry vehicles with decoys and other countermeasures. Research into alternative missile defense technologies will continue to have priority, however, particularly boost-phase intercept systems that would be deployed in close proximity to North Korean territory.[23] This is a very promising approach to improving missile defense performance, and it also presents a potential opportunity for cooperation between the United States and Russia in fielding a joint missile defense system for intercepting North Korean ballistic missiles from Russian territory near North Korea.

As long as North Korea persists in advancing its nuclear-weapon and ballistic-missile programs, it behooves the United States and its South Korean and Japanese allies to maintain their visible bulwark against North Korean aggression by conducting regular exercises of allied conventional forces. As a reminder of the U.S. nuclear umbrella, U.S. strategic bombers based in Guam or the United States operate visibly in the region. All of these programs and activities on all sides are, of course, subject to negotiation. At the time of this writing, a preliminary understanding had been reached between the United States and North Korea to suspend the North's missile testing along with U.S.-South Korean military exercises as initial steps toward the denuclearization of the Korean peninsula.

[23] Arthur Herman, "Boost-Phase Intercept Is Still the Best Defense Against the North Korean Nuclear Threat," *National Review Online,* June 15, 2017, www.hudson.org.

## C. *Iran*

Owing to the successful negotiation of the Joint Comprehensive Plan of Action and continuing Iranian compliance despite the recent unilateral U.S. withdrawal from the agreement, an Iranian nuclear-weapon threat is not a near-term contingency. All planning for U.S. nuclear strikes against Iran should cease for as long as Iran remains a non-nuclear-weapon state.

## D. *U.S. Alliance Military and Nonmilitary Power*

The United States pledges to defend allies by whatever means are necessary to deter and defeat the threats they face. U.S. conventional capabilities and second-strike nuclear capabilities provide the means. Both underwrite extended as well as central deterrence. As previously noted, as a general rule, both forms of deterrence are based on conventional responses to conventional aggression and nuclear responses to nuclear aggression except in circumstances in which formidable U.S. conventional options allow for a non-nuclear response to nuclear aggression.

U.S. alliances provide a degree of collective security that their rivals (great-power competitors) can only envy. Seventy-six countries host U.S. military bases for reasons of mutual security.[24] One hundred seventy countries host U.S. military forces on their territory, and dozens of those states host a sizable U.S. military presence.[25] Thirty-two strong allies are committed by the terms of their alliance to assist the United States (and vice versa) in the event of Russian, Chinese, North Korean, or terrorist aggression against any of them.[26]

This robust alliance network doubtless gives profound pause to any potential challenger, none of whom enjoy the support of many strong allies. Russia has military bases in a handful of countries, mainly former Soviet republics and pariah states such as Syria.[27] China has one base in one foreign country—Djibouti, where the United States has a sizable military contingent.[28] Russia, China, and others have no realistic prospect of winning a protracted large-scale conventional conflict waged beyond their borders against the U.S. alliance network. Current U.S. conventional forces, in addition to missile defenses, cyberweapons, special-operations forces and other non-nuclear military tools, provide credible deterrence. Combined with allied capabilities, they are sufficiently formidable to cause any rational decision maker to doubt his or her chances of achieving war aims through military aggression. By the same token, these combined capabilities offer compelling reassurance to allies.

To convince allies and adversaries alike that the threat of U.S. nu-

[24] David Vine, List of U.S. Military Bases Abroad, 2017 (May 14, 2017), Digital Research Archive, dra.american.edu.

[25] U.S. Department of Defense, Defense Manpower Data Center, *Military and Civilian Personnel by Service/Agency by State/Country* (Washington, DC, September 2017), www.dmdc.osd.mil.

[26] Those allies are NATO member states plus Japan, South Korea, Australia, and the Philippines.

[27] Arman Mussin, "Russia's Military Bases in Central Asia," *Nazarbayev University Political Science Review,* Nazarbayev University School of Humanities and Social Sciences, January 11, 2017, nupsreview.wordpress.com.

[28] Brad Lendon and Steve George, "China sends troops to Djibouti, establishes first overseas military base," *CNN,* July 13, 2017, www.cnn.com.

clear retaliation to nuclear aggression is credible, the United States keeps large numbers of strategic nuclear forces at the ready, independent of any immediate crisis.[29] The bulk of them are submerged at sea and highly survivable.[30] They are on alert even in peacetime. In a crisis, many hundreds of additional warheads and bombs can be loaded onto strategic bombers and placed on airstrip alert at airbases.[31] These aircraft can take off on initial indications of an enemy nuclear strike in progress and then be recalled if the indications prove false. The combined bomber- and sea-based nuclear forces far exceed actual deterrent requirements and are primarily assigned to destroy the Russian, Chinese, and North Korean military establishments.

The bulk of the U.S. silo-based missile force is also aimed at military targets, but this component contributes little to extended deterrence. Their inflexible flight paths require the missiles to overfly Russia to reach other adversaries and their "use or lose" characteristics cast doubt on their contribution to credible second-strike deterrence.[32]

The disparity of power in the world today tilts against great-power rivals of the U.S. alliance network for another reason: the skewed distribution of wealth and diplomatic power in favor of this network. The combined gross domestic product (GDP) of the U.S. alliance network is 40 times greater than Russia's alliance network, whose economic fortunes rise and fall with the market price of oil and gas, and four times greater than that of China.[33] Western capital and financial institutions dominate the global economy and access to it. The economic and diplomatic leverage at the U.S. alliance's disposal is thus enormous. It is readily available and can be flexibly applied. The alliance network wields economic clout—a source of nonmilitary power in the form of economic and financial sanctions—as well as diplomatic power in the form of visa and travel blacklists. A rational adversary could not fail to recognize the retaliatory threat this power represents.

The U.S. alliance's collective economic, diplomatic, and military power can impose an unacceptably high cost on hostile behavior by adversaries and thus can serve to deter aggression and stabilize crises. Nuclear weapons play a diminishing role in this space compared to the Cold War.

## *E. U.S. Global Leadership*

Raw collective power alone does not guarantee stability. Competent, cooperative, and law-abiding U.S. leadership is also essential. For more than half a century, the United States has led a strenuous effort

[29] Hans M. Kristensen and Robert S. Norris, "United States Nuclear Forces 2018," *Bulletin of the Atomic Scientists* 74 (2018): 120–131, doi:10.1080/00963402.2018.1438219.

[30] Ibid., 121.

[31] "Airstrip alert" refers to the U.S. Cold War practice of keeping nuclear-armed aircraft on "alert pads" at Air Force bases ready to fly when given the order. Under airstrip alert, bombers are prepared to taxi and take off with 10 minutes' notice.

[32] Global Zero U.S. Nuclear Policy Commission, *Global Zero U.S. Nuclear Policy Commission Report: Modernizing U.S. Nuclear Strategy, Force Structure and Posture* (Washington, DC: Global Zero, May 2012), 7–9, www.globalzero.org.

[33] The World Bank, World Bank national accounts data 2016, distributed by World Bank Data, worldbank.org.

to establish and uphold a rules-based global order. But that effort has waned and appears likely to ebb further before it recovers. The U.S. invasion of Iraq in 2003 sullied the reputation of the United States as a stalwart defender of the global order and weakened the constraints on others to act in their narrow self-interest when expedient. Alliance confidence and unity are suffering today from unsteady and disruptive U.S. leadership in the spheres of climate change, global free trade, international security, and, more broadly, diplomacy itself. As the United States withdraws from its leadership roles in these critical domains and alienates allies, states less committed to international norms fill the vacuum and the world grows more anarchic. If the trend continues, the U.S. alliance network could fray to the point of tempting insecure allies to forge new geopolitical and defense alliances and even pursue indigenous nuclear-weapon programs. Assuring the U.S. alliance network today depends far more on strong and steady U.S. leadership than on the size and yield of U.S. nuclear weapons. For this reason, the alliance is growing weaker by the day under the current U.S. administration despite its stated intention of bolstering regional deterrence by deploying new tactical nuclear weapons. Restoring U.S. leadership is the urgent order of the day.

# *IV.*
# *U.S. Objectives if Deterrence Fails*

There can be no certitude that deterrence will prevent a nuclear catastrophe. Deterrence itself could fail in any number of ways. World leaders are not destined to make good calls on every occasion. At times, they make very bad calls, decisions that may sharply deviate from the true security interests of their countries and increase the risk of the use of nuclear weapons. Even the calmest and most sensible of leaders may succumb to emotion and panic under the stress of nuclear coercion, escalating conflict, or flash messages reporting a nuclear attack underway. The smartest and most cautious of them may receive poor advice, misconstrue an adversary's intentions, lose awareness of what the adversary's, and often their own, military forces are doing, or miscalculate the pluses and minuses of next steps. One awful decision or one egregious incident may be enough to make a crisis spin out of control and produce a war no one intended.

It comes as no surprise that the United States hedges its bets on deterrence. It plans extensively and invests heavily for the calamitous day when deterrence fails. The collapse of deterrence may stem from accidental detonations, unauthorized acts, the acquisition of nuclear weapons by terrorist suicide bombers, a launch based on a false warning, irrational leadership, nuclear brinkmanship that spirals across the nuclear threshold, or the cold-blooded and malicious triggering of nuclear attack plans.

Any review that seriously considers U.S. objectives after nuclear deterrence breaks down must recognize that the postures of nuclear-armed states may themselves be to blame. Nuclear safeguards may fall short. Decision deadlines may be too tight to allow well-considered responses. Cyberwarfare aided by an insider may be responsible for the firing of Russian and U.S. nuclear missiles kept on launch-ready alert in underground silos. Regardless of the circumstance, missile boosters will ignite instantly upon receiving a short stream of computer code. National command protocols for ordering

the firing of these missiles during the short span of time required for enemy warheads to traverse the globe (30 minutes) may be driven by misleading information, possibly planted by cyber intruders.[34] This launch-ready posture, aptly described as "hair-trigger," risks leading decision makers to act on incomplete or false information and thus transgress the tenets of a rational decision process, which is the foundation of deterrence.

If the day ever arrives, the U.S. response, under current war plans, may go in any number of directions. U.S. nuclear forces would logically stay on the sidelines until the enemy carried out a nuclear strike. U.S. nuclear forces might then be employed with a view to dissuading the enemy from further escalation and to terminating the conflict at the lowest possible level of violence on the best achievable terms for the United States and its allies. This amounts to making the best of a terrible situation, not to winning. There should be no illusions that any side can win such a conflict. In the immortal words of Presidents Ronald Reagan and Mikhail Gorbachev, "a nuclear war cannot be won and must never be fought."[35]

The cause of a future failure of nuclear restraint may be not be known. There exist many hidden deficiencies in nuclear safeguards. This report therefore calls for further investigation of the risks of inadvertent or unauthorized use and other anomalies that could degrade the command and control of U.S. nuclear weapons and for redoubled efforts to drive these risks to zero or as close to zero as possible. This recommendation will very likely require remediation of deficiencies in C3 and early-warning networks and a decision to take nuclear missiles off hair-trigger alert. (See the "Modernization of Nuclear C3" section below.)

## *A. U.S. Employment Guidance for Nuclear Conflict Involving Russia or China*

Tensions with Russia and China have grown over recent years. In the case of Russia, they have entered the danger zone. The main source of antagonism between the United States and Russia is the former's steady expansion of NATO to Russia's borders and the latter's 2014 covert incursion into Ukraine in support of pro-Russia separatists and its occupation and annexation of Crimea. Military buildups, short-notice ("flash") exercises, and untold hundreds of hostile encounters involving Russian, U.S., and NATO military aircraft and ships since 2014 have further increased tensions.[36] The parties are caught up in an action-reaction cycle that significantly increases the risks of escalation sparked by brinkmanship, miscalculation, or an accidental downing of a warplane or other incident.

[34] Page Stoutland, "Growing threat: Cyber and nuclear weapons systems," *Bulletin of the Atomic Scientists,* October 18, 2017, thebulletin.org.

[35] "Joint Soviet-United States Statement on the Summit Meeting in Geneva," (November 21, 1985), Online by Gerhard Peters and John T. Woolley, The American Presidency Project, www.presidency.ucsb.edu.

[36] Jessica Sleight, *Global Zero Military Incidents Study,* (Washington, DC, May 1, 2017), globalzero.org, 4–59.

Tensions with China have also steadily risen. China's claim of ownership of most of the South China Sea, its construction of artificial islands for use as military outposts to police the sea and establish a protected bastion for its new fleet of ballistic-missile submarines, and the U.S. naval pushback there to assert freedom of navigation in international waters have caused serious friction that could escalate at any time.[37] Tensions over Taiwan could also flare up on short notice.

[37] Ibid., 60–109.

A nuclear conflict between the United States and Russia or China would likely grow out of conventional conflict on the periphery of these two countries. In the case of Russia, it probably would begin with limited Russian nuclear strikes on NATO targets.[38]

[38] Ministry of Foreign Affairs of the Russian Federation, *Voennaia doktrina Rossiskoi Federatsii* (Moscow, December 26, 2014), www.mid.ru.

At some stage of an escalating crisis, Russia envisions attacking U.S. and allied European critical civilian infrastructure with nonnuclear weapons, including cyberweapons, or detonating a small number of tactical nuclear weapons under its doctrine of "escalate to de-escalate."[39] Russian doctrine allows for the use of nuclear weapons if the very survival of the Russian state is threatened. No one in the West knows exactly what specific conditions would cross this threshold. In any case, either crippling attacks on critical Western infrastructure or small-scale nuclear strikes would carry high risks of nuclear escalation if the United States and its NATO allies lacked adequate conventional capabilities with which to respond. Since NATO does possess such conventional means to counter the actions, it could refrain from responding with nuclear weapons.

[39] Ibid.

A U.S. nuclear response may be ordered nevertheless, in which case the U.S. stockpile offers a variety of weapons of variable yield. At the low end of the yield scale are sub-kiloton B61 gravity bombs that can be delivered by heavy B-2A strategic bombers and dual-capable F-15/F-16 fighter bombers, and 5-kiloton W80 warheads on air-launched cruise missiles that can be fired from U.S. B-52H bombers.[40] There are approximately 1,000 of these weapons in the active stockpile. They, together with higher-yield U.S. nuclear munitions, provide a powerful deterrent threat and the means for a proportionate response if deterrence buckles.

[40] Kristensen and Norris, "United States Nuclear Forces," 121.

There should be no illusions, however, that any limited employment of nuclear weapons of any size can be contained. Any use of such powerful weapons by either side meant to de-escalate a conflict only increases the risk that it will escalate instead. Their use would elevate the stakes and make it harder for leaders to back down out of fear of looking weak, losing credibility, and inviting further aggression. Brandishing nuclear weapons for purposes of de-escalation could not be more ill-conceived and ill-advised.

If Russia or China nevertheless employed tactical or strategic nu-

clear weapons against the United States or its allies, the United States would presumably attempt, regardless of the nature, timing and scale of the strikes, to control escalation and terminate the conflict on the best possible terms. In the sterile parlance of current nuclear guidance, this means the U.S. response would "target what the aggressor values most and inflict damage to reduce its power while leaving intact enough for it to prefer to terminate the conflict."[41] This means that the U.S. goals are to make de-escalation less costly to the aggressor than escalation and to terminate the conflict with the least damage to the United States and its allies. However, if the other side unleashes its nuclear forces the option of triggering the preprogrammed massive-attack options directed primarily at the enemy's nuclear capabilities in response would be available.

[41] Global Zero Commission on Nuclear Risk Reduction, *De-alerting and Stabilizing the World's Nuclear Force Postures* (Washington, DC: Global Zero, April 2015), 73, www.globalzero.org.

The president would need early-warning assessments and expert advice and intelligence to determine the character and consequences of enemy nuclear strikes, including whether the attack was deliberate, accidental, or unauthorized. He or she would then have to determine the best course of action. The president would need a range of response options, the necessary time to consider how they might serve a coherent national purpose if exercised, and the ability to direct such operations through reliable C3 links.

Options for responding to Russia and China may be immediately available for execution. There exist literally dozens of options that are preprogrammed and can be immediately enabled by alert forces capable of covering a wide spectrum of targets. Alternatively, military commanders could prepare a new option at the president's behest; that would take hours to days to plan and execute. In general, the target categories found in all these options would be nuclear and other WMD, war-sustaining industry, and/or leadership.

Current U.S. strategy targets facilities in all three categories. The strategic war plans devised to support the strategy, which may be characterized as "maximum warfighting," designate an estimated 1,425 total primary and secondary aimpoints in the two countries.[42] There are 975 in Russia spread across the three categories: 525 for nuclear and other WMD, 250 for war-sustaining industry, and 200 for leadership.[43] The Chinese target set is approximately 50 percent smaller: 450 total aimpoints, including 140 for nuclear and other WMD, 250 for war-sustaining industry and 60 for leadership.[44] Many targets in all three categories are located in densely populated Russian and Chinese urban areas; 100 such aimpoints dot the greater Moscow landscape alone.[45]

[42] All estimates are the author's.

[43] Bruce Blair, "What Exactly Would It Mean to Have Trump's Finger on the Nuclear Button?," *Politico,* June 11, 2016, www.politico.com.

[44] Ibid.

[45] Ibid.

Depending on the character of a nuclear strike by Russia or China, the United States could attempt to control escalation and terminate the conflict through graduated responses across these target cate-

gories. In traditional U.S. nuclear war planning, such responses begin with counterforce strikes against the adversary's nuclear forces and end with strikes against leadership if the war proves impossible to end through negotiation and the violence escalates to its full potential. Today, non-nuclear options could also be implemented and would be effective under some circumstances. Longstanding operational practices are biased toward nuclear responses at the expense of de-escalatory conventional responses.

In any event, as noted earlier, controlling escalation is not a realistic expectation. The vulnerability of U.S. nuclear C3 and intelligence networks to kinetic (primarily blast) and nonkinetic (cyber, jamming, electromagnetic pulse) effects practically precludes it, and Russian nuclear targeteers appear to reject the target distinctions of their U.S. counterparts. Aside from tactical demonstration strikes, Russian strategy appears to emphasize comprehensive and indiscriminate strikes at the outset of a nuclear exchange. Attacks on administrative centers, critical infrastructure, and leadership and C3 facilities appear to have high priority in Russian target plans. Such networks and facilities are vulnerable to even small numbers of nuclear explosions. Negotiation during an ongoing conflict would be impossible under such circumstances, and escalation to all-out proportions would likely ensue. This author's experience and research indicate that U.S. nuclear exercises always escalate to an all-out nuclear exchange with Russia and the Soviet Union.

The aim of limiting damage to the United States and its allies in a conflict today is quite unrealistic. In the case of a nuclear exchange with Russia, this aim would entail partially destroying but mainly just disrupting the operations of Russian nuclear forces and C3 systems while leaving intact those channels needed to negotiate an end to the conflict on acceptable terms. The United States could employ a mix of nuclear, cyber, and conventional forces to selectively target Russian nuclear forces withheld from the initial attack, leadership or military command facilities, and military and industrial facilities that sustain nuclear warfighting. The expected attrition of Russian capabilities would still leave Russia able, for instance, to destroy the largest 100 cities in the United States. Even a full-scale U.S. preemptive surprise attack designed for maximum suppression of Russian nuclear capabilities would still leave 100 U.S. cities vulnerable to destruction.[46] About 62 million people (or about 20% of the current U.S. population) live in the 100 largest U.S. cities.

In the case of a nuclear conflict initiated by China, U.S. military planners envision a somewhat more effective counterforce campaign that goes well beyond mere disruption in seeking to limit damage. The effort would seek to minimize damage caused by Chinese nu-

[46] This estimate assumes that Russia fails to launch its strategic rockets in silos before they are struck by incoming U.S. warheads. Under surprise attack conditions in 2018, the only highly survivable Russian forces are their mobile strategic rockets when deployed out of their home garrisons and operating covertly at hidden field locations—approximately 10 regiments with nine missiles per regiment. The 90 missiles are armed with single- or multiple-warheads. The author estimates that U.S. surveillance and intelligence capabilities allow the U.S. strategic forces to hold at risk about 40 percent of the deployed regiments during normal peacetime conditions. Over 60 survivable missiles armed with a total of about 100 warheads could be launched against 100 cities in retaliation.

clear forces through U.S. nuclear and non-nuclear strikes that selectively targeted Chinese nuclear forces, leadership and military command posts, and war-sustaining industry. However, the resulting attrition would leave at least a dozen U.S. cities exposed to destruction by surviving Chinese strategic forces.

Although current U.S. strategy allows the president to strike any or all of the above target categories preemptively or in retaliation even if the targets are located in urban areas (see the "Legal Constraints on the Use of Force" section below), this analysis calls for war planners to provide non-nuclear options against targets in urban areas in order to avoid the slaughter of civilians. They should also give the president the ability to withhold nuclear strikes on leadership and other targets in urban areas and offer viable non-nuclear options if strikes against such targets are deemed necessary. In general, U.S. military officials historically have shown a bias against giving conventional forces a larger role in strategic wartime operations despite their effectiveness and de-escalatory characteristics.[47] This bias needs to be corrected.

This study also calls for transitioning to a U.S. deterrence-only posture. As described below, this shift will drastically reduce the size of the U.S. nuclear arsenal, alter its composition, and transform targeting policies while meeting reasonable requirements of deterrence. The goal of terminating conflict at the lowest possible level of violence once deterrence fails remains an intact aspiration, however unrealistic it may be.

Although this study also calls for the United States to adopt an NFU policy, this commitment should not preclude the employment of U.S. regional or global missile defenses to attempt to defeat limited nuclear missile strikes initiated by China or Russia, whether those aggressive actions are deliberate, accidental, or unauthorized. In some circumstances, U.S. missile defenses, particularly regional defenses, may also buy time in considering nuclear response options during a 24- to 72-hour period of re-alerting U.S. strategic forces. (See the "U.S. Missile Defenses" section below.) These defenses are effectively useless in the event of massive Russian or Chinese attacks. Nevertheless, their effectiveness appears to be rated more highly by these potential adversaries as well as North Korea, in which case missile defenses are both good and bad. They may reinforce deterrence of small-scale strikes but also bolster the inclination by Russia and China to mount large-scale preemptive strikes if deterrence begins to crumble.

[47] This record began in the early 1980s with the deployment of highly accurate and lethal long-range conventional cruise missiles. The then all-nuclear Strategic Air Command sought permission to no avail from the U.S. Air Force to integrate these missiles into their nuclear strike plans to cover vulnerable Soviet surface targets such as electrical power plants. Air Force officials denied permission to do so.

## *B. U.S. Employment Guidance for Nuclear Conflict Involving North Korea*

If conventional conflict breaks out with North Korea, the United States and its allies possess ample non-nuclear capabilities to prevail. Nuclear options are no longer needed to effectively suppress the artillery threat to Seoul posed by North Korean units dug into the mountains near the Demilitarized Zone. The terrain provides a natural fortress that protects these units from conventional attack, but advanced U.S. and South Korean conventional forces are capable of suppressing the North's artillery within hours. Seoul, however, would still likely suffer shelling by hundreds to thousands of rounds.

The conventional military capabilities of the U.S.-South Korean alliance also provide broader coverage of key inland military, leadership, and industrial facilities, including North Korean nuclear threats.[48] Such non-nuclear options—active and passive defenses as well as conventional offenses—could limit the damage that North Korea could inflict in wartime and greatly reduce if not obviate any need to initiate the use of U.S. nuclear weapons. But the possibility of intelligence gaps and hidden North Korean nuclear weapons and command bunkers would vex the U.S.-South Korean campaign. A conservative estimate would put millions of U.S. and allied populations in the region at risk.

[48] Ibid.

Should North Korea employ nuclear forces first—it currently possesses enough fissile material for an arsenal of 20–50 fission and thermonuclear devices and is rapidly advancing its ability to deliver them by ballistic missiles at short and long distances including intercontinental range—the United States has both conventional and nuclear options with which to respond.[49] The former includes thousands of accurate Tomahawk IV cruise missiles fired from specially equipped Trident submarines and Aegis destroyers, as well as Aegis and other ballistic-missile defenses with modest capabilities to intercept North Korea ballistic missiles.[50]

[49] NPR, 32–33.

[50] Ibid.

These capabilities combined with timely surveillance of the North's mobile ballistic missiles as they leave caves and other hidden locations in preparation for launch could partially suppress the North's nuclear capabilities in fairly short order, although millions of lives in the region could already have been lost to the North's nuclear strikes. If necessary in extreme circumstances, the United States could also mount nuclear strikes in an attempt to neutralize any remaining capabilities. U.S. nuclear forces—Ohio-class SSBNs and B-2A and B-52H heavy bombers but not Minuteman III missiles because of their flight path over parts of Russia or China—would allow for graduated and flexible strikes against a target set consisting of North Korean

nuclear and other WMD forces (50 aimpoints), leadership (10 aimpoints), and war-sustaining industry (20 aimpoints).[51] If time and circumstances permit, the heavy strategic bombers may be deployed forward to Guam and their B61 gravity bombs and W80 warheads on air-launched cruise missiles (ALCMs) dialed down to 0.3 and 5 kilotons, respectively.[52]

While U.S. nuclear weapons could quickly destroy much of the North's nuclear capabilities, Pyongyang may succeed for some time in hiding some mobile nuclear forces and later launching them. A severe downside to resorting to nuclear weapons is that the radioactive fallout from ground explosions could, depending on weather conditions, sicken and kill large numbers of people not only in North Korea but also in South Korea, China, Russia, and Japan.

In short, a nuclear war with North Korea, like a war with Russia or China, cannot be won in any meaningful sense. Although the number and reliability of the North's delivery systems remain in question, a conservative judgment of its capabilities is that North Korea is capable of inflicting large-scale death and destruction in the region, and thus of deterring a conventional or nuclear first strike by the United States and its allies.

[51] Blair, "Nuclear Button."

[52] The W80 warhead and B61-12 bomb, which is expected to enter into service in the mid-2020s, have selectable yields of 5–150 kilotons and 0.3–50 kilotons, respectively.

# *V.*
# *Modernization of Nuclear C3*

As long as nuclear weapons exist, they must always remain under strict control, even under the enormous stress of a nuclear attack. This is necessary for deterrence, as well as the prevention of accidental or unauthorized use. The required control entails a C3 network that is highly survivable, flexible, impervious to cyberattack, and fail-safe. Strong security measures, stringent safeguards, and effective safety features are required to ensure that neither insiders nor outsiders, including terrorists, can seize a nuclear weapon or illicitly gain the ability to cause one to launch or detonate.

Today's network was last comprehensively updated some three decades ago.[53] In fact, some of its key elements such as the computer operating system linking underground Minuteman launch centers with their missiles in nearby silos date back to the late 1950s. Nuclear C3 suffers from aging components, vulnerabilities to new cutting-edge threats, budget shortfalls, and the self-inflicted wounds caused by chronic mismanagement by the Office of the Secretary of Defense, the relevant agencies of the Defense Department and the services, particularly the Air Force Materiel Command.

The importance of modernizing this network cannot be overstated. Its critical role in directing nuclear forces to a coherent national purpose under presidential control and preventing their use without authorization sets it apart from every other defense program. Its strengthening should take clear precedence over the modernization of the nuclear forces themselves. If command and control fails, nuclear weapons become useless hazards.

The network modernization should serve several main principles and objectives:

## *A. Preserve Presidential Launch Authority*

Sole launch authority resides at the highest level of the executive branch, the presidency. Safeguards such as locking devices and

[53] U.S. Department of Energy, National Nuclear Security Administration, *Fiscal Year 2018 Stockpile Stewardship and Management Plan* (Washington, DC: U.S. Department of Energy, 2018), www.energy.gov.

personnel reliability programs help position the locus of launch capability at the highest practicable level and reduce the chances of unauthorized use. Locking devices were installed on strategic bombers, Minuteman launch centers, and strategic submarines in 1970, 1977, and 1997, respectively.[54] The unlocking of weapons does not take place until the president makes a decision to employ nuclear weapons. Force-wide or weapon-specific unlocking codes are provided in launch execution orders issued by the National Military Command Center or its alternates (STRATCOM and others) at the behest of the national command authorities.[55] The survival of at least one of about eight of these high-level command centers is critical in order to physically release the unlock codes to the firing units, who would be nearly paralyzed without them.[56]

The Defense Department and the National Security Council should be tasked with reviewing the current procedures for authorizing the use of nuclear weapons to ensure that any such order could come only from the president.

[54] Bruce G. Blair, John E. Pike, and Stephen I. Schwartz, "Targeting and Controlling the Bomb," in *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940*, ed. Stephen I. Schwartz (Washington, DC: Brookings Institution Press, 1998), 197–268.

[55] Dave Merrill, Nafeesa Syeed, and Brittany Harris, "To Launch a Nuclear Strike, President Trump Would Take These Steps," *Bloomberg*, January 20, 2017, www.bloomberg.com.

[56] U.S. SSBN crews have the physical tools onboard needed to defeat this safeguard if they chose to undertake an unauthorized launch.

## *B. Eliminate Vulnerable C3 Networks*

Vulnerable C3 networks have long been the Achilles' heel of U.S. deterrence strategy. Persistent vulnerabilities continue to threaten the continuity of government and the ability of presidents or their constitutional successors to direct nuclear forces to a coherent national purpose during conflict. The vulnerabilities create intense pressures and incentives to rapidly authorize the employment of nuclear forces before the networks collapse under attack or to delegate the president's nuclear launch authority in advance to military commanders.

Throughout the Cold War, every president but one explicitly assigned—or "predelegated"—emergency launch authority to senior military field commanders in the event the president and his legal successors were killed or rendered incommunicado by enemy attack.[57] The exception was President John F. Kennedy, who nonetheless decided not to revoke his predecessor's predelegation orders and thus implicitly continued the practice. These arrangements ended after the end of the Cold War for good reason: predelegation potentially compromises top-level civilian control over nuclear forces.

Although predelegation remains a prerogative of the president, this analysis recommends that the modernization of the network strive to remove the vulnerabilities that plague it in order to minimize any future reliance on transferring control of nuclear weapons from the president to military officers under wartime conditions of network disruption or decapitation. The Pentagon needs to ensure the survivability of the president and his or her legal successors, the

[57] Bruce Blair, *The Logic of Accidental Nuclear War* (Washington, DC: Brookings Institution Press, 1993), 49; see also, "First Documented Evidence That U.S. Presidents Predelegated Nuclear Weapons Release Authority to the Military," *The National Security Archive*, March 20, 1998, gwu.edu.

primary and alternate national command centers, and the communications links with the executing commanders of land-, sea-, and air-based strategic forces.

(This analysis recommends eliminating the silo-based leg of the strategic triad. If United States adopted this approach, there would be no need to strengthen links to the silo-based leg. Specifically, there would be no need to retain, let alone modernize, the underground and airborne launch control centers and their links to higher authority. Priority would shift to strengthening links to SSBNs patrolling in the Atlantic and Pacific Oceans.)

If the U.S. early-warning network reports that an incoming nuclear missile strike is underway, the priority of the command system should be to protect the elected president or his or her legal successors. This should take precedence over eliciting immediate nuclear instructions from the president (deciding whether to order launch on warning). A resilient command system that ensures continuity of constitutional government and enduring control over surviving U.S. nuclear forces will adequately underpin deterrence and retaliation if deterrence fails.

Four growing threats that could severely degrade the performance of the existing nuclear network require intensified effort to counter:[58]

[58] The United States also projects these key threats at its potential adversaries.

*Anti-satellite warfare.* Russia and China have developed the means to disrupt, disable, and destroy vital U.S. assets in space—notably surveillance, intelligence, and communications satellites.[59] To date these means have mainly utilized electronic warfare, such as jamming, but both countries are only a few short years away from acquiring the means to directly strike and destroy U.S. satellites.[60] These U.S. space assets form the critical backbone of U.S. early-warning systems against missile attack and the transmission of emergency action messages used in executing nuclear war plans.

[59] Elton Lossner, "Space Standoff: Uncertainty in Militarized Space," *Harvard Political Review,* August 13, 2017, havardpolitics.com.

[60] U.S. Congress, Senate, Select Committee on Intelligence, Statement for the record: worldwide threat assessment of the US intelligence committee, 115th Cong., 2d sess., 2018, 13, www.dni.gov.

*Cyberwarfare.* Advanced offensive cyberwarfare capabilities possessed by potential adversaries could be used against vital U.S. nuclear networks, many components of which cannot currently be certified as bug-free due to weak custody over the supply chain during design, manufacture, installation, and operation. These components were typically purchased off the shelf, often from foreign suppliers, and thus often require waivers to permit their use in critical operations despite the inability to gauge their contamination by exploitative malware. It is not unusual to discover such contamination.[61] A particular concern is the possibility of intrusion by cyber infiltrators corrupting or deleting the database generated by missile attack early-warning sensors and computers. Nuclear decision-making in a crisis depends heavily on the integrity of this

[61] Andrew Futter, *Hacking the Bomb: Cyber Threats and Nuclear Weapons* (Washington, DC: Georgetown University Press, April 2018).

database indicating the scope, targets, and other critical characteristics of an apparent incoming strike.[62]

*Close-in strikes.* A serious new means of U.S. decapitation has emerged in the form of stealthy Akula-II Russian attack submarines armed with advanced Kalibr cruise missiles.[63] These quiet vessels and their missiles are very difficult to detect and monitor. Akula boats periodically patrol waters adjacent to the East Coast of the United States and could suddenly launch nuclear-armed cruise missiles that destroy Washington, DC, along with the president and other top civilian and military officials.[64]

*Long-range maneuverable delivery vehicles.* The proliferation of maneuverable ballistic and cruise missiles and reentry vehicles is degrading the performance of U.S. early-warning networks in predicting the flight path and destination of attacking warheads. The reentry vehicles could suddenly change course and strike critical nodes in the U.S. nuclear command system, compounding a decapitation threat that already exists. This threat will further increase if Russia deploys the long-range nuclear-powered undersea drones that are now at an advanced stage of testing.[65] Armed with high-yield nuclear payloads, these high-speed autonomous torpedoes propelled by small nuclear reactors could navigate from northern Russian waters through the Atlantic Ocean to the bay waters near Washington, DC.

[62] Beyza Unal and Patricia Lewis, *Cybersecurity of Nuclear Weapons Systems: Threats, Vulnerabilities and Consequences* (London: Chatham House, The Royal Institute of International Affairs, 2018), www.chathamhouse.org.

[63] James Martin Center for Nonproliferation Studies at the Middlebury Institute for International Studies at Monterey, "Project 971/971U/971O Shchuka-B/Bars (NATO Name Akula)," (Nuclear Threat Initiative, June 2011), www.nti.org.

[64] Mark Mazzetti and Thom Shanker, "Russian Subs Patrolling Off East Coast of U.S." *New York Times,* August 4, 2009, www.nytimes.com.

[65] NPR, 8.

Remedies exist for all these threats, but much depends on the priority accorded to fortifying nuclear C3 links by the Defense Department and the military bureaucracy. Despite the obvious importance of eliminating serious deficiencies in the C3 network's performance, the services stint on investment in upgrades. The Office of the Secretary of Defense has not advocated strongly enough for modernizing the national strategic systems that transcend narrow service interests.

Arms control agreements could help. For instance, a ban on deploying nuclear-armed cruise missiles, especially sea-based cruise missiles, would remove the Akula-Kalibr cruise missile threat against the U.S. capital. Short of an outright ban, certain operational restrictions on the operating locations of nuclear-armed cruise missiles could be imposed. Restrictions on maneuverable reentry vehicles such as hypersonic glide vehicles, which are not yet widely deployed, are also desirable from the standpoint of protecting C3.

Fixing the existing grave deficiencies in nuclear C3 is going to require a level of determination and innovation never before seen in the history of the program. A new and costly-to-implement architecture will be required that strengthens old links, adds new ones, and

provides for reconstitution of C3 by innovative means such as post-strike satellite replenishment using ballistic missiles launched from submarines. Meanwhile, the ability of presidents or their successors to command U.S. nuclear forces will remain vulnerable to a small number of enemy nuclear and nonkinetic weapons directed at key nodes in the U.S. C3 network.

### C. *Expand Presidential Warning and Decision Time for Nuclear Responses to Nuclear Attack*

Increasing warning, decision, and execution time for the president and for all levels of the chain of nuclear command is of paramount importance. Reliance on prompt launch (launch on warning or launch under attack) should be eliminated. Scenarios of large-scale nuclear strikes by Russia or China are extremely remote, and yet the United States continues to plan for launching its strategic forces in response to a warning of an apparent attack.[66] As a result, the probability of accidental nuclear holocaust is unacceptably high.

[66] Ibid., 30–32.

Today's timeline of decision-making under the stress of an apparent nuclear attack leaves no room for error. On paper, the launch protocol provides enough time for detecting and assessing an attack, convening an emergency conference between the president and his or her top nuclear advisers, briefing the president on the available options and their consequences, authenticating the president's decision, and formatting and transmitting a launch order to the launch crews in time to ensure the survival and execution of their forces.[67] But each of these steps must be taken in only a few minutes; their feasibility in practice therefore is highly questionable. The frequent inability during exercises and real-world contingencies to connect the secretaries of defense and state, the national security adviser, and the chairman of the Joint Chiefs of Staff with the president or the president's surrogate in a timely manner is symptomatic of the impracticality of the launch protocol.[68]

[67] Merrill, Syeed, and Harris, "Launch."

[68] Bruce Blair, "Strengthening Checks on Presidential Nuclear Launch Authority," *Arms Control Today,* January/February 2018, www.armscontrol.org.

The president is the sole authority for ordering the use of nuclear weapons but must be able to consult with key senior advisers if time and circumstances permit during an emergency, in part to ensure that any response chosen would pass muster as justifiable self-defense under international and domestic law. Time permitting, the president also needs to consult Congress adequately prior to executing the response, but current procedures do not require such consultations and cast doubt on their taking place.

The protocol emphasizes speed over deliberation to such an extent that it tends to "jam" a president and others in the chain of command if an enemy nuclear strike appears underway. In other words, the

protocol puts intense pressure on the president and others to decide quickly to authorize the employment of U.S. nuclear forces. Still the norm, such "jamming" also emphasizes escalatory nuclear responses over de-escalatory conventional options.

Increasing the warning and decision time is key to ensuring that the president will never be pressured into hastily ordering retaliation in response to a false alarm. This means the protocol should no longer support a policy of launch on warning. Instead, it should support the quick evacuation of the national leadership to survivable command centers where retaliatory options may be weighed carefully and deliberately on the basis of more valid and complete information. The president would only have about 10 minutes to evacuate safely from the White House, and cannot easily participate in a secure emergency conference with his advisers while moving to board a helicopter and fly to safety.

The surge in proliferation and testing of ballistic missiles around the world, including the testing of North Korean nuclear-capable intercontinental missiles, compounds the risk of misperception and hasty response under the current protocol. Maneuverable strategic missiles also make attack assessment that much more difficult. The actions covered by the protocol must start earlier and acknowledge conditions of greater uncertainty about the degree of threat posed by missile-launch preparations or actual firings. During the Cold War, even the extremely close calls did not rise to the level of presidential notification.[69] There was much predictability in the U.S.-Soviet strategic confrontation. The United States knew a great deal about Soviet missiles and their ranges and the practices for testing them. By mutual agreement, the United States received advance notification of Soviet launches and vice versa.[70]

Today, there are many more missile launches by many more nations than there ever have been. The list of launching countries includes China, India, Pakistan, and Iran, as well as North Korea. Tracking these launches and determining whether they pose a threat has become correspondingly more difficult. Every day, events occur, often involving civilian rocket launches by corporate entities as well as military missile launches, that require a look by the early-warning crews at Petersen and Offutt Air Force Bases. Within three minutes of receiving the first reports from satellites and ground radar, the crews are supposed to provide a preliminary assessment as to whether North America is under attack by nuclear missiles. This notification process now runs through two distinct channels, Northern and Strategic Commands, with the latter striving to get a head start and activating the protocol before an attack is confirmed or even before a missile lifts off from its launch pad. Ironically, this surge in

[69] "'Close Calls with Nuclear Weapons."

[70] *Agreement Between The United States of America and The Union of Soviet Socialist Republics on Notification of Launches of Intercontinental Ballistic Missiles and Submarine-Launched Ballistic Missiles (Ballistic Missile Launch Notification Agreement)*, signed May 31, 1988, U.S. Department of State, Bureau of Arms Control, Verification and Compliance, www.state.gov.

proliferation and testing over the past decade has spawned great unpredictability, complicated assessment, and on multiple occasions, led to presidents being notified of an ambiguous imminent threat in progress.[71]

[71] Blair, "Strengthening Checks."

This history demonstrates again why ambiguity is destabilizing. The risks it engenders outweigh the alleged benefits of keeping a potential adversary off guard and guessing. A bad guess may have severe consequences for all the parties.

Increasing the transparency of missile launches worldwide, in part by providing advance notifications of them, would help reverse the trend toward shorter warning and decision times and thereby reduce the risks of misperception, false alarms, and inadvertent nuclear war. This recommendation applies to all missile-launching countries, including the United States, and is doubly important when launching maneuverable missiles or reentry vehicles.

## *D. Expand Presidential Decision Time, Information, and Flexibility for Non-Nuclear Military and Non-Military Responses*

This report advises the Defense Department to give higher priority to further expanding the menu of conventional options, both offensive and defensive, in order to widen the space for responding rapidly to aggression while also offering non-nuclear options for de-escalating a conflict. The 2018 National Defense Strategy affirmed this approach calling in particular for "integration of cyber capabilities into the full spectrum of military operations."[72] As Defense Secretary James Mattis observed in commenting on the 2018 National Defense Strategy, "we must be able to fight across the spectrum of conflict."[73] This is why the United States is making "investments in space and cyberspace, nuclear deterrent forces, missile defense, advanced autonomous systems, and resilient and agile logistics."[74]

[72] U.S. Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America* (Washington, D.C., 2018), 6, dod.defense.gov.

[73] Secretary of Defense James N. Mattis, "Remarks by Secretary Mattis on the National Defense Strategy" (press conference, Washington, DC, January 19, 2018), United States Department of Defense, dod.defense.gov.

[74] Ibid.

To further expand the president's decision space for dealing with situations prone to nuclear escalation, the State and Treasury Departments should prepare new diplomatic and financial instruments for preventing and managing confrontation. The two departments, together with the National Security Council, should intensify their simulation, gaming, and exercises to better anticipate, comprehend, prevent, and contain situations in potential nuclear flashpoints around the world—the Korean peninsula, South Asia, NATO Europe and Western Russia, and the South China Sea. The United States may become entwined in complex crisis dynamics in any and all of these regions.

## *E. Centralize the Diffuse Management and Acquisition of C3 Systems*

The C3 network is an integrated national system, but the authority and responsibility for designing, procuring, and managing it are highly fragmented within the Defense Department. This deficiency harks back to the beginning of the nuclear era. Its legacy is incompatible systems and breakdowns in connectivity.[75] This history of gross suboptimization must finally be addressed by the chairman of the Joint Chiefs of Staff, the key Defense Department stakeholders, and the secretary of defense. A coherent architecture for modernization under the firm direction of a "C3 czar" with budgetary clout is essential to ensure the optimal integration, resilience, and effective performance of the network. Defense Secretary James Mattis's recent assignment of this responsibility to STRATCOM seems a step in the right direction if adequate budget authority is given to this command.[76]

[75] Bruce Blair, *Strategic Command and Control* (Washington, DC: The Brookings Institution, 1985).

[76] General John E. Hyten, "The Mitchell Institute Triad Conference," (speech, Kings Bay, GA, July 17, 2018), U.S. Strategic Command, www.stratcom.mil.

For this reform of C3 governance to succeed, the Defense Department needs to make broad changes in its acquisition policy. The skyrocketing cost of military equipment and supplies of all kinds has reached crisis proportions, threatening a hollowing out of the military over the long term. Nowhere is this need clearer than in the arena of space-based detection and tracking of ballistic and cruise missiles. Advanced surveillance satellites cost $1 billion apiece, with procurement processes sometimes requiring lead times exceeding a decade.[77] In spite of the tremendous sums of money that these critical space assets have absorbed, they are becoming more vulnerable every day to the growing anti-satellite capabilities of Russia and China. These capabilities are much cheaper to deploy than the satellites they are targeting. This worsening situation demands a radical new approach to acquisition that allows for assembling readily available commercial components into cheap, redundant, and survivable configurations that can be deployed quickly and will adequately perform the basic service. This approach concurrently demands a quantum-leap improvement in screening against malware infections in commercial products, which in turns entails much tighter scrutiny and control of the chain of supply.

[77] Bernard Fox, Kevin Brancato, and Brien Alkire, *Guidelines and Metrics for Estimating Space System Cost Estimates* (Santa Monica, CA: RAND Corporation, 2008), www.rand.org.

In summary, it is essential that C3 and early-warning networks be configured to survive in an extremely adverse nuclear environment that may include a massive strike of nuclear warheads and bombs as well as electromagnetic-pulse detonations at high altitudes. Even under worst-case scenarios, it is vital to ensure that second-strike retaliatory forces are responsive to orders given by the president and the duly constituted presidential successors. If the United States

is to preserve the continuity of government in accordance with the provisions of the Constitution, applicable legislation, and lawful presidential instructions, then it must reorganize its agencies responsible for designing and procuring the necessary elements and give them the budget authority to deploy them. This is a daunting but surmountable challenge.

# *VI.*
# *Near-Term Guidance for Reducing the Risks of Prompt Launch*

The current U.S. (and Russian) nuclear force posture is on a hair trigger. Land-based missiles on launch-ready alert—95 percent of the deployed force of 400 missiles—will fire immediately upon receiving a short stream of computer code. The computers aboard U.S. missiles may be accessed through underground cables (30,000 miles of cable interconnecting the missiles with underground launch centers) and radio antennas linked to airborne launch centers.[78] Both the cables and the antennas represent potential access points and apertures for unauthorized cyber infiltration. The missiles cannot distinguish between a valid launch code from an authorized source and one from an unauthorized source.

[78] Blair, *Command and Control*, 162.

The launch crews are also hypervigilant, ready to carry out the launch process a minute or so after receiving a valid and authentic launch order. They will accept and implement such an order regardless of its original or immediate source.

The higher-level commanders are also primed to react very rapidly to a deteriorating security environment or indications of imminent or apparent actual attack. Crisis procedures call for rapidly putting off-alert forces on alert, and, subject to presidential approval, launching the alert forces on warning of an attack that is imminent or in progress. These operations relegate the actions of the president and hundreds of subordinates throughout the chain of command to split-second choices and short checklists.

Instead of pressing the president to make fateful decisions in minutes or even seconds, the U.S. posture should afford the president and senior advisers ample time, measured in hours or days, to consider the best course of action. Furthermore, the posture should not project a sudden first-strike threat that exerts intense pressure on Russia or any other nuclear-armed potential adversary to decide in minutes whether to launch on warning during the 15- to 30-minute

flight time of incoming U.S. nuclear warheads lofted by submarine- and land-based ballistic missiles, respectively. Projecting a constant threat of massive attack only increases the risk that the United States will be on the receiving end of an attack triggered by false warning, misjudgment, panic, or unauthorized acts. Currently, Russia's posture reflects this dangerous time sensitivity; it requires a presidential launch decision within two to four minutes after ground radars pick up missiles or warheads in flight and enables Moscow-based senior military commanders to fire their dispersed remote silo-based missile forces in 20 seconds.[79]

Steps should be taken to reduce the U.S. and Russian bias toward prompt launch and shift it toward second-strike retaliation in order to preserve the president's sole launch authority, increase his or her warning and decision time, and generally strengthen stability and safety. One critical step discussed in detail below is for both sides to abandon their deterrence-plus-warfighting strategies, whose successful execution depends heavily on preemption and launch on warning. Another step is to adopt NFU and make it operationally credible and transparent. The option to execute a sudden large-scale decapitation strike against Russia involving more than 300 U.S. warheads should be eliminated by progressively de-alerting the U.S. nuclear missile forces.

The United States should institute near-term de-alerting measures requiring 24–72 hours to reverse, such as "safing" silo-based missiles to block launch circuits.[80] Reversing that step requires maintenance crews to reenter the silos and switch on the launch circuitry. Another step would be removing warheads or other critical components from missiles and storing them at their home base or other locations, such as the 50 empty Minuteman silos in Montana. By 2028, the de-alerted Minuteman force should be fully dismantled and permanently retired and its replacement program canceled.

All U.S. SSBNs at sea should be placed on "modified alert" status. The handful that today routinely patrol at their launch stations in the North Atlantic and western Pacific Oceans and the Norwegian Sea ready to fire within 15 minutes of receiving an order to do so would adopt a less taut posture. The current strict requirements of speed, depth, navigation, and communications would be relaxed. The current requirement for alert submarines to maintain continuous communications and readiness to fire in minutes would be extended to 24–72 hours as is currently the case with U.K. ballistic-missile submarines.[81] In addition to reducing the risks of an unintended nuclear launch, this step would provide greater freedom to train and exercise at sea. Other measures, such as the removal and onboard storage of "inverters," which permit electricity to flow to the explosives that

[79] Bruce Blair, "Could U.S.-Russia Tensions Go Nuclear?," *Politico,* November 27, 2016, www.politico.eu; Col. (ret.) Valery Yarynich, personal communications with the author, May 1993.

[80] For detailed technical information on de-alerting steps discussed in this review, see "Appendix A: Illustrative De-alerting Measures," in *De-Alerting and Stabilizing the World's Nuclear Force Postures,* Global Zero Commission on Nuclear Risk Reduction (Washington, DC: Global Zero, 2015), 91–106, www.globalzero.org.

[81] French submarines may operate similarly.

propel submarine missiles out of their launch tubes, are among the many de-alerting steps to be considered to reinforce the new timeline requirement.

Regarding U.S. tactical nuclear weapons, the forward-based bombs in Europe assigned to U.S. and NATO dual-capable aircraft (DCA) currently reside in their collocated storage vaults and bunkers in peacetime, with warhead uploading and other re-alerting steps requiring days to many months for different portions of the force.[82] These nuclear-capable warplanes are highly vulnerable and have little or no military utility. The United States should seek NATO approval to withdraw the tactical nuclear weapons, of which there are about 180, back to U.S. central storage locations as a confidence-building measure on the condition that Russia reciprocates on a comparable scale.[83] A portion of Russia's approximately 800 forward-deployed tactical nuclear weapons, located at a dozen or so bases on the European continent—with warheads/bombs stored separately but near to the missiles and warplanes—would be relocated to Russia's central storage sites. These changes, if fully adopted by Russia as well as the United States, would significantly reduce the risks of premature, mistaken, unauthorized, and accidental use of their tactical nuclear weapons and could help improve the security environment in Europe. It would extend warning and decision time by at least 24 hours in one of the current nuclear flashpoint regions of the world. The overall effect would be to greatly strengthen strategic stability.

The United States should also strike an agreement with Russia that steadily decreases the number of strategic weapons on alert, particularly silo-based "use or lose" missiles. A worthwhile goal would be a seven-year phased and verifiable de-alerting regime resulting in a total peacetime force of 200–250 warheads on alert on each side, with no more than 100 warheads on land-based missiles. The remaining forces of all types would require 24–72 hours to return to alert. Off-alert units would periodically rotate back to alert to relieve units rotating off alert. The goal beyond the next seven years would be to stand down the entire alert force on both sides and eliminate the option of prompt launch from their operational arsenals. The United States could take all its forces off of launch-ready alert independent of Russia's alert posture without weakening its deterrence-only posture.

The U.S. Defense Department has often expressed unfounded concern that a crisis would spark a frenzied re-alerting race that destabilizes a confrontation. In its view, such a race would court misperception of intentions and could well tempt the faster racer to strike preemptively.

But this argument ignores the basic fact that no such incentives

[82] James Martin Center for Nonproliferation Studies at the Middlebury Institute for International Studies at Monterey, *U.S. Nuclear Weapons on the Territories of 5 NATO States* (Washington, DC: Nuclear Threat Initiative, February 10, 2017), www.nti.org.

[83] Global Zero NATO-Russia Commission Report, *Removing U.S. and Russian Tactical Nuclear Weapons from European Combat Bases* (Washington, DC: Global Zero, 2012).

would exist as long as survivable second-strike forces remain on both sides, capable of delivering a devastating blow in response to an attack, even if delayed by a day or more. There would be no advantage gained by either side, whether by racing to re-alert or by striking preemptively. Any putative lead in a re-alerting race would be meaningless compared to the catastrophic punishment that could be assuredly meted out by the opponent's retaliation.

The Defense Department has lost sight of its own core principle that a credible threat of devastating retaliation is the bedrock of nuclear deterrence. Survivability, not alert status, is the necessary and sufficient condition of its effectiveness. Any re-alerting fears would be further allayed if both the United States and Russia would shift from their current deterrence-plus-warfighting strategies inclined toward preemption to deterrence-only strategies geared to second-strike responses. A fleet of five survivable at-sea U.S. SSBNs in a deterrence-only posture would be more stabilizing and less prone to re-alerting pressures than today's deterrence-plus-warfighting posture.

# *VII.*
# *Moving the U.S. Strategic Force Toward a Deterrence-Only Strategy*

The current U.S. nuclear posture features a deterrence-plus-warfighting strategy geared to holding at risk a wide spectrum of targets, including nuclear forces, war-sustaining industry, and leadership in Russia, China, North Korea, and Iran. Options exist for simultaneous or sequenced strikes on these target sets or subsets of them in an attempt to terminate a nuclear conflict at the lowest possible level of violence.[84] In the case of Russia, if deterrence fails, the initial stage of conflict might be limited to a counterforce exchange in which each side concentrates its strikes on opposing nuclear forces rather than populations. Since there are many hundreds of these targets, however, a counterforce attack would not in fact be very limited. It would likely result in the deaths of millions of people.[85]

The catastrophe would be even worse if escalation could not be controlled and cities were engulfed by a nuclear blast. Then the death toll on each side could exceed 100 million.[86] However, target assignments might be flexibly reprogrammed away from urban areas as circumstances and objectives evolve in the course of conflict. The option exists to withhold direct strikes against population centers. Urban areas downwind from any large-scale attack would nonetheless suffer severe casualties from deadly radioactive fallout, especially in the case of massive attacks directed at hardened nuclear forces and C3 facilities whose destruction requires "dirty" surface bursts.

A deterrence-only strategy is a preferable alternative. The primary targets of a deterrence-only strategy would consist of key elements of state control and its economic-industrial base: leadership facilities; banking, communications, and transportation networks; oil pipeline and shipping infrastructure used in petroleum exporting; electric power plants; and oil refineries and metal works plants.[87] The destruction of this infrastructure is not time sensitive and therefore would not require prompt or preemptive strikes to disable it. Addi-

[84] Merrill, Syeed, and Harris, "Launch."

[85] For a dated but relevant and scientific analysis of casualties, see William Daugherty, Barbara Levi, and Frank Von Hippel, "Casualties Due to the Blast, Heat, and Radioactive Fallout from Various Hypothetical Nuclear Attacks on the United States," in *The Medical Implications of Nuclear War,* ed. Fred Solomon and Robert Q. Marston (Washington, DC: National Academy Press, 1986).

[86] Ibid.

[87] Examples of specific Russian refineries and metal factories are: Omsk refinery: 55.067°, 73.225°; Angarsk refinery: 52.560°, 103.926°; Kirishi refinery: 59.484°, 32.069°; and Magnitogorsk Iron and Steel Works: 53.441°, 59.051°.

tionally, an estimated 30 to 50 percent of these targets are vulnerable to conventional and cyberattacks, allowing U.S. non-nuclear forces to be substituted for nuclear weapons in substantial numbers and offering the president response options designed to encourage de-escalation. As Defense Secretary James Mattis noted in 2017, "war is war. And any kind of conflict in the future could well include cyber or space assets."[88]

Under this strategy, attack plans would no longer be directed primarily at opposing nuclear forces. Instead, deterrence would be explicitly based on threatening to destroy the key elements of state control and economic power in response to their nuclear aggression.[89] Many of these targets are located in densely populated areas. The Kremlin, many oil refineries, petroleum export infrastructure, banking networks, metal works, and electric power plants are located inside or near metropolitan areas. However, as just noted, the president could restrict initial nuclear strikes to facilities outside of major cities, such as remote leadership redoubts in places like Mount Yamantau in Russia. The president could even order U.S. commanders to refrain from using nuclear weapons entirely in an initial response. This would not strip the president of options. On the contrary, the high lethality of U.S. conventional and cyberweapons allows for non-nuclear coverage across the entire spectrum of targets, including many high-level leadership facilities.

While conventional weapons would provide the most survivable and lethal means for destroying key elements of state control, power, and wealth, cyberweapons are increasingly potent and would make a significant contribution. In this regard, Presidential Policy Directive of October 2012 (PPD-20) defined U.S. cyber operations policy objectives under Offensive Cyber Effects Operations (OCEO).

> The United States Government shall identify potential targets of national importance where OCEO can offer a favorable balance of effectiveness and risk as compared with other instruments of national power, establish and maintain OCEO capabilities integrated as appropriate with other U.S. offensive capabilities, and execute those capabilities in a manner consistent with the provisions of this directive.[90]

Most of the key elements of Russian state control are in fact not well-protected and are thus vulnerable to strikes by a combination of conventional and cyberweapons. Wartime options that initially withhold nuclear strikes against these "soft" targets, especially in urban areas, would provide de-escalatory tools with which to respond. They would be backed by nuclear options to deter further escalation.

The biggest advantages of a deterrence-only posture are that it would eliminate targets whose destruction is time-sensitive (that is,

[88] Secretary of Defense James N. Mattis, "Media Availability with Secretary Mattis en route to Colorado Springs, Colorado" (press conference, November 16, 2017), United States Department of Defense, dod.defense.gov.

[89] For an excellent reference on the targeting of U.S. strategic nuclear forces, see Hans M. Kristensen, Robert S. Norris, and Ivan Oelrich, *From Counterforce to Minimal Deterrence: A New Nuclear Policy on the Path Toward Eliminating Nuclear Weapons* (Washington, DC: Federation of American Scientists and National Resources Defense Council, April 2009).

[90] Barack Obama, *United States Cyber Operations Policy, Presidential Policy Directive PPD-20,* October 2012, Federation of American Scientists Intelligence Resource Program, 9, fas.org.

silo-based missiles) in favor of targets whose destruction is not. The posture would be far less operationally inclined for preemption and would not project a counterforce first-strike threat, which is destabilizing during a crisis. As a purely second-strike strategy, it would encourage a shift to highly survivable forces such as submarines and away from vulnerable forces such as silo-based missiles. And a much smaller arsenal would suffice. Adopting this strategy would halve the size of the arsenal.

## *A. Updating the Target Sets for Deterrence-Plus-Warfighting and Deterrence-Only Strategies*

Under the current U.S. deterrence-plus-warfighting strategy, there are about 825 aimpoints for priority targets in Russia and China. An additional 80 aimpoints are located in North Korea.[91] This number has declined over time due to shrinking stockpiles in Russia, targeting efficiencies attained by identifying critical nodes in networks, and otherwise winnowing out targets through better intelligence collection and analysis such as figuring out how to distinguish between real and fake entrances to underground command posts. Further reductions could be achieved by relaxing the requirements to hold at risk Russian and Chinese mobile missile forces deployed in hidden field locations.[92] Destroying these mobile forces requires an excessive discharge of U.S. firepower against missiles whose position can be located only to an area of tens of miles. Barrage attacks of vast geographic expanses are not judicious and effective. Planning for them should be discontinued.

[91] Blair, "Nuclear Button."

[92] This mission intensified after the 2010 Nuclear Posture Review of the Obama administration.

Under the current deterrence-plus-warfighting strategy, U.S. planners allocate weapons against the 825 total aimpoints according to the following breakout:[93] Of the total, 571 are allocated to Russia—325 for nuclear weapons and other WMD, 136 for war-sustaining industry; and 110 for leadership. China has a total of 254 aimpoints—85 for nuclear weapons and other WMD, including two-on-one strikes against every missile silo; 136 for war-sustaining industry, and 33 for leadership (see Table 3).

[93] Aimpoint total and allocations provided here and below are the author's estimates.

| | Russia | China | North Korea |
|---|---|---|---|
| WMD | 325 | 85 | 50 |
| War-Sustaining Industry | 136 | 136 | 20 |
| Leadership | 110 | 33 | 10 |
| Total | 571 | 254 | 80 |

Table 3: Priority Aimpoint Allocation Under Current Nuclear Deterrence-Plus-Warfighting Strategy.

Under a deterrence-only strategy, the corresponding target set—key elements of state control and economic-industrial output—would largely overlap two of the three target categories (leadership and war-sustaining industries) in the existing U.S. strategy. As emphasized earlier, it would exclude opposing nuclear forces. The U.S. nuclear posture, force structure, and planning would be decoupled from the size of opposing nuclear forces and would no longer be geared to the immediate destruction of those forces. And most importantly, a deterrence-only strategy would dampen the current U.S. posture's operational inclination toward preemption and launch on warning. These characteristics run an inherent and unacceptably high risk of an inadvertent, accidental, or unauthorized triggering of the operational attack plans. This risk is compounded by Russia's equally strong inclination toward early and rapid employment of nuclear weapons during a confrontation. A deterrence-only posture would greatly reduce the risk.

U.S. weapons would have to continuously cover the 272 total war-sustaining industry aimpoints in Russia and China (plus 20 in North Korea) and 143 total leadership aimpoints in the two countries (plus 10 in North Korea). These target sets would be modified somewhat to ensure that key elements of state control and economic-industrial power are fully covered. Conventional and cyberwarfare options would also be strengthened to cover much of the critical infrastructure on which state control and power depend. These options would reduce reliance on nuclear weapons and facilitate de-escalation at least during the initial stages of conflict.

Although this total number (445) is roughly one-half the number of aimpoints (905) under a deterrence-plus-warfighting strategy, the prewar deterrent effects would be no less powerful. In fact, the scale of destruction possible under the deterrence-only strategy would still exceed any reasonable judgment of actual deterrent requirements. The prospect of the annihilation of scores of cities housing banking and oil infrastructure as well as key manufacturing and leadership facilities would intrinsically deter any rational leader. In general, a case can be made for a deterrence-only force on the grounds that it projects a powerful threat while minimizing the inherent liabilities of a deterrence-plus-warfighting strategy—crisis instability and the pressures to launch an attack preemptively or in response to a warning of enemy strikes underway.

How much is enough under the deterrence-only strategy? This analysis estimates U.S. planners would program attacks against 246 Russian aimpoints under this strategy. This dovetails closely with the 270 Russian targets whose destruction would effectively deter Russia, according to a former senior U.S. official who had access to

intelligence on the views of senior officers in the Russian strategic forces.[94] Nuclear strikes that inflict severe damage at 246 aimpoints would actually destroy more than 270 targets because many aimpoints encompass more than one target. Since many of the targets represent critical nodes within the leadership and C3 category, such U.S. strikes would constitute a decapitation threat that would paralyze the Russian military as well as pose a severe threat to Russian economic centers and population.

This report establishes a conservative benchmark for the requirements of deterrence. Core deterrence surely can be established at much lower numbers, perhaps down to fewer than a dozen aimpoints. In the view of Russia's top political and military leadership, the destruction of only a handful of Russian cities would inflict unacceptable damage to Russia and deter a Russian nuclear first strike.

[94] Former senior U.S. official, personal communication with the author.

## *B. Legal Constraints on the Use of Force*

Deterrence-plus-warfighting and deterrence-only strategies both stumble over the law of war. If deterrence fails and a nuclear exchange involving hundreds of weapons ensues, one or both of the belligerents would be in violation of their obligations under the law of war and other binding restrictions. The side that struck first, particularly if the attack involved large numbers of weapons, would be especially culpable.

Striking first has a high bar to surmount: justifiable self-defense. The United States is obligated to abide by the UN Charter. The United States (as well as Russia and China) ratified the treaty at the end of World War II and assumed its legal obligations. According to the U.S. Constitution, a ratified treaty is the law of the land. A key provision of the charter is that, absent approval from the UN Security Council, members are prohibited from using or threatening to use military force against the political independence and territorial sovereignty of other members (Article 2) except when they are undertaking those actions in self-defense in response to an attack underway (Article 51).[95]

That means that unless there is a confirmed nuclear attack, an imminent threat of such an attack, or a clear and present danger to the survival of the state arising during conventional conflict, an order to launch a U.S. first strike against Russia, China, or North Korea is illegal.[96] The unleashing of the U.S. nuclear arsenal without apparent cause against the very large target sets or subsets enumerated in the U.S. nuclear war plan would clearly fail to satisfy the criterion of justifiable self-defense. So would a preventive strike meant to disarm the nuclear capabilities of a country such as North Korea.

[95] United Nations, *Charter of the United Nations,* October 24, 1945, 1 UNTS XVI, www.un.org.

[96] *Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion,* I.C.J. Reports 1996, 226, International Court of Justice (ICJ), July 8, 1996, www.refworld.org.

Even if this criterion is met, any use of military force must still conform to basic principles of the law of war including necessity, minimization of civilian causalities, and proportionality.[97] This is a very high bar for nuclear weapons to surmount. U.S. nuclear policy subscribes to the just-war doctrine's principle of necessity, which obligates war planners to use only the minimum amount of military force necessary to achieve their goal. Under this principle, the United States cannot use nuclear weapons against any target that can be reliably destroyed by conventional means. If effective U.S. conventional options are available, then nuclear weapons are unnecessary, and first use of U.S. nuclear weapons would be illegal. According to this analysis, the strict application of this criterion would also reduce the current set of nuclear aimpoints by at least an estimated 30 percent and thus diminish the amount of nuclear force required if a U.S. nuclear response proved necessary.

A nuclear attack against the United States also would not necessarily justify a large-scale U.S. nuclear response. The law of war would still apply and require restraint.[98] Guided by the law of war, U.S. policy prohibits the intentional targeting of civilian populations, facilities, or other objects.[99] Presidential nuclear employment guidance under the Obama administration directed the U.S. military to "apply the principles of distinction and proportionality and seek to minimize collateral damage to civilian populations and civilian objects."[100] These principles require the military to discriminate between combatants and civilians (distinction) and limit the loss of civilian life and objects so as not to exceed the level of destruction required for the direct military advantage sought (proportionality). The Obama guidance pledged that the United States will not intentionally target those populations or objects.

These rules often appear to be treated as rules meant to be twisted or broken. A noteworthy example of a circumventing interpretation proffered by some lawyers advising nuclear commanders concerns the so-called doctrine of belligerent reprisal. The argument goes that if an adversary employs nuclear weapons in an indiscriminate way that egregiously violates the law of war—for instance, by striking civilian administrative, economic, or industrial facilities in urban areas or striking military targets in a way that results in large-scale collateral damage to civilian populations—then a U.S. response in kind could be justified by this doctrine.[101] They argue that an otherwise indiscriminate and illegal use of force is allowable if it is deemed necessary to compel an adversary who has committed an unlawful act of aggression to return to compliance with the law of war and cease further illegal strikes. This interpretation is controversial and debatable, particularly in the context of a "no-holds-barred" massive

[97] For a comprehensive review, see Gro Nystuen, Stuart Casey-Maslen, and Annie Golden Bersagel, eds., *Nuclear Weapons Under International Law* (Cambridge: Cambridge University Press, 2014).

[98] John Burroughs, "International Law and the First Use of Nuclear Weapons" (presentation given as part of the Virtual Roundtable on Presidential First Use of Nuclear Weapons, February 26, 2018), www.publicbooks.org.

[99] Other objects include transportation and the natural environment. U.S. Department of Defense, Office of General Counsel, *Department of Defense Law of War Manual* (Washington, DC: June 2015).

[100] U.S. Department of Defense, *Report on Nuclear Employment Strategy of the United States Specified in Section 491 of 10 U.S.C.*, 4–5.

[101] Shane Darcy, "The Evolution of the Law of Belligerent Reprisals," *Military Law Review* 175 (2003): 184–251.

nuclear attack when an all-out response could not possibly bring the attacker back into compliance. Such an all-out response would represent illegal punitive retaliation, plain and simple. All leverage on the future course of the war would be exhausted both by the initial all-out attack and the response in kind.

Military lawyers and the Department of Justice bear responsibility for ensuring that conventional or nuclear force is never applied illegally and that Congress's power to declare war under Article I of the Constitution is scrupulously respected.[102] They should conduct a review to determine the specific conditions under which the exercise of specific U.S. nuclear plans would be legally justified, with and without invoking the belligerent-reprisal doctrine. Nuclear commanders need to be trained and given clear instructions as to what actions under what circumstances constitute the unlawful use of nuclear force.

[102] Bruce Ackerman, "Presidential Lawlessness: The Case for Fundamental Reform" (presentation given as part of the Virtual Roundtable on Presidential First Use of Nuclear Weapons, February 26, 2018), www.publicbooks.org.

Military commanders at all levels are duty-bound to disobey an illegal order to carry out a nuclear strike. This obligation constitutes a check on the misapplication of nuclear force. However, military disobedience should not be viewed as a standard, effective, or dependable safeguard, especially under the stress of a nuclear attack against the United States or its allies. The bomber-, submarine-, and land-based missile crews are drilled to execute a message that meets the technical standards of a valid and authentic message. They lack the context to evaluate an order's legality. Military intervention to block an illegal order would have to happen at the highest levels of command, such as the four-star general who heads STRATCOM, or the chairman of the Joint Chiefs of Staff. This check would be unpredictable and likely ineffectual since launch orders flow from the Pentagon war room headed by a one-star general or colonel directly down the chain of command to the individual force commanders. Relying on such disobedience would be foolish. It would also undermine the disciplined execution of lawful orders and erode the sacred tenet of civilian control over the military. Nevertheless, the re-routing of launch orders to ensure that they always pass down through a senior military commander before reaching the launch crews in the field makes sense.

Neither of the deterrence strategies under consideration—deterrence-only or deterrence-plus-warfighting—stands out as more legally defensible than the other. Both could entail the wholesale targeting of facilities in densely populated environments, and both could readily be revised at the direction of the national command authorities to try to minimize civilian casualties, assuming C3 networks remain intact. In general, however, a deterrence-only strategy is preferable because it requires only a fraction of the forces required by a deterrence-plus-warfighting posture. The fewer nuclear weapons expended in

wartime, the less harm that may be inflicted. It is also less prone to crisis escalation and preemption, raising the threshold for the use of nuclear weapons, and is more geared to second-strike response. Finally, this study calls for deploying conventional and cyberwarfare capabilities that offer the president the option to employ non-nuclear weapons, including in strikes against targets in urban areas. These attributes align deterrence-only strategy more closely with the requirements of justifiable self-defense and the law of war.

## *C. Sea-Based Deterrent Force*

The current Trident submarine fleet consists of 14 Ohio-class boats, of which two are in long-term overhaul and an average of eight to nine are at sea at any given time under normal peacetime conditions. As many as four to five of them typically stand ready to fire their missiles at any given moment while patrolling at their launch stations in the North Atlantic and western Pacific (two in each ocean). The other boats at sea are typically performing training and other tasks or transiting on modified alert (reeling out an antenna every four to eight hours to receive communications) to relieve the boats nearing the end of their alert patrol. Subs typically go to sea for 70 days (10 weeks).[103]

When on patrol they are virtually undetectable and carry highly accurate, high-yield warheads able to strike the full spectrum of "soft" to "very hard" targets from a wide range of reentry angles. They are highly responsive. Once an alert submarine receives a launch order, it takes only 15 minutes for the crews to retrieve the fire control key from a safe using combination codes contained in the order and begin the sequential firing of their missiles (up to one firing every 15 seconds) out of their launch tubes.[104] The short delay stems mainly from the need to start up the missiles' flight-navigation gyroscopes and position the boat at proper launch depth (150 feet). A preliminary emergency action message can be sent to shorten this preparation time to five minutes. The time from launch to detonation on targets in Eurasia would average around 15 minutes.[105]

The additional boats at sea on modified alert would require hours to days to be notified and readied for launch at their assigned stations from which missiles could reach their targets in less than 15 minutes. With a typical loading of approximately 100 warheads per boat, the four boats on peacetime alert augmented by the five boats on modified alert represent a survivable fleet equipped to deliver 900 total warheads.[106] In a crisis, the United States could, within a few days, add another few hundred warheads by dispatching from port to sea another two or three boats that were out of service to undergo

[103] Submarine patrol rates for 2017 are discussed in Hans M. Kristensen, "U.S. SSBN Patrols Steady, But Mysterious Reduction in Pacific in 2017," Federation of American Scientists, May 24, 2018, fas.org. This article's estimate of four to five SSBNs on patrol at any given time appears to be high; three to four is a more conservative estimate. See also, Sebastien Roblin, "An Attack from Just One of These U.S. Nuclear Submarines Would Destroy North Korea," *National Interest*, November 24, 2017, nationalinterest.org.

[104] Douglas C. Waller, *Big Red: The Three-Month Voyage of a Trident Nuclear Submarine* (New York: HarperTorch, 2002).

[105] Bruce Blair, "Protocol for a U.S. Nuclear Strike" (presentation given as part of the Virtual Roundtable on Presidential First Use of Nuclear Weapons, February 26, 2018), www.publicbooks.org.

[106] Kristensen and Norris, "United States Nuclear Forces," 122.

replenishment and maintenance.

If desired, the current fleet could upload additional warheads beyond the four or five typically carried on each missile. The D-5 missile has been successfully tested with eight warheads and therefore it would be technically feasible to outfit the fleet with well over 2,000 warheads.[107] This number, however, would exceed the limit of 1,550 deployed warheads set by New START.

[107] Ronald Gutridge, "USS Nebraska Successfully Tests Trident II D5 Missile," *Navy News Service*, March 29, 2018, www.navy.mil.

Under this study's plan for a new nuclear posture, the entire U.S. submarine fleet at sea would operate on modified alert status according to the de-alerting guidance presented in the "Near-Term Guidance for Reducing the Risks of Prompt Launch" section above. The proposed posture would keep zero warheads on launch-ready alert, far fewer than the 270 alert warheads that pose a sudden decapitation threat to Russia in the view of senior Russian military leaders.

The major uncertainty surrounding the SSBN fleet's performance turns on the question of communications reliability following a nuclear attack. The specific core issues are whether ground or airborne command posts carrying the president and special communications aircraft linking the president to the ballistic-missile submarine fleet would survive and successfully transmit a launch order via radio to the fleet at sea. The primary communications link used to order the launch is vulnerable to direct attack and jamming. This link relies on a couple of fixed ground-based antennae backed up by several aircraft equipped with a reel-out antenna that is several miles long. Other backup links rely heavily on vulnerable satellites and require the boats to rise to the surface and expose an antenna. SSBN crews could not be authorized to fire their missiles if these links failed, and they would be physically hampered though not prevented from firing their missiles if the links failed to deliver the combination code for opening the onboard safe containing the boat's fire control key.

## *D. Silo-Based Minuteman III Missile Force*

In the United States, 400 ICBMs deployed in 400 underground silos are spread across five states—North Dakota, Montana, Wyoming, Colorado, and Nebraska.[108] An additional 50 empty silos are kept on standby with plans to rotate missiles into them periodically.[109]

[108] U.S. Air Force, Air Force Global Strike Command Public Affairs Office, *LGM-30G Minuteman III Factsheet*, (Barksdale AFB, LA: September 30, 2015), www.af.mil.

[109] Ibid.

Minuteman III missiles operate with their gyroscopes spinning continuously. This feature cannot be turned off without a time-consuming process to restart them under maintenance supervision, unlike the dormant gyroscopes on submarines, which can be turned off and on at will.[110] The Minuteman missiles can be launched in less than one minute from the time their underground launch crews receive a valid and authentic launch order.[111] The order would des-

[110] Donald A. MacKenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, MA: MIT Press, 1993), 330.

[111] Blair, "Protocol."

ignate the wartime target plan and contain unlock codes needed to fire the missiles. Minuteman missiles offer the fastest reaction time of any strategic weapons system, but their survival critically depends on their prompt launch when under large-scale Russian missile attack. This rapid response capability contributes to deterrence but not to stability.

If the Minuteman force is not promptly launched and most are destroyed on the ground along with their underground launch centers, the surviving missiles would automatically activate an antenna at their silos to receive radio signals from surviving airborne launch control centers flying within line of sight of the silos. These flying launch centers can transmit targeting instructions, unlock codes and coded firing signals directly to the surviving missiles. If these links are destroyed or their communications severed by nuclear damage, neither the underground nor the airborne firing crews could carry out the president's launch order. The inability to deliver the unlock code would neutralize any surviving missiles.

In peacetime, Minuteman missiles are aimed at the broad open ocean as a safety precaution against accidental launch. But they carry multiple wartime targets in their onboard missile computers, and their ocean targets are easily switched to wartime targets.[112] Launch crews can issue target instructions prior to launch to all 400 missiles in seconds, and after launch, the missiles automatically execute in a fraction of a second a slight change of elevation angle that switches their ocean aimpoints over to their designated wartime targets.

[112] Ibid.

Minuteman III missiles possess high-yield, accurate warheads and decoys to defeat enemy interceptors, but they are the least flexible of the triad forces. They offer limited azimuths of attack because of their fixed location and lack of maneuverability in flight, and their great-circle routes (the ballistic arc from silo to target) combined with range limitations would require them to fly over the poles and traverse Russian territory to reach China or North Korea (or Iran). In the event of nuclear conflict with China or North Korea, the United States would not risk overflights of Russia that could too easily appear on Russian radar screens as an attack directed at it and trigger a mistaken Russian launch in response. To avoid such confusion and respect Russian territorial integrity, U.S. strategic submarines and bombers, rather than ICBMs, are assigned the nuclear mission against China or North Korea in the absence of a simultaneous conflict with Russia.

The Defense Department asserts that the "shelf life" of the Minuteman III missile ends in 2030 and calls for its replacement.[113] This report recommends against replacing the missile after its removal from service. The Defense Department should immediately cancel work on the Ground-Based Strategic Deterrent missile slated to re-

[113] Kristensen and Norris, "United States Nuclear Forces," 120.

place it.

During the next decade, the Minuteman III force also should be taken off alert in stages according to the de-alerting guidance presented in the "Near-Term Guidance for Reducing the Risks of Prompt Launch" section above. It should be completely removed from combat service by 2028.

## *E. Strategic Nuclear Bomber Force*

The strategic nuclear bomber force, a versatile and visible part of the triad, consists of 44 B-52H and 16 B-2A nuclear-tasked bombers. Each B-52H is capable of carrying up to 20 single-warhead ALCMs with a variable yield of 5 to 150 kilotons.[114] The B-2A is equipped to drop high-yield (1.2 megatons) B83 gravity bombs and variable-yield B61 gravity bombs with yield options ranging from 0.3 kilotons to 150 kilotons.[115]

[114] Ibid, 127.

[115] Ibid.

These planes and their supporting refueling tankers have not been on combat alert since 1991.[116] Their nuclear payloads are in local base storage. During a crisis, they could be put on alert and dispersed beyond their three peacetime bases to forward-deployed destinations such as Guam. They take a minimum of about 12 hours to be uploaded with nuclear payloads transferred from nearby storage bunkers, primarily at Minot Air Force Base in North Dakota.

[116] Eric Schmitt, "Cheney Orders Bombers Off Alert, Starting Sharp Nuclear Pullback," *New York Times,* September 29, 1991, www.nytimes.com.

Within 24 to 48 hours, the entire B-52H/B-2A fleet could receive at least 500 weapons (less than half its maximum capacity) and assume airstrip or airborne alert.[117] Bombers placed on full alert on U.S. soil during heightened tensions would be highly survivable under attack and could deliver a very large number of nuclear weapons. It would take them 10 minutes to get airborne and about six to eight hours to approach the border of their target countries a safe distance away from enemy air defense missiles and fighter-interceptors. Forward-deployed bombers would have shorter flight times to reach their launch locations. Bombers based at the three main bases in the United States could be launched under positive control and sent on their wartime flight plans without immediately receiving the "go code" to attack. But the farther they fly outside U.S. airspace, the harder it becomes for them to receive the launch order and the codes needed to unlock their payloads prior to release, and the harder it becomes to recall any bombers that have been ordered to attack.

[117] Under airborne alert, nuclear-armed bombers are in the air 24 hours a day.

From their launch locations, the B-52H aircraft would fire their cruise missiles at inland targets located up to 1,000 miles beyond the border of enemy territory. The B-2A stealthy bombers would proceed to fly into defended enemy airspace to drop gravity bombs. With in-flight refueling, both aircraft have virtually unlimited range

and endurance. They can be recalled at any time, but communications with bombers can be especially uncertain during the polar leg of their flight paths. Satellite communication links to the bombers depend heavily on jammable UHF radio transponders on extremely-high-frequency satellites. The B-2A bombers are not yet equipped to receive very-low-frequency transmissions, which are robust for long-distance communications even in a nuclear environment.[118]

The B-52H operational fleet could be expanded to 70–75 by returning reserve bombers to operational deployment. At least 20 of the bombers in reserve could be returned to service in a fairly short period of time—phased in over a period of one to three years. This expansion may be undertaken as part of the new posture this study recommends.

## *F. Current Nonstrategic Nuclear Forces*

During the Cold War, the United States deployed scores of different types of tactical nuclear weapons, also described as nonstrategic nuclear forces. The majority were designed to produce low yields for battlefield use. They were deployed by the thousands on land, at sea, and on aircraft.[119]

The United States retired and dismantled almost all of these weapons because they lacked adequate survivability, military utility, and operational security. Their use first in conflict would have likely triggered escalation with diminishing prospects for terminating a conflict short of an all-out nuclear exchange. After 1992, the vast majority of U.S. tactical weapons were repatriated to the United States under the U.S. and Russian Presidential Nuclear Initiatives.[120] Today, fewer than 200 are deployed, with another 350 in storage. The inventory consists exclusively of B61 gravity bombs.[121]

These bombs are carried by F-15E DCA deployed at five NATO bases in Europe.[122] Of the approximately 180 B61 tactical nuclear weapons in the European theater, a portion of them could be transferred in wartime to several NATO allies that fly F-16 DCA.

With their B61 payloads in collocated storage vaults (underground, directly below the aircraft, which are housed in individual hangars) or in nearby outdoor bunkers, these U.S. and NATO warplanes could be returned to 10-minute alert over time during a crisis. The timeline for such a transition to maximum alert varies from days to many months for different portions of the force.[123] If necessary, additional U.S.-based DCA capable of carrying about 350 B61 bombs could be deployed from U.S. territory to Europe or Northeast Asia.

These nuclear-capable warplanes and their in-flight refueling tankers are meant to contribute to regional deterrence stability and

[118] The U.S. Air Force plans to add Common Very Low Frequency Receivers to B-2 bombers starting in 2018. See Kris Osborn, "Would America's B-2 Stealth Bombers Work During a Nuclear War?," *The National Interest*, July 12, 2017, nationalinterest.org. The definitive report on the current status of nuclear communications vulnerabilities and modernization is Elaine Grossman, "How Putin Might Yank Away Trump's Control Over America's Nuclear Weapons," *War is Boring Blog*, July 3, 2017, warisboring.com.

[119] For an example from the waning years of the Cold War, see Stephen Biddle and Peter D. Feaver, eds., *Battlefield Nuclear Weapons: Issues and Options* (Lanham, MD: University Press of America, 1989).

[120] James Martin Center for Nonproliferation Studies at the Middlebury Institute for International Studies at Monterey, *Presidential Nuclear Initiatives: An Alternative Paradigm for Arms Control* (Washington, DC: Nuclear Threat Initiative, March 1, 2004), www.nti.org.

[121] Union of Concerned Scientists, *U.S. Nuclear Arsenal (as of January 2017)* (Washington, DC: Union of Concerned Scientists, January 2017), www.ucsusa.org. A February 2018 report from Amy Woolf notes the United States has approximately 500 total nonstrategic nuclear weapons with about 200 deployed in Europe, leaving approximately 300 in storage. Amy Woolf, *Nonstrategic Nuclear Weapons* (Washington, DC: Congressional Research Service, February 13, 2018), fas.org.

[122] James Martin Center for Nonproliferation Studies, *U.S. Nuclear Weapons on the Territories of 5 NATO States.*

[123] Bruce Blair, *De-alerting Strategic Forces* (Washington, DC: Brookings Institution Press, 2004).

the assurance of allies. Additionally, if deterrence fails, they are intended to provide a flexible means of responding to aggression. In reality, they suffer from all the deficiencies that led the United States to withdraw and retire every other tactical nuclear weapon that had been deployed during the Cold War. Having little or no military utility, their presence in Europe today is largely symbolic. They are seen as contributing to NATO solidarity and to the NATO commitment to remain a nuclear alliance as long as Russia possesses nuclear weapons.

## *G. If Deterrence Fails: Three Russian-U.S. Scenarios*

U.S. nuclear strategy has always relied on a triad of nuclear forces, but that is no longer necessary. To a first approximation, the U.S. SSBN force by itself provides the capabilities for an adequate response to large-scale nuclear aggression under all conditions. Its warhead capacity and assured survivability support even the most demanding deterrent strategies requiring massive coverage of all categories of potential targets. In the most realistic of scenarios—a conflict escalating over time that allows for off-alert U.S. bombers and more submarines to be placed on alert—the U.S. strategic capabilities would very substantially exceed the wartime target requirements of today's strategy of deterrence-plus-warfighting. They would vastly exceed the requirements of a deterrence-only strategy.

The U.S. strategic-bomber and SSBN forces also provide for adequate responses to regional nuclear contingencies.

Consequently, the U.S. Minuteman III force is redundant and dispensable regardless of the scenario and mission.

Putting aside doubts about C3 resilience, the robustness of the current U.S. nuclear posture to fulfill deterrence-plus-warfighting or deterrence-only missions in response to enemy nuclear attacks under wide-ranging conditions is illustrated by the cases below. These cases also illustrate the ICBM force's lack of contribution to current requirements to cover primary targets in Russia, China, and North Korea.

### *Case 1: Bolt from the Blue: Russian Worst-Case Surprise Attack*

This scenario assumes the United States abides by New START's warhead limitations. It also assumes the Ohio-class Trident submarine fleet carries no more than 1,084 warheads. Of the remaining 466 warheads allowed under New START, 400 are carried by the U.S. Minuteman strategic missile force and the rest by the bomber force of 46 B-52H and 20 B-2A aircraft. Under New START counting rules,

each aircraft is counted as carrying only one warhead even though in reality, it may be armed with multiple cruise missiles and gravity bombs.[124]

Today a full-scale Russian attack without strategic warning and thus without the raising of U.S. alert levels would destroy the U.S. bomber fleet and the vast bulk of the Minuteman III force.[125] The latter might survive if the president gave timely enough authorization for its prompt launch.

Although the bomber and Minuteman forces may be destroyed, four survivable Ohio-class submarines normally on alert patrol could respond immediately with others responding within 24 to 72 hours (after their alert level was raised and they reached launch stations). Having the capacity to deliver as many as 905 total warheads, the SSBN fleet today ensures full target coverage of all potential adversaries under a strategy of deterrence-plus-warfighting, encompassing 905 total aimpoints across the three categories in the three targeted countries—571 in Russia, 254 in China, and 80 in North Korea.[126]

The Minuteman III force of 400 warheads would not be needed at all. There would be no point in even attempting to launch them on tactical warning. They are dispensable weapons that should be eliminated.

Under a deterrence-only strategy, in which only the leadership and economic-industrial facilities are targeted, U.S. submarines would need to cover only 445 aimpoints—246 in Russia, 169 in China, and 30 in North Korea. The United States could therefore halve its current fleet of Ohio-class SSBNs, cutting the fleet from 14 down to seven, of which five would be kept at sea at all times. If the president opted to eliminate the Minuteman III warheads and commensurately increase submarine warhead loadings from four to eight per D-5 missile, the number of subs could be reduced further, down to five as long as three could remain seaworthy at all times. These calculations give an idea of the logic behind the French and U.K. deterrent strategy. Each of these allies possesses four boats and normally keeps only one of them at sea, though with far fewer warheads on board than the United States.

The resilience of the U.S. C3 system remains the largest uncertainty in the equation. The conclusions above assume survival of the system, but, as noted above, this is the weakest link in the deterrence chain for all the forces. Direct kinetic and nonkinetic attack could break the chain.

The bottom line is that deterrence holds today even under the worst-case assumption of a massive surprise Russian attack. The current U.S. Ohio-class submarine force alone is fully able to meet the target-coverage requirements of a deterrence-plus-warfighting strat-

[124] Amy F. Woolf, *The New START Treaty: Central Limits and Key Provisions* (Washington, DC: Congressional Research Service, February 5, 2018), fas.org.

[125] Alex Lockie, "Putin just said Russia has 'unstoppable' nukes—here are the areas in the US most likely to be hit in a nuclear attack," *Business Insider,* March 1, 2018, www.businessinsider.com.

[126] Furthermore, the burden of holding at risk Russian nuclear-missile targets, particularly silo-based missiles, would theoretically be lessened by the fact that Russia would have to expend many hundreds of its most accurate silo-based weapons in its initial attack. Although empty Russian silos may have some residual value as vessels for reloading, the number of Russian nuclear-missile and associated command-and-control targets that U.S. forces would need to destroy in retaliation would drop by about 150–200. Moreover, a sizable fraction of Russian targets are "soft" or "semi-hard" and thus vulnerable to U.S. conventional forces. Some 1,000 U.S. Tomahawk cruise missiles on board four specially modified Trident submarines and scores of Aegis destroyers could alone inflict severe damage to these targets. Under the Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I) of 8 June 1977—which imposes limits on the use of weapons—conventional forces should be used instead of nuclear weapons if time and circumstances allow. Their survival and availability in the wake of conventional conflict would not be assured, however.

egy and is two times larger than necessary to support a deterrence-only strategy.

*Case 2: Russian Large-Scale Strike: U.S. Forces on Full Alert*

If fully raised to combat readiness, the current U.S. triad would have far greater capacity to respond than required to destroy all the current target sets. Capable of delivering nearly 2,000 nuclear warheads and bombs, the forces provide blanket coverage of all aimpoints in all potential adversaries. Assuming the command system remains intact and functional, the president could comfortably choose to ride out the attack even though the vulnerable silo-based Minuteman missile force could be destroyed. U.S. submarines at sea and U.S. bombers on runway alert would survive in sufficient numbers to strike back at the full Russian target set while withholding sufficient numbers to preserve blanket coverage of China and North Korea with more than 1,000 weapons to spare.

Under a deterrence-only strategy, the survivable U.S. submarines and bombers would possess five times the necessary deliverable weapons. This excess potential drives home the point that current U.S. forces could be substantially reduced regardless of the strategy adopted.

The bottom lines for Cases 1 and 2 are that current U.S. strategic forces adequately support a deterrence-plus-warfighting strategy in the extremely remote event of a massive surprise Russian strike, exceed the maximum requirements of that strategy by a factor of two under full-crisis conditions—that is, when the full nuclear force, including the reserve bomber force, is on alert—and exceed requirements of a deterrence-only strategy by a factor of three to five under all hypothetical conditions of Russian attack.

*Case 3: Russian Non-Nuclear Strike or Limited Nuclear Strike Against Critical Civilian Infrastructure*

In the 1990s, Russia's conventional armed forces nearly collapsed. Starved for resources during a prolonged period of extreme economic distress in the country, the Russian military could barely defeat a ragtag insurgency in Chechnya during two wars there, much less stand up to the might of NATO. Despite large-scale U.S. and NATO demobilization of their standing Cold War forces during this time period, Russia perceived an expanding NATO alliance as a growing threat to its existence.

After the NATO bombing campaign in the Balkans in the late 1990s and Vladimir Putin's ascension to power in 2000, Russia devised a "cheap fix" involving nuclear weapons to address its con-

ventional inferiority to NATO. If a conventional conflict with NATO broke out and Russia were losing, it could use one or more "low-yield" nuclear weapons on NATO territory to cow the alliance's leaders into ceasing offensive operations against Russia and accepting a truce in place. By crossing the nuclear Rubicon, Russia would demonstrate its willingness to raise the ante and attempt to escalate its way out of a conventional debacle.[127]

This so-called "escalate to de-escalate" doctrine was practiced during major exercises over the past 15 years. It remains an option today.[128]

But it puts the burden of whether to use nuclear weapons first on Russia. In recent years, Russia has sought to shift this burden to NATO. It developed asymmetrical non-nuclear options designed to coerce NATO leaders as much as a nuclear demonstration explosion or two would. The most noteworthy of these options involve strikes aimed at shutting down critical civilian infrastructure—banks, stock markets, utilities, and communications and transportation networks.[129] By surgically attacking and neutralizing these targets in NATO countries and the United States by means of cyberwarfare, special operations, and conventional missiles, Russia would seek to rouse Western populations in opposition to the war efforts of their own governments. The Kremlin's calculus is that the political and psychological impact of depriving people of their heat and air-conditioning, iPhones, ATMs, transportation, and other necessities of modern living would so sway public opinion against the conflict that U.S. and European leaders would be compelled to lay down NATO arms.

Like the nuclear option of escalating to de-escalate, this "non-nuclear strategic attack" option is primarily a form of psychological warfare. Russia would gain no military advantage from either of them. Neither would directly change the course of a conventional conflict, which Russia would eventually lose after NATO fully mobilized its military forces and asserted its air superiority. Unless the psychological warfare succeeded in bringing NATO operations to a halt, Russia would face the choice of either retreating from NATO territory initially seized on its periphery where Russia enjoys a clear-cut military advantage or raising the ante and climbing the nuclear ladder in another desperate bid to de-escalate through escalation.

A NATO nuclear response to either of these Russian options—a demonstration Russian nuclear strike or a non-nuclear attack on Western critical civilian infrastructure—would be an overreaction fraught with risk of further escalation to a large-scale nuclear exchange. A conventional or cyber NATO response makes far more sense. The alliance possesses ample non-nuclear means to respond to

[127] Ministry of Foreign Affairs of the Russian Federation, *Voennaia doktrina.*

[128] "Russian Armed Forces held Strategic Nuclear Forces control training," Ministry of Defence of the Russian Federation, October 26, 2017, eng.mil.ru.

[129] "Genshtab: osobennost'iu konfliktov budushchego stanet primenenie robotov i kosmicheskikh sredstv," *TASS,* March 24, 2018, tass.ru.

Russian regional escalation, whatever form it takes. This would leave the burden of deciding to use nuclear weapons first and risk further nuclear escalation on Russia.

U.S. and NATO leaders would have nuclear options at their disposal, however. NATO could turn to U.S. F-15 and NATO F-16 DCA stationed throughout Europe. They are armed with B61 gravity bombs whose explosive yield can be dialed down to 0.3 kilotons (the equivalent of 300 tons of TNT). This is one-fortieth of the explosive yield of the Hiroshima bomb. When the B61-12 version enters service—starting in 2022, according to the current schedule—this option will also allow for pinpoint accuracy.

The United States and NATO also could turn to less vulnerable U.S. strategic bombers, dispatching B-2A stealthy bombers armed with variable-yield B61 gravity bombs or B-52H bombers armed with long-range cruise missiles capable of being dialed down to a yield of 5 kilotons (one-third the explosive power of the Hiroshima bomb). The latest Nuclear Posture Review issued by the current administration contends that these bombers are too vulnerable to carry out strikes with high confidence and calls for the United States to deploy a low-yield fission nuclear weapon ("primary only") delivered by an invulnerable SSBN. But this assessment flies in the face of the clear ability of U.S. strategic bombers to deliver cruise missiles and gravity bombs against Russian targets even if the latter are protected by air defenses.

U.S./NATO nuclear strikes on Russian soil would obviously risk further nuclear escalation. Striking forward-deployed Russian forces occupying NATO territory—most likely eastern parts of Baltic states—would be no more acceptable for many reasons. One major one is that it could cause more harm to the alliance than the Russian occupation itself. The choice of a nuclear versus non-nuclear response would depend heavily upon U.S. and NATO leaders' calculations of costs, benefits, and risks.

With about 1,000 deliverable low-yield nuclear weapons in the U.S. stockpile, it is difficult to imagine how the addition of new low-yield weapons in the form of a submarine-launched ballistic missile (SLBM) warhead with an atomic rather than a thermonuclear explosive package or a new sea-launched cruise missile (SLCM) would alter the calculations on either side. U.S. nuclear weapons should not even play a major role in these scenarios. There is no point in resorting to them at all since U.S. and NATO conventional forces could defeat Russia in this type of conflict.

# *VIII.*
# *Nuclear Modernization Program*

The United States plans to replace its aging strategic nuclear bombers, submarines, and land-based missiles, as well as DCA assigned to regional nonstrategic nuclear missions. The choices represent 50-year decisions for each of the three types of strategic weapons systems. The price tag is high: $1.25 trillion ($1.7 trillion with inflation) at a minimum over the next 30 years for full-scale modernization of all three components together with their operations and maintenance costs.[130]

Russia's and China's comprehensive nuclear rearmament programs, begun a decade ago and in full swing today, provide impetus for the U.S. program. Public displays of nuclear bravado by Russian leaders coupled with growing antagonism between the United States and Russia and the atrophy of bilateral U.S.-Russian nuclear arms regulation add to the pressures. Many view these developments as marking the onset of a new nuclear arms race.[131]

While an action-reaction dynamic is doubtless underway, aging and obsolescence are the main causes of what amounts to overlapping modernization programs in the three countries. In the case of Russia, the mundane reality is that replacing its decrepit forces was long overdue when it began more than a decade ago. Its nuclear and conventional forces had all but collapsed during the 1990s along with the Russian economy, which relied heavily on income from exports of oil and gas. Lacking resources, Russian forces decayed in place. As long as Russia intended to keep a nuclear arsenal, which it could not afford to abandon in view of NATO's and China's conventional superiority, it had no choice but to rebuild.

Sharply rising oil prices during the first decade of the new millennium enabled Putin to allocate the necessary funds.[132] Russia's budget for strategic offensive forces, air and missile defenses, and C3 networks increased to approximately $400 billion over two decades, which in purchase-parity terms (the cost of the weapons if built in the United States) is roughly equivalent to $1.2 trillion, which is

[130] Congress of the United States, Congressional Budget Office, *Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046* (Washington, DC, October 2017), 1, www.cbo.gov.

[131] See, for instance, Richard Burt and Jon Wolfsthal, "American and Russia May Find Themselves in a Nuclear Arms Race Once Again," *The National Interest,* January 17, 2018, nationalinterest.org; Eric Schlosser, "The Growing Dangers of the New Nuclear-Arms Race," *The New Yorker,* May 24, 2018, www.newyorker.com.

[132] Crude Oil Prices – 70 Year Historical Chart, Macrotrends, www.macrotrends.net.

roughly equal to Russia's total annual GDP.[133] Russia therefore has been busily dismantling and replacing old weapons systems and reviving stagnant projects such as the notorious nuclear-capable long-range undersea drone, a project started decades ago that is now coming to fruition. As a key part of this activity, Russia very energetically developed weapons systems that could overcome U.S. missile defenses. Much of the research and development for these systems, such as maneuverable reentry vehicles (for example, hypersonic glide vehicles) that are to be mounted atop heavy Russian ICBMs such as the new Sarmat, began soon after the United States announced its unilateral withdrawal in 2002 from the Anti-Ballistic Missile (ABM) Treaty.

Similar exigencies are driving Chinese nuclear modernization. China's economic boom has provided ample financing to build a modern though modest nuclear force. Beijing is deploying new land-mobile ICBMs and a five-boat fleet of modern, though noisy and detectable, strategic submarines capable of launching long-range ballistic missiles.[134] In addition, China has vastly expanded its deployments of short- and intermediate-range ballistic missiles, which could strike U.S. allies and U.S. forces in Asia. Many of these missiles are technologically advanced with maneuverability for defeating U.S. missile defenses.

But China's nuclear ambitions remain modest. It describes its nuclear doctrine as minimum deterrence.[135] Its arsenal probably will not exceed 300 total nuclear weapons for the foreseeable future. China has long proclaimed a policy of no first use and is expected to adhere to this position.[136] Its nuclear posture is far from taut. Almost all of China's stockpile of about 200 nuclear weapons remain separated from their means of delivery and stored at a single location.

During the upgrading of Russian and Chinese forces, U.S. nuclear forces did not languish, as some have claimed. The United States quietly refurbished its Minuteman III missiles with new solid-fuel cores and guidance sets and otherwise maintained and upgraded a reliable and capable strategic force. There have been no known instances in which U.S. generals have expressed envy over Russia's nuclear forces or declared that they would swap the U.S. strategic force for that of any other country.

But the United States now finds itself in a similar position of needing to replace aging nuclear forces reaching the end of their shelf life. How many and what types should be replaced are the relevant questions.

The timelines for all three modernizations extend over multiple decades, hardly a rush by any of the three countries to gain exploitable strategic advantage over one another.

[133] *Military expenditure by country, in local currency, 1988–2017*, Stockholm International Peace Research Institute (SIPRI), 2018 (hereinafter SIPRI military expenditure in local currency); *Military expenditure by country, in constant (2016) US$ m., 1988–2017*, SIPRI, 2018 (hereinafter SIPRI military expenditure in constant U.S. dollars).

[134] Hans M. Kristensen and Robert S. Norris, "Chinese nuclear forces 2016," *Bulletin of the Atomic Scientists* 72 (2016): 205–211.

[135] Liping Xia, *China's Nuclear Doctrine: Debates and Evolution* (Washington, DC: Carnegie Endowment for International Peace, June 30, 2016), carnegieendowment.org.

[136] Ibid.

Characterizations of these overlapping and drawn-out modernizations as signs of renewed great-power competition are overwrought and melodramatic. Extensive modernizations would doubtless have occurred even if U.S.-Russian-Chinese relations were much better.

But outbursts of nuclear brinkmanship reminiscent of the Cold War era have created an atmosphere of nuclear arms racing. The security environment has unquestionably grown more hostile, and there is no absence of assertive self-interest by each country at the expense of the others' security. The list of disputes, which has expanded, includes border issues, claims of illegal occupation of territory, and—for Russia and the United States—mutual allegations of cheating on an arms control treaty. The forward deployment of quick-reaction conventional forces to areas near the NATO-Russia border and the carrying out of flash exercises in those areas raise the very real specter of clashes leading to conflict. Aggressive actions and reactions justified in the name of self-defense and deterrence have taken on a life of their own with hundreds of hostile encounters in the air and sea occurring each year in the European region.[137]

[137] Sleight, "Military Incidents."

A massive U.S. nuclear buildup is not the solution to these disputes. While the United States will need to modernize its nuclear C3 network and replace some of its aging weapons, it can, at no risk to its security, build far fewer weapons than currently planned under deterrence-plus-warfighting and fewer still by moving to deterrence-only. U.S. security and investment in it would be better served through scaling down the U.S. arsenal, negotiating arms limitations, and adopting confidence-building measures that reduce the risks that a nuclear weapon will be used.

Large-scale nuclear modernization is also not the solution to the other major nuclear challenges of our age: proliferation and terrorist acquisition of WMD. The nuclear-arms buildups underway around the world—in Pakistan, India, and North Korea, as well as the United States, Russia, and China—in fact send a counterproductive message to nuclear aspirants about the importance of these weapons and present terrorists with more opportunities to get their hands on them as the weapons increase in numbers and are more widely dispersed.

U.S. modernization plans should go forward, but on a smaller scale with clearer priorities and a better grasp of their myriad implications.

## A. *Future Strategic and Nonstrategic Nuclear Forces*

### *Transition to Submarine-Based Monad*

As discussed above, U.S. SSBNs at sea are by themselves sufficient for deterrence. Within the next decade, the United States should therefore begin transitioning to a strategic deterrent force consisting only of submarines. Five Columbia-class boats would support a deterrence-only strategy and seven would support a strategy of deterrence-plus-warfighting (see Table 1 on Page 7). This assessment reflects a significant contribution to target coverage by U.S. conventional and cyberweapons. If planners insist upon discounting such contributions, then the SSBN fleet size would consist of six boats under a deterrence-only strategy and ten boats under a deterrence-plus-warfighting strategy. These numbers are far smaller than the current excessive modernization plan envisions.

A nuclear monad replacing today's triad would yield abundant benefits with little downside. As long as they are backed by a resilient C3 network, a maximum of four to seven survivable U.S. SSBNs at sea would greatly diminish any temptation or pressure to unleash nuclear forces by either side during a crisis, allow for stabilizing operational changes such as moving away from first use and launch on warning to purely second-strike responses, encourage further nuclear-arms reductions, and substantially reduce the costs of nuclear modernization.

Strategic bombers and Minuteman III missiles are therefore redundant and dispensable. However, bombers could provide a crucial hedge against unanticipated problems that might temporarily ground part or all of the submarine fleet, such as an unexpected vulnerability or technical defect requiring emergency repairs.[138] A case can therefore be made for retaining and replacing the bomber fleet as it ages out. Although the chances that such a systemic vulnerability or technical failure would put the entire submarine fleet in jeopardy appear at this moment to be very remote, a reserve bomber force capable of shifting to survivable alert status could offer an insurance policy. In any case, the Air Force wants to replace the U.S. long-range bomber force primarily for delivery of conventional weapons.

The Minuteman III force does not possess the versatility, flexibility, recallability, and other characteristics desired in such a reserve hedge force. It should be phased out over the next ten years and not replaced.

It is incumbent upon the country's intelligence and defense agencies to assess the long-term viability of the U.S. SSBN force and analyze alternative options for a hedge force. If significant risks are

[138] The bomber payloads would consist of two highly accurate and lethal nuclear weapons: the W80 warhead for its long-range cruise missiles and the B61-12 warhead for its gravity bombs. When the latter are deployed in the 2020s, the current high-yield B83 bomb will be retired.

identified, or if the agencies conclude that an enemy breakthrough in anti-submarine warfare could escape detection, a capable hedge might consist of a mixed fleet of 40 to 70 heavy bombers (B-52H, B-2A, and B-21 Raider, which is still in development) armed with ALCMs, B61 gravity bombs, conventional cruise missiles and, optionally, the new air-launched long-range standoff (long-range standoff, or "LRSO") cruise missile. The fleet size would vary from a low of 40 aircraft for a deterrence-only hedge to 70 for a deterrence-plus-warfighting hedge.

If production of B-21 Raider stealthy bombers falls drastically short of the planned 100 aircraft, then the bomber hedge force may need to be augmented by either an expanded B-52H fleet modified to maximize its cruise missile capacity or a new airborne cruise missile carrier derived from existing commercial aircraft platforms. Work should begin now to weigh the merits of these and other alternatives and to prepare a contingency plan in case the B-21 Raider program fails to materialize in the required numbers.

In any case, it is worth reiterating that the vulnerable, inflexible, and destabilizing silo-based Minuteman III missile force can be retired. A single squadron might be retained and converted to other uses such as emergency rocket communications. This leg of the triad would otherwise contribute little or nothing. In fact, deterrence will be more stable without it.

### *Downsizing the Columbia-Class SSBN Fleet*

The official U.S. modernization plan foresees a transition from 14 Ohio-class to 12 Columbia-class modern submarines beginning as the older boats retire over the period 2023–2042 and the new ones start entering service in 2031.[139] The new Columbia-class boats have fewer launch tubes and missiles (16 rather than 24). They will be equipped with lifetime reactors that require less maintenance and overhauling. Consequently, they will be able to maintain a higher tempo of operations at sea and higher readiness to surge out of port during a crisis. It is likely that eight or nine out of the 12 could be deployed at a given time in peacetime and as many as 10 and possibly 11 within days to weeks after the onset of a crisis.

[139] NPR, 49.

If desired, these new submarines can carry additional warheads. Test launches have proven that D-5 missiles and their planned replacement have the ability to carry at least eight warheads. Thus, the survivable Columbia-class fleet of eight to 11 boats depending upon the circumstances could feasibly deliver between 1,024 and 1,408 warheads at aimpoints throughout Eurasia. This greatly exceeds the number of weapons needed to fully support the aims of a deterrence-

only strategy, which requires the ability to deliver warheads at 445 aimpoints in Russia, China, and North Korea, and meets the number needed to cover 905 aimpoints under a deterrence-plus-warfighting strategy.

The Columbia-class fleet can therefore be cut from the planned 12 boats to five. This fleet size factors in the potential contribution of conventional forces. Three boats at sea in peacetime would contribute 384 survivable warheads; the remainder of the 445 aimpoints would be covered by non-nuclear weapons (see Table 1 on Page 7). If conventional capabilities are ignored, then six boats would suffice to ensure full target coverage. Four would be maintained at sea carrying a total of 512 warheads.

A deterrence-plus-warfighting strategy would require only seven boats. Five at sea would cover 640 aimpoints and conventional weapons could cover the balance of the 905 total aimpoints.[140]

In all cases, additional boats could be sent to sea in a crisis to provide additional warheads, a cushion which could be used to lighten the warhead numbers on some of the missiles in order to extend their range when they were armed with heavier W88 warheads or if patrol areas were enlarged well beyond the current boundaries.[141] It would also mitigate unanticipated adversities, including the possible loss of one or more boats to anti-submarine warfare.

SSBNs are highly self-sufficient and can operate autonomously at sea for many months. After several months, their food supplies run out. They could extend operations for much longer—almost indefinitely—if additional provisions could be brought onboard. To extend the endurance and increase the self-sufficiency of submarine operations in the event that the two major home ports—in the states of Georgia and Washington—are damaged or destroyed by a military strike, a robust plan should be developed and implemented to expand port logistical support to alternative coastal locations as well as to points at sea where naval maintenance and logistical capabilities could service the essential operational needs of the Ohio- and Columbia-class submarine fleet. A Minimum Essential Emergency Submarine Support program would address the critical node vulnerability of the two ports and ensure that their disabling would not cripple operations at sea.[142] Savings from the elimination of other nuclear forces and bases, particularly Minuteman bases, could be shifted to configuring and stocking backup port facilities.

A parallel effort should also be undertaken to strengthen the ability of the existing Minimum Essential Emergency Communications Network to ensure enduring connectivity between SSBNs and the top civilian and military commanders during and after a nuclear attack. The focus of the network's near-term upgrades should be to improve

[140] If US non-nuclear conventional and cyber weapons are ignored, then a fleet of 10 SSBNs would be required. This translates into seven survivable boats at sea capable of delivering 896 total warheads.

[141] A D-5 missile armed with eight of the lighter W76 warheads has a range of 6,000 miles and could reach virtually any target as soon as the SSBN leaves port.

[142] The three Minuteman main bases and the three B-52H and B-2A main bases also represent a small number of critical nodes whose destruction would largely paralyze force maintenance, staffing, and operations. The submarine fleet is much more autonomous and enduring than either the Minuteman or bomber forces, whose endurance would be measured in days compared to months for submarines.

the very-low-frequency trailing wire antenna and the extremely-high-frequency satellite links between high-level airborne and mobile ground-based command posts and the boats at sea. For the medium-term, the Defense Department and STRATCOM should design a new C3 master plan featuring innovative capabilities for reconstituting the network in a post-attack environment.

In summary, a small fleet of Ohio-class submarines would provide adequate target coverage to respond to an attack by Russia or China under any deterrent strategy. Five or seven would suffice if dedicated conventional forces are assigned to the nuclear deterrent missions under the strategies of deterrence-only or deterrence-plus-warfighting, respectively. If planners choose to ignore conventional contributions, six to 10 boats would support these respective strategies. In any case, the planned construction of 12 Ohio-class SSBNs exceeds real needs.

### *The Future of Strategic Nuclear Bombers*

U.S. strategic bombers could have a vital role to play in this deterrence architecture. Beyond their normal assignments in conventional warfighting operations, the B-52H, B-2A and B-21 platforms could perform several missions. First, they could continue to be used for signaling—flying close to hot spots around the world as a show of resolve to reassure allies subject to nuclear threats and warn adversaries. Second, they could deliver low-yield bombs or cruise missiles during a regional nuclear conflict in which a potential adversary initiates the first use of nuclear weapons and a nuclear response is deemed necessary. These heavy bombers could thus replace the F-15/F-16 nuclear missions and bump the F-35 nuclear-capable aircraft as well as the proposed low-yield SLBM and new SLCM out of the modernization plan. Third, they could be kept in reserve and returned to operational status with nuclear payloads on board during peacetime in an emergency involving a common-mode failure of the submarine fleet that necessitates suspending operations of part or all of it. As noted above, this appears to be an extremely unlikely contingency. But the risk of such a failure due to breakthroughs in an adversary's ability to detect and sink U.S. strategic submarines or due to a systemic technical problem—such as a propulsion reactor flaw or defective warheads—requiring urgent correction cannot be categorically ruled out. That is especially true over the 42-year lifetime of the replacement boats.

In this dire circumstance, 40 heavy bombers armed with at least 450 nuclear warheads would be placed on 10-minute runway alert to provide coverage of 445 Russian, Chinese, and North Korean economic and leadership aimpoints, assuming a transition to a

deterrence-only strategy, as this report recommends (see Table 2 on Page 10). Under a deterrence-plus-warfighting strategy, an additional 30 aircraft for a total of 70 bombers would assume runway alert armed with at least 900 nuclear weapons, the nominal number required to cover the 905 aimpoints in the three countries.

These bombers would be quickly ordered into the air if U.S. commanders perceived an enemy missile strike against the planes' home bases. (There are currently three such primary bases and numerous potential dispersal bases, where the bombers could be positioned to launch under attack or to remain if they could not return to their home bases.) They need not be sent strike orders for many hours after taking off. Their flight time over the poles from the United States would approach seven to eight hours before reaching the locations outside Russian territory at which B-52H and B-21 bombers could fire their standoff cruise missiles at inland targets or, alternatively, B-2A or B-21 bombers could penetrate enemy airspace to attack inland targets with cruise missiles and gravity bombs. After taking off, bombers, unlike Minuteman missiles, could be recalled soon thereafter if indications of an enemy missile attack proved false.

In sum, a reserve hedge force of 40–70 heavy bombers armed with 450–900 nuclear bombs and cruise missiles, depending on deterrent strategy adopted, would provide the necessary insurance in case of an emergency suspension of submarine operations. Any suggestion that a total of 175 aircraft—75 B-52H and 100 B-21 bombers—are needed for the nuclear deterrent mission is an exaggeration.[143] In an emergency, even today's older bomber force could cover for the submarine fleet if necessary.

[143] In a March 2018 hearing before the Senate Armed Services Committee by Commander of STRATCOM General John E. Hyten stated his belief that the minimum bomber capability requirements for nuclear deterrence consisted of 75 B-52s and 100 B-21s with the B-2 force retiring by the early 2030s. See SASC Hearing on U.S. STRATCOM, 44.

### *The Challenge of "Defense Suppression" to Assist Bomber Operations*

A reserve bomber fleet drafted into this emergency role would face the daunting wartime challenge of entering Russian (or Chinese) airspace, which would be bristling with air-defense interceptor missiles and fighters. The B-52H fleet could remain outside enemy territory and beyond the reach of most air defenses when firing cruise missiles at inland targets, but many other plans would contend with dense defenses while flying for hours to targets deep inside the country before dropping B61 gravity bombs or firing cruise missiles aimed at high-priority hard targets such as leadership bunkers located underground or inside mountains.

Analysts who say the United States should deploy the new B-21 stealthy penetrating bomber armed with new LRSO cruise missiles argue that these weapons systems are needed to cope with the thick enemy air defenses found in Russia and China today.[144] This asser-

[144] See Dave Majumdar, "How America Plans to Make Sure the B-21, B-2 and B-52 Can Bomb Russia or China," *The National Interest*, February 7, 2018, nationalinterest.org

tion is only partially true. It ignores the reality that such defenses are readily avoided or suppressed before penetrating bombers fly through their planned attack corridors to their targets. Currently, the B-52H fleet can launch hundreds of nuclear-armed ALCMs to destroy air defenses from the borders to 1,000 miles inland, and an estimated 70 nuclear weapons launched mainly from Minuteman silos and Ohio-class submarines are also charged with destroying the air defenses along the bombers' attack corridors. These strikes would clear the path to the target for penetrating bombers, which would have a probability of more than 90 percent of reaching their inland targets. Even the most heavily fortified targets could be destroyed. The very last sortie in the current strategic war plan would likely be a B-2A penetrating bomber flying through devastated defenses low over Moscow to drop a B61 bomb on the Kremlin and its labyrinth of underground tunnels.

The key question for this analysis is whether the U.S. bomber force could penetrate enemy airspace successfully without assistance from other U.S. weapon systems. There would be no "defense suppression" by Minuteman III or SSBN missiles. The assumption here is that Minuteman III forces have been eliminated and SSBN operations have been suspended. So how would bombers suppress defenses on their own, or what other deployed weapons systems could be tapped for this purpose?

As noted above, the current B-52H bomber fleet could cripple air defense installations using nuclear-armed ALCMs launched from standoff locations outside enemy territory. The future fleet of B-52H and B-21 bombers would retain this capability by firing conventional or nuclear cruise missiles—for instance, stealthy extended-range Joint Air-to-Surface Standoff Missiles, which are conventional; nuclear ALCMs; or, possibly nuclear LRSOs—either from standoff locations outside enemy territory ahead of inland bombing runs or from inside enemy territory as the penetrating stealthy B-21s fly through their assigned corridors en route to inland targets. Conventional cruise missiles on board heavy bombers would probably be effective in clearing the corridors. The planned nuclear LRSO would therefore not be needed even after its predecessor, the aging nuclear ALCM, is retired.

Additional outside assistance could help suppress the air defenses. Conventional and cyberweapons in the current U.S. inventory—for example, Tomahawk IV cruise missiles fired from specially outfitted Trident submarines, from Aegis destroyers stationed in the Baltic and Black Seas, or from Virginia-class attack submarines could be employed.[145] With a range of 1,000 miles and an accuracy of 10 meters, these precision-guided, low-flying cruise missiles have the ability to

[145] Under current U.S. nuclear force structure, four Trident submarines are deployed, each capable of firing 156 Tomahawks.

evade or destroy air defenses deep in enemy territory. The United States deploys more than 5,000 conventional cruise missiles that could lay down a heavy barrage. They could even reach Moscow to suppress C3 systems as well as air defenses. In fact, this particular conventional weapon system alone could destroy a significant fraction of the "soft" vulnerable targets in the current or future U.S. war plans. Cyberwarfare also could be quite effective against air-defense radars and C3 networks used in defensive operations.

In sum, the future backbone of this reserve hedge force of 40–70 bombers will be the B-21, which is scheduled to enter service in the mid-2020s, and the B-52H whose longevity is being extended into the 2050s. The new stealthy B-21 will be equipped to carry both B61 gravity bombs and conventional or, optionally, nuclear LRSO cruise missiles. Older B-52H bombers, which are having their engines replaced as part of their life extension program, may be armed with the new LRSO as the older ALCMs are decommissioned. Alternatively, they could be converted into carriers of conventional cruise missiles with the assignment of suppressing vulnerable air defense installations to pave the way for penetrating B-21 and B-2A bombers. The aging B-2A bomber fleet will remain in service armed with B83 high-yield and B61 gravity bombs until the B61-12 becomes available, at which time the B83 bomb will be retired. The B-2A itself will retire soon thereafter. A new tanker aircraft capable of in-flight refueling is scheduled to enter service in parallel and will be able to support all bombers in the fleet.

Whatever the mix, there is no doubt that the bomber force can provide a reliable, effective reserve force to hedge against unexpected problems that diminish the viability of the submarine force.

### *Bomber Hedge 2.0*

The cost uncertainties associated with the B-21 are sufficiently great to warrant the contingent development of a cruise missile carrier aircraft such as the Boeing 747 civilian aircraft or large-capacity military cargo planes. The planned procurement of 100 B-21 bombers may well fall victim to budgetary pressures or political and bureaucratic obstacles, as happened to the B-2A fleet that topped out at a total of 21 built. It may well prove to be cost-effective to modify existing commercial aircraft or military C-5 cargo aircraft to be so-called "arsenal planes" loaded with nuclear or conventional cruise missiles. The Boeing 747 is capable of carrying and launching up to 76 cruise missiles.[146] In the current plan, the B-52H plays this role. This plane can itself be modified to carry many more missiles than its present maximum load of 20. The B-52H inventory consists of 76 active air-

[146] Tyler Rogoway, "Why Boeing's Design For A 747 Full of Cruise Missiles Makes Total Sense," *Jalopnik*, July 19, 2014, foxtrotalpha.jalopnik.com.

craft, of which 48 are fully operational combat planes, plus 10 in long-term storage that can be recalled to duty as needed.

The Air Force should be tasked with completing an analysis of the alternatives to clarify the performance and costs of the different platform candidates and whether to build arsenal planes in lieu of the B-21.

### *Decommissioning the Minuteman III Force*

A last-gasp argument for retaining the vulnerable silo-based Minuteman III missiles is that they could absorb a large fraction of the Russian warhead inventory in wartime. Before he was appointed secretary of defense, Mattis testified before Congress that Russia might need to expend two, three, or four warheads to each Minuteman silo in order to be highly confident of destroying them.[147] Russia might have to allocate the bulk of its current strategic arsenal to take out all 450 silos and their associated underground launch control centers, effectively disarming itself in the process.

[147] Aaron Mehta, "Mattis Enthusiastic on ICBMs, Tepid on Nuclear Cruise Missile," *DefenseNews*, January 12, 2017, www.defensenews.com.

Proponents of this view contend that the Minuteman force essentially would act as a sponge to absorb most of Russia's strategic warheads. But this argument has not reckoned with the more judicious Russian targeting strategy of destroying the 45 vulnerable underground launch centers controlling the 400 missiles while seeking to disable the backup airborne launch centers and sever their UHF radio links to the silos.[148] If the Russian attack also allocated one warhead to each silo, many silos might survive, but the aboveground UHF antennas that link them to airborne launch centers would likely be disabled. The Russians may be smarter targeteers than the sponge theorists imagine.

[148] NPR, 31.

From the point of view of this analysis, the strongest selling point of the sponge view is that Minuteman missiles or their replacements, known as the Ground-Based Strategic Deterrent (GBSD), could be de-alerted if their only purpose was to encourage the enemy to waste firepower in attacking them. This would absolutely preclude a launch in response to a false warning while allowing the missile complex to soak up warheads if the warning indications prove valid.

Not surprisingly, this de-alerting argument has not been widely embraced. De-alerting land-based missiles runs deeply against the grain of the strategic-planning culture in the United States. (Russian attitudes are no different in this regard; officers of Russia's Strategic Rocket Forces often remark that the "natural" state of a nuclear missile is to be always ready for immediate launch.)[149] If GBSD missiles are deployed despite this study's advice to cancel the program, strong pressure to keep them poised for immediate launch

[149] Russian Strategic Rocket Forces officers, personal communication with the author.

will doubtless persist. The launch crews in the underground command centers certainly cannot be expected to embrace retaining a de-alerted missile force to soak up hundreds of Russian warheads as their raison d'être. It would undermine their esprit de corps.

The sponge argument also misses the key point that a vast warhead drawdown can be accomplished peacefully through arms control negotiations. It makes no sense to rationalize massive numbers of groundbursts on U.S. territory that spread lethal radioactive fallout across much of the country if the alternative is to cancel out each side's warheads in an arms control deal. Even the unilateral elimination of the Minuteman/GBSD force could produce this effect. As a matter of targeting logic, the Russian targeting rationale for deploying more than 1,000 silo-busting warheads would evaporate. Scrapping 495 U.S. hard targets (450 silos plus 45 launch centers) would pull the rug out from under Russian targeteers' main justification for deploying new land-based rockets, including the new Sarmat silo-based heavy rocket to be deployed with a suite of 10 to 15 maneuverable, "boost-glide" reentry vehicles in its nose cone. If the U.S. targets of this destabilizing first-strike missile and other Russian rockets armed with multiple warheads disappeared, Russia would have excess weapons and good reason to curb its heavy-missile production and deployment.

This curtailment would in turn shorten the U.S. list of Russian targets assigned to Minuteman/GBSD missiles. A positive feedback loop could take hold. Crises would become more stable if the opposing "use or lose" forces shrank on both sides.

Ideally, this shrinkage would be accomplished through verifiable arms control agreements. A mutual drawdown of silo-based strategic missiles with a view to eliminating them entirely should be an item on the agenda of any future strategic talks with Russia.

An alternative way to deploy land-based missiles is to put them on mobile launchers, just as Russia and China deploy mobile rockets today. This option would reduce their vulnerability but also incur serious liabilities. Providing security would be more complicated, and the deployment costs would greatly exceed the current GBSD architecture built around existing silo infrastructure. Mobile missiles preparing to roam beyond their garrisons into the countryside in a crisis, and occasionally venturing out of their garrisons on training exercises, would also doubtless generate considerable opposition at the local, state, and national level. The deck appears stacked heavily against a mobile-missile scheme. The next generation of land-based missiles, if deployed at all, will very likely remain silo-based and acutely vulnerable.

The liabilities of Minuteman III and GBSD based in silos exceed

any putative benefits, including serving as warhead sponges. This study recommends de-alerting and phasing out all 400 Minuteman III missiles over the next decade and immediately terminating the GBSD program.

### *Future Nonstrategic Nuclear Forces*

The B61 gravity bombs carried by dual-capable F-15/F-16 fighters and deployed by the United States and NATO should be relocated from storage bunkers at combat bases in Europe to a national storage site in the United States. The new replacement F-35 aircraft need not be certified to carry nuclear weapons. The nuclear missions of all these DCA along with their B61 arms can be transferred to B-52H, B-2A, and future B-21 heavy strategic bombers. Their low-yield armaments include an inventory of 500 B61 gravity bombs and at least 500 ALCMs.

The contention that additional low-yield weapons—such as a fission-primary-only warhead on a D5 submarine missile carried by Ohio- and Columbia-class boats, or a new SLCM armed with a low-yield warhead—are needed to bolster the U.S. ability to deter the use of low-yield nuclear weapons by Russia or other potential adversaries does not rest on a body of evidence. The argument heavily discounts without good reason the deterrent effect of a U.S. nuclear arsenal that already possesses yield flexibility, and the deterrent effect of powerful U.S. conventional forces.

The contention that new low-yield weapons are needed to deter and respond to non-nuclear strategic attacks such as strikes against critical civilian infrastructure similarly discounts the yield flexibility of existing U.S. weapons. But more importantly, it discounts the high risk of escalation that the first use of any U.S. nuclear weapons, however limited in yield, would run. The crippling of civilian infrastructure networks does not rise to the level of an existential threat warranting the first use of U.S. nuclear weapons. First use is what in fact poses a threat to the survival of the United States or its allies because it could easily lead to a large-scale nuclear exchange. The logical answer to the threat to civilian networks is not to brandish a nuclear threat but to reduce the vulnerability of the infrastructure to cyberattack and prepare to respond with appropriate conventional and cyber strikes.

Advocates of new tactical nuclear weapons have short memories. During the Cold War, the United States designed scores of low-yield weapon types and deployed them by the thousands around the globe. They all proved to have little if any military utility, and they ran unacceptable risks of accidental or unauthorized use, uncontrol-

lable escalation if used, and theft or capture. All were withdrawn or retired except for the DCA-delivered gravity bombs still deployed on NATO territory, which were retained at the request of certain NATO allies after the end of the Cold War. They provide a political symbol of NATO solidarity but little else. The proponents of low-yield nuclear weapons could learn from this Cold War history.

## *B. Nuclear-Weapon Personnel*

The personnel responsible for ensuring the safety, security, reliability, and effectiveness of nuclear weapons must be held to the highest standards of performance and reliability. In response to a pattern of lapses in training and discipline and the declining morale stemming from past neglect by higher authorities of poor working conditions,[150] micromanagement, and other failures of command, the senior leadership of the Defense Department and Air Force have instituted changes to improve working conditions and performance across the board.[151] Progress toward these ends remains uncertain, but a concerted effort must be sustained. If personnel are not well supported, command and control could fail with potentially catastrophic consequences.

[150] Robert Burns, the senior national security correspondent for the Associated Press, has almost singlehandedly chronicled the travails and scandals among Air Force nuclear personnel. See his many articles at www.airforcetimes.com. The situation inside the nuclear Navy has not been reported and remains unclear.

[151] Valerie Insinna, "Morale Improving, But Sustainment Problems Still Dog Air Force's Nuclear Enterprise," *DefenseNews,* December 14, 2016, www.defensenews.com.

### *Modernization Plan Summary*

This review recommends a number of significant changes to the currently planned U.S. nuclear force posture.

1. The highest priority is to modernize nuclear C3 and early-warning networks. Ensuring the high performance and survivability of these networks takes precedence over modernizing nuclear delivery vehicles, warheads, and bombs. Failure to strengthen these networks would weaken presidential control over U.S. nuclear forces and perpetuate an unacceptably high risk of presidential miscalculation and launch on false warning.

2. The strategic triad should be restructured into a monad consisting of a new Columbia-class submarine fleet with nuclear-capable bombers having a backup role.

3. The intelligence and defense agencies should perform an in-depth assessment to determine whether any foreseeable technical deficiencies or emerging vulnerabilities could severely disrupt the long-term viability of the new SSBN fleet.

4. In order to hedge against this future risk, this study provisionally recommends planning for a reserve hedge force composed of

heavy strategic bombers and various conventional forces, particularly cruise missiles. The specific composition of this hedge force is B-21 stealthy strategic bombers capable of carrying B61 gravity bombs, conventional cruise missiles, and, optionally, nuclear-tipped LRSO cruise missiles; B-52H bombers equipped to launch existing nuclear ALCMs and, optionally, the new LRSO; B-2A penetrating bombers armed with B61 gravity bombs until these planes are decommissioned in the 2030s; and other conventional forces, particularly conventional Tomahawk IV cruise missiles deployed at sea on board attack submarines, specially configured Trident boats, and Aegis destroyers, to aid in the suppression of air defenses and decrease the risk to penetrating bombers.

5. The GBSD, the new land-based missile slated to replace the existing Minuteman III missiles in the same vulnerable fixed underground silos, should be canceled. The current Minuteman III force should be de-alerted in stages and eliminated within 10 years as the Minuteman II force was after the end of the Cold War.

6. STRATCOM should deploy capabilities to deliver nuclear weapons against a total of 445 aimpoints whose targets constitute key elements of state control and power in three countries—Russia, China, and North Korea. The capability to cover this target set meets requirements under a deterrence-only strategy. STRATCOM should dedicate conventional and cyber weapons to cover about 30 percent of the targets and offer credible and de-escalatory options to the president during conflict.

7. Whether the United States transitions to a strategy of deterrence-only as this report recommends, or retains its current strategy of deterrence-plus-warfighting, the necessary U.S. force structure and warhead/bomb inventory could be substantially smaller and less expensive than currently planned. For a deterrence-only strategy, the requirements can be fully met with only five Columbia-class SSBNs—three at sea at any given time, each uploaded with eight warheads on each of the 16 missiles on board for a total of 384 deliverable warheads supplemented with dedicated conventional and cyber weapons to increase the coverage to a total of 445 aimpoints in the three countries. For the reserve hedge force, a mixed fleet of only 40 heavy bombers would provide an adequate hedge. The essential requirements of the deterrence-plus-warfighting strategy can be fully met with a fleet of seven Columbia-class SSBNs (compared to 12 in the official modernization plan). Five boats at sea capable of delivering 640 warheads supplemented with dedicated non-nuclear forces could destroy the targets in close proximity to

the 905 aimpoints designated under this strategy. For the reserve hedge force, a mixed fleet of only 70 total heavy bombers (B-52H, B-2A, and new B-21) capable of delivering 900 nuclear weapons would provide full target coverage in an emergency when submarine operations must be curtailed. In short, the United States needs a fleet of only five to seven submarines and a reserve force of 40–70 strategic bombers to meet deterrence requirements under deterrence-only and deterrence-plus-warfighting strategies. If planners ignore the potential contribution of conventional forces to the mission the SSBN fleet size would grow to six to 10 boats under these respective strategies.

8. The elimination of Minuteman III missiles and the sharp reduction in the size of the nuclear stockpile would allow substantial downsizing of future requirements for warhead design and refurbishment. This retrenchment would also add significantly to the inventory of reserve fissile materials and further push back the need for additional manufacturing capabilities for plutonium-pit production and enriched-uranium production for naval propulsion and tritium-production reactors.

9. The B61 gravity bombs in storage at combat bases hosting F-15 and F-16 DCA aircraft would be relocated from Europe to the United States. The new replacement F-35 aircraft would not be nuclear-capable, and the mission responsibilities, along with the B61 armaments, would be transferred to U.S. heavy strategic bombers.

# *IX.*
# *Nuclear-Weapon Infrastructure: The "Complex"*

Under this review's modernization plan, the number of different types of nuclear weapons in the active U.S. inventory would decrease from seven types today to four—W76 and W88 warheads on D-5 missiles carried by Ohio/Columbia-class SSBNs, B61-12 gravity bombs for B-2A and B-21A bombers, and W80 warheads on ALCMs carried by B-52H bombers. W80 warheads could also be carried by LRSO cruise missiles on B-21A bombers, but this option is expected to be shelved in favor of advanced conventional cruise missiles for the B-21A aircraft.

The life extension program (LEP) for the W76 is almost complete and the B61-12 LEP, along with W88 alterations, will be complete in about five years. The B61-12 deployment will allow the aging B83 high-yield bomb to be retired from its apparent missions of holding deep underground command posts at risk. The last LEP synchronizing the W80 life extension with its LRSO delivery vehicle will take more than a decade.

The plan developed in this review envisions a transition to a deterrence-only force structure, buttressed by the conventional and cyberwarfare capabilities made possible by the large investments made in recent years, entailing a steep decrease in the number of warheads and bombs. The U.S. stockpile would shrink to 640 submarine-delivered warheads with a possible hedge of 450 total bomber-delivered reserve warheads and bombs.[152] The latter could be moved to combat-alert status if warranted by a breakthrough in the anti-submarine-warfare capabilities of a potential adversary or by other dire circumstances causing the submarine fleet to suspend normal operations for a period of time.

The need for warhead refurbishment would greatly diminish under this plan. Most weapons in the current pipeline awaiting life extension would drop out of the active inventory. This curtailing of refurbishment would save many billions of dollars and substantially relieve the workload of the nuclear-weapons complex. The

[152] If the United States were to ignore its imposing conventional and cyberwar capabilities during wartime and rely only on its current nuclear deterrence-plus-warfighting forces, then the U.S. stockpile would consist of 896 warheads assigned to SSBNs with a possible hedge of 900 warheads held in reserve for the strategic-bomber force.

dismantling of the Minuteman III force and cancellation of the GBSD program would end work on the W78 replacement warhead and the interoperable warhead that was being designed for both Minuteman/GBSD and D-5 SSBN platforms.[153]

Fissile materials could be recovered from the newly decommissioned warheads that would be consigned to the dismantlement queue. Lithium supplies could be replenished along with highly enriched uranium (HEU) fuel used partly to fuel naval reactors and partly for downblending to low-enriched uranium needed for producing tritium.

The need to manufacture plutonium pits would also decline. Fewer weapons and types of weapons in the stockpile translate into reduced need for pit production capacity. This need was already relatively low since pits have an estimated minimum shelf life of 85 years and the oldest pit in the current stockpile is only 40 years old.[154]

In addition to surveillance and periodic destruction and examination of a warhead,the U.S. stockpile stewardship program closely monitors the reliability of nuclear warheads using computer simulations and can accurately project their longevity without underground testing. As a consequence, the likelihood that a problem with warhead reliability would suddenly appear is extremely low. Nevertheless, it cannot be ruled out that a particular class of warhead would exhibit aging problems that reduce confidence in its proper functioning.

Under this study's modernization plan and its proposal to transition to a deterrence-only strategy, there would be ample surplus capacity to absorb the loss of a warhead class without needing to increase the production of plutonium pits. The most difficult case would be the loss of the W76 warhead inventory due to pit problems. This would pose difficulties because the W88 inventory of 387 warheads would be 253 short of the 640 required under the strategy. This would require placing some strategic bombers on emergency alert to offset the shortfall.

The need would still exist to manufacture new pits to correct the defect and return the W76s to service, however. In this situation, there would be a need to ramp up pit production well beyond current capacity. At the present time, the only functioning facility for pit manufacturing for servicing the stockpile—the PF-4 building at Los Alamos National Laboratory (LANL) in New Mexico—has almost no capacity due to various safety concerns.[155] In the early 2000s, LANL demonstrated a limited capability to produce up to 11 pits per year.[156] A planned $30 billion investment in LANL is expected to increase the annual throughput to as many as 30 pits per year by 2026.[157] The U.S. Congress established a higher requirement; the Na-

[153] The interoperable warhead project would develop new nuclear warheads that could be affixed to multiple delivery vehicles. For example, the proposed IW-1 would replace the W78 warhead currently on ICBMs and the W88 warhead currently on SLBMs. The 2018 Nuclear Posture Review scrapped the project.

[154] NPR, 62. By comparison, Russian pits have a shelf life of 10–12 years which requires the constant remanufacturing of pits.

[155] Patrick Malone and R. Jeffrey Smith, "Safety lapses undermine nuclear warhead work at Los Alamos," *Washington Post,* June 18, 2017, www.washingtonpost.com.

[156] Jonathan E. Medalia, *U.S. Nuclear Weapon 'Pit' Production Options for Congress* (Washington, DC: Congressional Research Service, February 21, 2014), fas.org; and U.S. Department of Energy, National Nuclear Security Administration, *Final Report for the Plutonium Pit Production Analysis of Alternatives: Executive Summary* (Washington, DC, October 2017), 1, www.lasg.org.

[157] General Hyten considers this level to be essential. See SASC Hearing on U.S. STRATCOM, 44.

tional Nuclear Security Administration (NNSA)—a semiautonomous agency within the Energy Department—is required to be capable of producing as many as 80 pits per year by 2030.[158] Production at this rate would require a new facility to be built. Two sites currently under consideration for this purpose are LANL and the Savannah River Site in South Carolina.[159]

Under this analysis's proposal for transitioning to a deterrence-only strategy, a new facility would not be necessary. At a rate of 30 pits per year, it would take between several years and a decade to manufacture enough replacement pits in the event of a systemic W-76 (or W-88) warhead failure, but this rate can be increased significantly without building new facilities. Adding extra work shifts could raise capacity to 40 pits per year. With the addition of extra equipment, which would take five to six years to install, surge capacity could be increased to perhaps as many as 80 pits per year. Other stopgap methods, such as a combination of pit manufacturing and pit reuse, could push the throughput even higher, but there is only so much plutonium that can be present within a fixed amount of floor space without exceeding safety tolerances. This would mean at least several years of high-capacity work would be required to finish the job of restoring a 640-warhead submarine deployment under a strategy of deterrence-plus-warfighting.

In sum, the planned upgrade to the PF-4 building at LANL should be able to replace a sufficient number of pits at an acceptable rate. In combination with other emergency steps to ramp up throughput, this upgrade obviates the need to build a new multibillion-dollar facility in New Mexico or South Carolina. However, some small additional risk of reduced stockpile reliability must be acknowledged if one shrinks the number of different warhead types from seven to four, and the margin of comfort for replacing an entire category of weapons in the event of a systemic defect is not large. On balance, however, this study assesses these risks to be quite low, and acceptable.

Nevertheless, the pertinent entities—NNSA, the national laboratories, and STRATCOM—need to conduct a comprehensive survey to determine an optimal infrastructure for transitioning to 640 SSBN operational warheads backed by a hedge stockpile of 450 warheads for strategic bombers. The NNSA should be tasked with assessing the infrastructure "footprint" necessary to support this proposed new arsenal and to prioritize the facility repairs, refurbishments, and replacements this support will entail.

[158] Mark Oswald and Michael Coleman, "Feds split 'pit' work between LANL and S.C.," *Albuquerque Journal*, May 10, 2018, www.abqjournal.com.

[159] Ibid.

# X.
# *Countering Nuclear Terrorism*

The main objectives of U.S. nuclear strategy in countering nuclear terrorism are ensuring that U.S. nuclear weapons and weapon-grade fissile materials are secure from terrorist theft, capture, or other illicit acquisition; making sure that if weapons or materials do fall into terrorist hands, effective safeguards will prevent their detonation long enough for U.S. personnel to locate, regain custody of, and disable them; and eliminating any possibility that terrorists or other nonstate actors could hack into U.S. nuclear C3 systems and either disable or launch of U.S. nuclear weapons.

Under the deterrence-only strategy proposed by this study, a smaller SSBN-only force with a backup force of strategic bombers would reduce the total number of U.S. operational and reserve nuclear weapons by 75 percent. It would concentrate them at sea where they would be invulnerable to terrorist seizure and at a few storage bases on U.S. territory. U.S. tactical nuclear weapons would no longer be dispersed overseas where they pose security risks, and the extensive highway transportation of U.S. Minuteman ICBM warheads would end as this force is eliminated under the proposed plan. As a consequence of these changes, the terrorist threat to U.S. nuclear weapons would be substantially reduced.

The United States remains committed to assisting other nations in securing and repatriating weapon-grade plutonium and HEU in their civilian nuclear programs. U.S. cooperation with Russia, begun in the 1990s to secure Moscow's stockpile of materials and weapons, resulted in a drop in the number of smuggling cases.[160] Although Russia ended this cooperation during the Obama era, the United States remains open to resuming it, as well as to intelligence sharing that may have a nuclear-terrorism dimension. The U.S. program to buy HEU taken from Russian weapons after conversion by Russia to low-enriched uranium (LEU) has also ended, but its success provides a model for similar transactions in the future.

The thinking behind the nuclear security summits initiated by

[160] Matthew Bunn, William H. Tobey, Martin B. Malin, and Nickolas Roth, *Preventing Nuclear Terrorism: Continuous Improvement or Dangerous Decline?* (Cambridge, MA: Belfer Center for Science and International Affairs, Harvard University, March 2016), www.belfercenter.org.

President Obama to raise the priority of securing civilian fissile materials around the world has enduring merit. The United States should continue to lead this global effort and extend it to some military materials where practical and consistent with national security regulations. This effort should include conversion of naval propulsion reactors to burn LEU instead of HEU fuel.

Strengthening the security of nuclear weapons and weapon-grade materials during transportation as well as storage is a top priority to guard against terrorist capture or theft. But it has also become apparent that guarding against state or nonstate cyberattacks that could disrupt nuclear operations is a rising priority. The posture changes recommended by this report address this concern. The nuclear C3 and early-warning networks should receive better cyber protection, and the time required to launch Minuteman III missiles should be increased by taking them off alert. Minuteman missiles must not continue to be technically configured to fire instantly upon receiving a short stream of computer signals whose source may be unauthorized actors who have succeeded in hacking the network.

U.S. nuclear weapons have no role in directly countering nuclear terrorism. However, they have a role in deterring states from deliberately enabling terrorists to obtain or employ nuclear weapons against the United States or its allies. The 2018 U.S. Nuclear Posture Review asserts that any state that is complicit in such a nuclear terrorist attack will be considered a nuclear aggressor and will be held accountable for it by any means necessary.[161] This makes sense if the state sponsor can be positively identified and its intention is clear. For deterrence purposes, the United States should reserve the right to respond in kind against the sponsoring state. However, the United States possesses ample conventional tools for responding to state-sponsored nuclear (or biological) terrorism. A non-nuclear response may be the prudent choice in many circumstances.

[161] NPR, XVI.

# *XI.*
# *Nonproliferation and Strategic-Arms Control*

The United States and its allies have a compelling reason to seek a world without nuclear weapons. The threat of nuclear destruction by states or terrorists is an existential one.

The time horizon for physically eliminating all nuclear weapons and weapon-grade materials is undoubtedly long. The time frame will be measured not in years but in decades.

Negotiating an agreement among the nine nuclear-armed states to prohibit the possession and use of nuclear weapons and begin the process of physical elimination through phased, proportional, and verified reductions could take considerably less time. Progress toward such denuclearization will take persistent effort from the United States to improve relations with Russia and China and advance nuclear arms control on the basis of equal security for all. The interlocutors will also have to find a new approach to arms control that encompasses the myriad non-nuclear as well as nuclear factors that shape the security perceptions and nuclear dependency of the nuclear-armed states. This presents a complicated set of issues that will require patient dialogue and flexibility to find common ground.

The key action items on the disarmament agenda are the following:

- Countering nuclear proliferation and saving the NPT and the moratorium on nuclear testing;

- Saving the Intermediate-Range Nuclear Forces (INF) Treaty and rejuvenating U.S.-Russian strategic-arms control;

- Initiating multilateral strategic-arms control; and

- Negotiating a treaty or agreements banning the first use of nuclear weapons.

## *A. Nonproliferation and the NPT*

The spread of nuclear weapons is the surest detour from the path to disarmament and the surest guarantee that they will be eventually be used. Since 1998, three states—India, Pakistan, and North Korea—joined the nuclear club by testing nuclear weapons and beginning their assembly while several others—Iraq, Syria, and Iran—sought without success to acquire them.[162] Farther back in time, a host of nations—Sweden, Switzerland, South Korea, Taiwan, Brazil, and Argentina among them—had fledgling programs that they eventually abandoned, sometimes under pressure from the United States.

The potential for further proliferation is quite large. Today 50 states have civilian nuclear-power programs at various stages of research, development, and operation. Civilian reactors can be readily diverted to military applications by extracting plutonium from their spent fuel. Japan's separation and stockpiling of plutonium have produced enough material to build thousands of nuclear weapons and have given Japan the status of a de facto nuclear-armed state in the eyes of some potential adversaries, such as China. Iran has a latent nuclear-weapon capability—the ability to enrich uranium to weapon-grade levels if it chooses to do so. Under the Joint Comprehensive Plan of Action, Iran is under strict constraints, some of which are set to expire in the next decade. In the wake of the recent U.S. withdrawal from the deal, the warning time for an Iranian breakout could be shortened but Iran has indicated its intention to remain a non-nuclear-weapon state under its NPT obligations.

India, Pakistan, and Israel did not sign the NPT and remain outside its purview. North Korea signed but later announced its withdrawal. Nevertheless, the treaty provides a firewall against further proliferation. The NPT remains the cornerstone of the nuclear nonproliferation regime. The United States also regards credible U.S. extended deterrence as essential insofar as it encourages more than 30 U.S. allies and partners to refrain from acquiring their own independent nuclear-weapon capabilities.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) banning all nuclear-weapon testing is also a pillar of nonproliferation. The United States has signed the CTBT, firmly supports the current testing moratorium, and should ratify the treaty now that the major concerns have been laid to rest.[163] CTBT verification has become efficacious under the auspices of the Comprehensive Nuclear-Test-Ban Treaty Organization and national technical intelligence capabilities. Clandestine explosive testing with any significant yield would run a high risk of detection. The sophisticated computer simulations of nuclear explosions run under the U.S. stockpile stewardship program

[162] India conducted its first nuclear test in 1974, calling it a "peaceful nuclear explosion." Its first nuclear weapons tests came in 1998.

[163] The U.S. Congress passed a nine-month nuclear testing moratorium bill in 1992, setting an end date of September 30, 1996, for U.S. testing. In 1993, President Bill Clinton announced he would extend the moratorium. In 1996, he signed the CTBT, which the Senate has yet to approve for ratification.

verify weapon reliability without underground testing.

North Korea poses challenges that could gravely weaken the treaty. The recent U.S.-North Korean summit in Singapore secured commitments to denuclearize the Korean peninsula and raised expectations that the diplomatic breakthrough would produce concrete steps toward this end. No one knows for sure, but it would not be unrealistic to expect North Korea to reverse course and resume its nuclear and missile programs or at least to balk at relinquishing its arsenal of 20 to 60 nuclear weapons. This outcome would harm the NPT's standing as an effective tool in blocking proliferation, not only in this particular case but more broadly if the North's program spurred U.S. allies in the neighborhood to revisit the question of whether an indigenous nuclear capability would serve their security interests. A North Korean reversal could be even more catalytic if the U.S. commitment to extend deterrence to its allies, who have perceived some wavering by President Trump, is called into question. The eroding credibility of this commitment could accelerate the spread of the bomb throughout the Far East.

The United States faces two other major NPT challenges. The first concerns technical verification. The U.S. track record in detecting clandestine nuclear facilities has been good in the past. From 1945 until today, no nation (including the United States) has been able to secretly produce enough plutonium or HEU for a single nuclear weapon without having its program first be detected by foreign intelligence agencies. Indeed, the Soviets infiltrated spies into the supersecret effort to build the first atomic bomb and built their first weapon on a significant amount of technical knowledge acquired clandestinely from scientists working at Los Alamos. For its part, the United States has sometimes been surprised by the timing of some nuclear tests by other countries, but in every case, it had solid evidence of the existence of a program to produce weapon-grade fissile material years before a significant quantity of this material was produced or a nuclear test was conducted.[164]

The early years of this history of detecting secret bomb programs were successful despite the absence of satellite surveillance, on-site arms inspections, open skies, and inspection agencies such as the International Atomic Energy Agency. They simply did not exist. Monitoring has been enhanced manyfold since those days.

Nevertheless, clandestine programs have become harder to detect. Of particular concern is that HEU can now be produced in very small facilities with available commercial centrifuge technology or by other readily available isotope separation technologies. This presents a nightmare scenario for intelligence agencies and has major implications for countering nuclear terrorism as well as proliferation.

[164] Steve Fetter, personal communications to the author, June 27, 2009.

Verifying the dismantling of individual weapons from existing stockpiles as part of future arms control and disarmament efforts is also a daunting technical hurdle.[165] This has never been attempted in real-world situations, and monitoring tools are not yet good enough to achieve verification confidence without disclosing classified details of a weapon's design. Scientific advances are fortunately making it possible to envision setting up an international declaration and monitoring arrangement over the next decade that provides an initial basis for accounting accurately for global stockpiles of nuclear weapons and materials.

[165] For details on verification, see Steve Fetter and Ivan Oelrich, "A Comprehensive Verification System," in *Elements of a Nuclear Disarmament Treaty,* eds. Barry Blechman and Alex Bollfrass (Washington, DC: The Stimson Center, 2010); Corey Hinderstein, ed., *Cultivating Confidence: Verification, Monitoring, and Enforcement for a World Free of Nuclear Weapons* (Washington, DC: Nuclear Threat Initiative, 2014).

Another major challenge is getting the five NPT-recognized nuclear-weapon states to comply with the treaty's disarmament provisions. It is doubtful whether their past steps deserve a passing grade. "Passing" means abiding by their Article VI obligation to pursue nuclear disarmament in good faith and living up to other obligations assumed during NPT review conferences, which are held every five years. These include taking concrete steps to reduce the role and salience of nuclear weapons—for example, by reducing their operational readiness. In most cases, the five states have not followed through on their commitments.

The clearest sign of their resistance to disarmament is the ambitious modernization programs that currently are underway in Russia and China and soon will be in the United States. To the 160 non-nuclear-weapon states who have faithfully observed their obligations under the NPT and who have not turned to U.S. extended deterrence for their security, these efforts that envision continuing to prepare attack plans enabled by thousands of alert nuclear weapons operating for at least another half century appear to betray the letter and spirit of Article VI.

The United States would meet its current NPT obligations by implementing the recommendations of this study, including the arms control proposals laid out below.

## *B. Nuclear Arms Control*

The treaties and agreements regulating the nuclear forces and ballistic-missile defenses of the United States and the Soviet Union/Russia have served to reduce uncertainty, build confidence, foster cooperation, and enhance mutual security for more than 50 years. The risks of nuclear conflict between them decreased, and the arsenals of the two nuclear behemoths shrank from a combined total stockpile of 70,000 weapons down to today's 15,000. Their elaborate provisions for verification and on-site inspections helped forge a predictable and stable strategic relationship. They also helped avoid and resolve

disputes.

But the most important of these agreements have been abandoned, subverted, or jeopardized. The United States unilaterally withdrew from the ABM Treaty, which Russia viewed as a cornerstone of strategic stability.[166] The INF Treaty is heading toward dissolution, due to mutual accusations of cheating. New START, the third and last pillar, which regulates long-range strategic forces, will expire in three years and no follow-on negotiations are visible on the horizon to fill the impending vacuum. Nuclear-arms agreements appear to be headed to the footnotes of history.

[166] "Joint Statement by the Presidents of the United States of America and the Russian Federation on Principles of Strategic Stability," (Moscow, June 4, 2000), www.nci.org.

To reverse this erosion of U.S.-Russian nuclear-arms cooperation, the first order of business is to resolve the issue of compliance with the INF Treaty. According to General John E. Hyten, head of STRATCOM, Russia is increasing its production and deployment of SSC-8, the missile suspected of violating the INF Treaty.[167] This portends a new arms race in the class of short- and intermediate-range weapons capable of flying 500–5,500 kilometers. The U.S. Congress has already reacted by funding the development of a U.S. cruise missile similar to the SSC-8. Failure to resolve allegations of cheating will also dash hopes of implementing any new bilateral strategic-arms agreements that advance disarmament in any class of nuclear weapons. The Senate will almost certainly spurn any future arms agreements with Russia until and unless the INF question is put to rest.

[167] SASC Hearing on U.S. STRATCOM, 22.

## *C. Rejuvenating U.S.-Russian Strategic-Arms Negotiations*

Progress on bilateral strategic-arms control also depends on constructive talks with Russia in framing the scope of future negotiations. To succeed, the scope needs to be enlarged to include new types of weapons, both nuclear and conventional, that are not covered by existing treaties. Strategic nuclear forces are no longer the only coin of the realm of strategic equilibrium. Weapons systems that fall outside the traditional domain of strategic assessment and arms control increasingly affect, and may greatly disrupt, stability.

The basket of weapons that may thus wind up on the bargaining table will likely include any weapons that have strategic implications. The leading candidates besides strategic nuclear forces from a Russian standpoint are U.S. ballistic-missile defenses, precision-guided munitions, and cruise missiles. From a U.S. standpoint, they are Russia's tactical nuclear weapons, anti-satellite weapons, nuclear-armed cruise missiles, and perhaps undersea long-range nuclear-capable drones. Other candidates of equal concern to both sides may include cyberweapons and certain novel weapons such as hypersonic glide vehicles, a maneuverable vehicle launched by an ICBM and capable

of delivering conventional or nuclear warheads.

Negotiations over such a variety of weapons and asymmetries in numbers deployed by the two sides may be difficult, but it is hard to imagine an alternative approach. Here are some examples of key asymmetries that affect the balance of strategic power and that would need to be taken into account:

- Russia deploys warplanes and missiles along with their munitions (800 tactical nuclear bombs and warheads) at a dozen combat bases in European Russia and keeps about 1,000 additional tactical weapons in central storage, compared to 180 U.S. tactical weapons at five bases in European NATO countries and another 350 in storage on U.S. soil.[168] The numerical balance is clearly lopsided and concerning to NATO if French and British nuclear weapons are not counted.

- In the arena of space, the United States depends far more on satellites than does Russia, and Moscow's anti-satellite capability therefore is far more significant.[169]

- The U.S. alliance network leads in many other comparisons, the most significant of which from a Russian standpoint is the vast conventional superiority of U.S./NATO forces over Russian forces.

- There is also a large disparity in the resources at the disposal of Russia in comparison with the United States and its NATO allies. The United States alone spends 10 times more than Russia on defense (perhaps seven times more after adjusting for purchase power parity), and the annual combined GDP of NATO countries is roughly 35 times Russia's.[170]

In Russia's view, nuclear weapons are essential equalizers to the West's superiority in conventional forces and economic strength. They have come to represent the cornerstone of Russian security. Proposals for negotiating their deep reduction, let alone eventual elimination, will meet implacable resistance unless concessions that mitigate Russia's conventional inferiority enter into the bargain. It all makes for a complex set of trade-offs. On the other hand, expanding the playing field may increase the degrees of freedom in negotiations. It may create more room for maneuver by allowing each party to mix or match its force structure in different quantities while lowering the number of nuclear weapons. From the perspective of this study, the negotiators should seek an agreement that mixes the apples and oranges while capping the nuclear arsenals at a minimal level—say, 650 total nuclear warheads dedicated to a deterrence-only strategy.

[168] Global Zero Commission on Nuclear Risk Reduction, *De-alerting*, 40.

[169] Shaan Shaikh, "Russia Tests Nudol Anti-Satellite System," CSIS Missile Defense Project, April 2, 2018, missilethreat.csis.org.

[170] SIPRI military expenditure in local currency; SIPRI military expenditure in constant U.S. dollars.

*U.S. Missile Defenses*

One of the biggest sticking points for Russia has been U.S. missile defenses. Russia's reluctance to restart bilateral strategic-arms negotiations stems in part from its concern that the United States is seeking the capability to nullify its strategic nuclear-missile force through a combination of U.S. swords and shields.[171] This envisions a worst-case scenario in which U.S. strategic forces (nuclear and conventional) destroy their Russian counterparts and U.S. missile defenses then mop up the handful of surviving Russian missiles launched in retaliation. From a U.S. perspective, this defies reality, given the ease with which inexpensive Russian countermeasures could overwhelm expensive U.S. defenses. In a worst-case surprise U.S. attack today, well over 100 Russian warheads would survive the strike, and the current U.S. GBI missile defense system could plausibly intercept and destroy no more than 10 to 25 of them.[172] The surviving missiles could reduce the 100 largest U.S. cities to radioactive ruin.[173] This represents a powerful retaliatory threat that unquestionably would deter any rational U.S. leader from launching a first strike. (It is worth pointing out that the U.S. deterrence-only strategy analyzed earlier would entail a threat of comparable scale in directing U.S. strategic-submarine forces against 136 Russian urban-industrial aimpoints.)

But Russia fears that U.S. missile defenses may dramatically improve, perhaps by evolving into increasingly potent variants (including space-based strike systems) that are harder for Russia to offset with inexpensive countermeasures. This worry grows out of a generalized apprehension of U.S. technological prowess and from the opacity and unpredictability surrounding the U.S. program. Some of Russia's concern is arguably disingenuous. By portraying the United States as bent on negating Russia's strategic deterrent, the accusations and fearmongering yield political benefits for nationalistic politicians and business for the Russian defense industrial sector.

On the other hand, the U.S. missile defense systems clearly have missions partially aimed at Russia. The GBI system would be activated to attempt to intercept handfuls of Russian (or Chinese) long-range missiles fired as part of a limited strike against the United States, which could be an accidental or unauthorized strike or a greatly weakened retaliatory strike following a crippling U.S. first strike. The regional U.S. missile defenses in Europe and Asia also have missions to intercept and destroy sub-intercontinental-range ballistic missiles such as the Russian SS-21 and SS-26. In short, Russia is clearly in the sights of the U.S. programs.

Russia has asked for a formal guarantee that U.S. missile defenses

[171] The literature on this issue is voluminous. An excellent recent article is George Lewis and Frank von Hippel, "Limitations on Ballistic Missile Defense: Past and Possibly Future" *Bulletin of the Atomic Scientists* (Vol 74: 4, June 28, 2018), thebulletin.org.

[172] Steven Pifer, "The Limits of U.S. Missile Defense," Brookings Institution, March 30, 2015, www.brookings.edu.

[173] Jennifer Knox and Jessica Sleight, *Estimated U.S. Fatalities from a Russian Nuclear Retaliation* (Washington, DC: Global Zero, January 23, 2017), www.globalzero.org.

will not target and undermine Russia's strategic-deterrent forces.[174] The U.S. demurral to this request constitutes a major obstacle to resuming bilateral strategic nuclear arms control. Breaking the impasse will require a creative new approach to arms control and redoubled effort on both sides to build confidence and cooperation.

[174] Steven Pifer, "NATO-Russia Missile Defense: Compromise is Possible," Brookings Institution, December 28, 2012, www.brookings.edu.

### *U.S. Actions for Discussion in Strategic-Stability Talks*

The United States should adopt the following guidelines to assure Russia that its strategic-deterrent capabilities will not be put in jeopardy:

First, the United States should reiterate its intent not to nullify the Russian strategic deterrent or to introduce new threats that would destabilize the military relationship between the two countries. This commitment would be incorporated explicitly into U.S. declaratory doctrine and stated in declaratory terms in a NATO-Russia Council memorandum of understanding.

Second, the United States would implement measures to reduce the number of launch-ready strategic-missile warheads below 270, the level at which the Russian military calculates that a decapitating first strike could be carried out. This study recommends that all U.S. forces be taken off launch-ready alert.

Third, the United States would establish 100-mile exclusion zones for U.S. missile defense deployments adjacent to Russian territory, except for U.S.-Russian joint missile defense programs that the two sides may agree to establish.[175] Such exclusion zones would reduce potential U.S. missile defense capabilities against Russian long-range missiles.

[175] Bilateral cooperation on joint missile defenses near the North Korean border involving boost-phase interceptors could offer a solution to the threat that North Korean ballistic missiles pose to Russia and the United States. Long-range missiles on great-circle arcs pass over eastern Russia en route to U.S. territory.

Fourth, U.S. missile defenses would not operate continuously unless a third-country threat actually materialized. They would be fully deployed and put on full combat alert only once Iranian or North Korean missile deployments posed an imminent threat. Russia would be briefed on such threats and notified well in advance of actions to put missile interceptors and their battle management radar and C3 systems on high alert.

Fifth and last, the United States would propose a formula for counting deployed missile defense interceptors, as well as deployed conventional or nuclear hypersonic glide vehicles, against any ceiling on nuclear warheads that may be negotiated in the future. (For example, the two sides might agree to count 500 deployed interceptors as 250 nuclear-arms units against the ceiling.)

This approach to missile defense is illustrative of the many other concerns that need to be creatively addressed in strategic-stability talks. If such a dialogue proves constructive in fostering mutual

understanding and agreement on the basic elements of stability in today's complex security environment, it could lay the groundwork for success in future strategic-arms negotiations.

### *Key U.S. Objectives for Bilateral Strategic-Arms Control*

The U.S. and Russian presidents could serve their respective countries' interests and the common good by extending New START for five years beyond its 2021 expiration date and beginning a new round of bilateral negotiations to further reduce the numbers of nuclear and certain non-nuclear strategic weapons systems. They should aim to convene and complete a productive round of strategic-stability talks that illuminates the path forward within one or two years and then begin follow-on negotiations no later than 2020.

The main U.S. goal of the negotiations should be to reach an agreement that supports a transition that initially reduces the number of U.S. and Russian nuclear warheads on each side to approximately 650 operationally deployed and no more than 450 in reserve. This goal aligns with the earlier analysis showing that a deterrence-only strategy could be supported by these numbers. For the United States, the submarine fleet would constitute the deployed force. The U.S. heavy-bomber force would constitute a potential reserve hedge force under a new treaty on the agreed condition that it remained off alert under normal circumstances, the exception being any emergency suspension of U.S. submarine operations. The parties would negotiate the terms of the prior notifications required if reserve weapons were to be shifted to combat-alert status during emergencies.

Another high priority in the negotiations would be to protect SSBNs from anti-submarine-warfare operations. Large swaths of the oceans could be designated as off-limits to opposing aircraft and submarines carrying out anti-submarine operations.

Numerical parity with Russia in nuclear weapons should not be a rigid guideline for U.S. decisions on the size and composition of its force or on its negotiating position in formal strategic nuclear-arms talks. The United States should seek comparable Russian reductions and other steps that preserve rough equality. Rough numerical equality works to reassure U.S. allies. However, the overarching aim should be to phase out the "use or lose" Minuteman III forces and move to a 650-warhead operational arsenal within the next decade, and soon thereafter to a 300-warhead force. The timing of the latter goal will depend upon progress made in negotiating ceilings and then reductions with nuclear-armed states besides Russia. This agenda for multilateral negotiations is discussed in greater detail in the "Multilateral Strategic-Arms Regulation" section below.

Other key priorities for U.S. negotiators include reaching an executive agreement to de-alert nuclear forces and eliminate the risk of launching missiles on the basis of faulty indications from early-warning networks. The two sides should agree to expunge the option of launch on warning/launch under attack from operations, exercises, and trainings under U.S. and Russian nuclear command systems. The United States and Russia should also revive plans to build and operate a joint data exchange center, or joint early-warning center, in order to further reduce the risk of false alarms and other misperceptions.

These goals transcend the current state of poor relations between the parties. While efforts to improve their relations may be a prerequisite to making significant headway on the arms control agenda described above, the history of arms control suggests that progress often occurs despite deep strains in their relations. Indeed, national security imperatives often drive the antagonists to seek compromises that advance mutual interests; such progress can be a catalyst for improving their relations. Dramatic progress can be made at the most dangerous moments.

## *D. MULTILATERAL STRATEGIC-ARMS REGULATION*

The goal of a world without nuclear arms will remain out of reach until strategic-arms regulation becomes comprehensive (covering all types of nuclear weapons, as well as non-nuclear strategic forces) and universal (involving all nations possessing strategic nuclear and non-nuclear capabilities). For nearly half a century, nuclear-arms negotiations have been exclusively between the United States and Russia, a two-sided affair that excluded China and all other nuclear-armed nations even though the greatest increase in the risks of nuclear-weapon proliferation, use of the weapons, and arms race instability came in areas outside the U.S.-Russian relationship, especially in South and Northeast and South Asia.

Strategic-arms dialogue and negotiations should therefore expand to include China, India, Pakistan, and others in a multilateral process to cap, freeze, and reduce the number of nuclear weapons they have; de-alert the weapons; cease production of plutonium and HEU for weapons; and otherwise constrain their nuclear-arms programs in conjunction with U.S.-Russian nuclear reductions and de-alerting.

After the United States and Russia agree to cut their arsenals down to approximately 650 total operational weapons, they can reasonably expect China and others to join a strategic dialogue. The U.S. and Russian presidents should invite the other nuclear-armed countries, including India, Israel, and Pakistan, to participate in a

nuclear-weapons summit to discuss multilateral force reductions and de-alerting. Since North Korea is already involved in separate denuclearization negotiations with the United States, it would not be expected to participate initially in this multilateral forum.

The U.S. and Russian presidents would have the opportunity to present a basic nuclear-arms reduction proposal in which they would pledge to cut their arsenals to 300 total deployed operational weapons—an 85 percent reduction from today's levels—on the condition that the other nuclear-armed states agree to cap their arsenals at 300 total nuclear weapons.

The proposed ceiling of 300 aligns well with other nations' existing and projected stockpiles. France possesses about 300 nuclear weapons. Others have significantly fewer weapons in their current stockpiles (see Figure 1 on Page 15), and 300 is the upper end of the projections for the stockpiles 10 years from now in Pakistan (currently at 140–150), India (currently at 130–140), Israel (currently at 80), and China (currently at 280).[176] All parties should feel comfortable endorsing this cap.

[176] Kristensen and Norris, "Worldwide deployments." The Chinese stockpile appears to be lower than this estimate. 200 weapons may be a more accurate estimate.

A nuclear-weapons summit hosted by the United States and Russia would also aim to clarify the positions of all the participating countries on what preconditions must be met in order to enter into multilateral negotiations and what a road map and timeline for phased, proportional, and verified reductions would look like from their individual standpoints.

The summit should also identify and seek agreement on multilateral confidence-building measures that could provide comprehensive advance notification of ballistic-missile launches. These notices would include launches of cruise missiles and short-range and medium-range ballistic missiles within range of other nations' territories. Expanded missile deployments and intensified testing programs by China and many other countries are increasing the frequency of ambiguous missile threats. These actions increase the risk of false alarms, misperception, and mistaken use of nuclear weapons. To mitigate that risk, the parties need to provide adequate advance notification of the time and other characteristics of upcoming tests.

## *E. A TREATY OR OTHER AGREEMENT PROHIBITING THE FIRST USE OF NUCLEAR WEAPONS*

A formal consensus among the nuclear-armed states to prohibit the first use of nuclear weapons would be a transformational breakthrough in several major respects. If seriously embraced and credibly implemented, such a ban would contribute to stabilizing crises, accelerating nuclear disarmament, countering proliferation, allaying

apprehension among some U.S. allies, and restoring U.S. leadership in nuclear-security affairs.

An NFU treaty or executive agreement would stabilize crises by narrowing the scope for miscalculating intentions. Allaying fear of an adversary's first strike would relieve the pressure to strike preemptively or launch an attack immediately upon the receipt of initial indications of an enemy strike in progress. It would tend to establish a degree of trust between adversaries that should work to foster restraint. These traits would tamp down a tendency to become ensnared in an escalatory cycle that leads to the outbreak of inadvertent nuclear conflict. An NFU accord also would reinforce the taboo against using nuclear weapons in conflict.

An NFU treaty or similar instrument could also accelerate nuclear disarmament by firmly establishing that the sole purpose of nuclear weapons is to deter their use by others, a principle that sets up the logic of "global zero." If all parties limit their weapons' role to deterring first use by threatening second use, then there is really no point in having them at all. If everyone sincerely vows never to use them first, and their operational postures align with a deterrence-only strategy, then logic suggests it is possible to give them up entirely if adequate monitoring arrangements can be instituted to guard against the possibility of a secret program or a breakout from the agreement.

An NFU commitment would counter proliferation by strengthening the NPT's agenda of reducing the role and salience of nuclear weapons in the security strategies of the nuclear-armed states. If non-NPT countries would join an NFU treaty, they too would become de facto supporters of this NPT agenda. A commitment to NFU would promote de-alerting and other steps that parties have advocated during past NPT review conferences and would militate against keeping large arsenals poised for rapid employment against opposing nuclear arsenals. It would encourage a transition away from deterrence-plus-warfighting toward a true second-strike strategy of deterrence-only, requiring lower numbers of weapons. In advancing such reductions, a commitment to NFU would advance the key NPT goal of nuclear disarmament and buttress the treaty's overall edifice.

A credible NFU agreement would also help allay apprehensions among a subset of U.S. allies and partners that worry to some degree about their protector, the United States, using nuclear weapons first, as well as their potential adversaries using them first. The countries in this group would welcome an NFU commitment that credibly takes this option off the table.

Finally, an NFU agreement would help restore U.S. leadership in nuclear-security affairs. Apart from its recent engagement with North Korea on denuclearization and prominent role in negotiating the Iran

deal, from which it recently backed out, the United States has not been actively leading in this arena for nearly a decade. Meanwhile, key prior agreements have stagnated, and the world has grown more anarchic and volatile. This regression could end up looking like the fraught, chaotic, and dangerous days before nuclear arms control took root in the late 1960s.

U.S. support for an NFU agreement would be welcomed by several nuclear-armed states who have advocated for it in the past. China and India strongly support NFU (with some qualifications). China proffered an NFU treaty at the United Nations in the early 1990s. The proposal was roundly rebuffed, but it led Russia and China to sign a bilateral agreement committing them not to use nuclear weapons first against each other. The United Kingdom's nuclear posture is clearly geared to second-strike responses; London therefore should be amenable to such a treaty. In short, a critical mass of countries appears to be favorably disposed to endorse some form of agreement on NFU. If a multilateral treaty proves elusive, then bilateral and multilateral agreements might be possible, laying the groundwork for such a treaty.

The implementation of a treaty or other agreement would have to go beyond rhetoric into the realm of operations and force structure in order to be credible. One variant of an NFU posture looks like China's. The key elements of such an arsenal are modest numbers of weapons, the vast bulk of which reside in storage bunkers; few weapons deployed in the field on delivery vehicles and kept at a relatively low level of combat readiness; a deterrence-only doctrine with highly centralized command systems and tightly controlled forces; and a strategy that eschews launch on warning and counterforce warfighting in planning, targeting, training, and exercises. China's commitment to NFU is quite evident. Its posture is worthy of emulation. The adoption of NFU by others should be made transparent by modifying their operational practices and communicating them through dialogue and data sharing with other nuclear-armed states. States that enter into an NFU agreement should also work to provide the means, including on-site inspections, for others to monitor certain training and exercises that demonstrate commitment to NFU.

## *F. A WORLD FREE OF NUCLEAR WEAPONS*

Every step taken toward a world without nuclear weapons is a step toward true security for the United States and its allies. The threat of nuclear war that hangs over the world is not endemic to contemporary geopolitics. It can be eliminated. It will require greater security cooperation among the nuclear-armed states and bringing them to

the negotiating table. They will need to negotiate a ban treaty with provisions for phased, proportional, and transparent reductions. The treaty must ensure that the elimination of all nuclear weapons and weapon-grade nuclear materials can be verified and enforced.[177]

The United States ought to acknowledge the grave humanitarian consequences of the use of nuclear weapons and the unacceptability of any such use—the driving motivation behind the 2017 Treaty on the Prohibition of Nuclear Weapons—and begin work on a practical and plausible road map for verified and irreversible elimination of all nuclear weapons. Other nuclear-armed states should be encouraged to prepare similar plans. These plans could provide a basis for talks among them and others on the many practical and technical challenges of actual disarmament and getting to global zero. Nuclear disarmament will undoubtedly require the active participation of the nuclear-armed states from the beginning of the process and a years-long negotiation of a historic treaty detailing a phased process of multilateral implementation over a long period of time, probably measured in decades.

The U.S. president should direct the National Security Council (NSC) to lead an interagency effort to devise an action plan outlining the myriad steps that need to be accomplished to achieve global zero within such a time frame. The NSC would coordinate the Defense, State, and Energy Departments as well as the intelligence community to devise a coherent plan. The underlying analysis should work back from a variety of possible target dates—say, 15 to 40 years into the future—to specify the implications for the nuclear force structure; C3 and early-warning networks and operational posture including security and safety measures; the nuclear-weapons complex, including the national laboratories and other infrastructure involved in maintaining stockpile reliability and in dismantling weapons; and arms control strategy, including a timeline for negotiating phased, verified reductions leading to the total elimination of nuclear weapons in all countries. This road map must have alternative pathways, "off ramps," hedge options, and other adaptive features that allow for flexibly rebooting the plan to adjust to unanticipated complications, setbacks, and opportunities.

In the view of this study, a credible conception of the path toward global zero would involve adopting a number of measures that bring the nuclear-armed states to a position close to the endgame. Setting the stage for phased, proportional, and verifiable reductions culminating in complete elimination would involve developing provisions besides deep reductions to 650 total deployed weapons. The most

[177] An indispensable introduction to the myriad political and technical challenges is George Perkovich and James M. Action, eds., *Abolishing Nuclear Weapons, Adelphi Paper 396* (London: International Institute of Strategic Studies, 2008). For an innovative technical approach, see Harold A. Feiveson, Alexander Glaser, Zia Main, and Frank N. von Hippel, *Unmaking the Bomb: A Fissile Material Approach to Nuclear Disarmament and Nonproliferation* (Cambridge, MA: The MIT Press, 2014).

important such provisions are the following:[178]

- Adopting a deterrence-only strategy and a 300-weapon ceiling on operational stockpiles;[179]
- Adopting an NFU policy that categorically prohibits any initial use or threat of use of a nuclear weapon for any purpose;
- De-alerting nuclear forces, which removes weapons from operational status to secure storage separated from delivery systems and placed under monitoring;
- Creating an international monitoring program that, when fully evolved, would provide the basis for accurate accounting and reliable security of all weapons and weapon-grade materials (plutonium and HEU) on a continuing basis; and
- Ending all testing of nuclear devices, all production of weapon-usable fissile materials, and all fabrication of new weapons out of preexisting fissile-material stocks.[180]

An additional provision may be necessary to ensure the sovereignty of states that face existential non-nuclear threats: prohibiting the unauthorized initial use of conventional weapons for any offensive mission.[181] Ensuring that offensive conventional warfare would never be undertaken without the full authorization of the U.N. Security Council can plausibly be considered necessary for enlisting comprehensive support for nuclear disarmament.

The willingness of the nuclear-armed states to undertake these steps can be taken as a fair test of their seriousness about reducing the danger of nuclear conflict and ultimately eliminating nuclear weapons. To date none of them passes this test with high marks, but the path outlined is in their interest and the rest of the world's as well. That it is overwhelmingly in the U.S. interest is clear. It is the commonsense solution for limiting and eventually eliminating the only means by which the United States can be suddenly and massively devastated within an hour of this moment.[182]

[178] Steinbruner, personal communications.

[179] Except for the United States and Russia, all nuclear-armed states are currently estimated to be at or below the suggested 300-weapon cap and are not expected to exceed this number over the next 10 years.

[180] Steinbruner, "Security Policy and the Question of Fundamental Change," and personal communications with the author.

[181] Ibid.

[182] Ibid.

# *XII.*
# *Conclusion*

The United States, Russia, and China remain committed to policies of mutual nuclear deterrence. Two of these rivals—the United States and Russia—maintain nuclear warfighting strategies that simultaneously rationalize oversized arsenals, stimulate arms competition during peacetime, and fan escalatory updrafts during crises.

A more constructive approach to preventing nuclear conflict is to reduce the role, salience, and numbers of nuclear weapons. For the United States in particular, vast opportunities exist for substituting other forms of power for these weapons. Today deterrence and stability flow less from threatening nuclear destruction than from having a broader mix of capabilities, including conventional precision-guided munitions, cyberdefenses and weapons, missile defenses, anti-satellite capabilities, big-data intelligence collection and fusion, nonmilitary power such as economic and financial sanctions, diplomatic clout, and robust alliances with strong allies. The United States has these capabilities in abundance. It could capitalize on them not only to minimize the role of its own nuclear weapons but also to advance the goal of nuclear threat reduction and disarmament.

To the latter end, the United States should play a leading role in persuading the nuclear-armed nations to reduce to or cap their arsenals at low numbers of nuclear weapons, take them off of high alert, renounce their first use, and seek comprehensive monitoring arrangements that will eventually provide the basis for accurate accounting and assured security of all weapons and weapon-grade materials.

As part of this restructuring of its nuclear posture, the United States should scrap its deterrence-plus-warfighting strategy and thereby eliminate its massive-attack plans enabled by hair-trigger forces inclined for preemption or launch on warning. By adopting a deterrence-only strategy consisting of a mix of nuclear and nonnuclear options, the risks of escalation and inadvertent nuclear war would be drastically reduced, and the United States would need

to build only five new ballistic-missile submarines, only three of which would need to be deployed at sea at all times to ensure an adequate response if deterrence should ever fail. The size of the U.S. operational nuclear stockpile would shrink from 2,000 to 650, a two-thirds reduction that could be instituted independent of Russian stockpile levels without any diminution of the deterrent effect. Under this shift, the United States can and should substitute conventional for nuclear forces and largely remove population centers from the crosshairs of U.S. nuclear weapons in responding, at least initially, to enemy nuclear aggression. A deterrence-only strategy is a de-escalatory approach to conflict in contrast to the escalatory and nuclear-dependent character of the current deterrence-plus-warfighting strategy.

All other U.S. nuclear forces, current and planned, would become superfluous and should be scrapped, with the probable exception of 40 heavy strategic bombers that could be assigned to a reserve hedge force if a portion of the submarine force became vulnerable or had to be grounded for technical reasons. This reserve force capable of delivering 450 nuclear weapons combined with 640 operational SSBN warheads would represent a total U.S. nuclear stockpile that is 75 percent lower than today's stockpile.

If the United States remains on its current unwise course committed to its legacy posture of a deterrence-plus-warfighting strategy, it still will not require the triad of forces that are currently deployed or the new triad of forces in the pipeline. This anachronistic strategy can be easily supported with only seven ballistic-missile submarines, five of which would be deployed at sea augmented by conventional forces dedicated to the strategic deterrent mission. If a nuclear hedge force is deemed necessary, 70 heavy strategic bombers capable of delivering 900 nuclear weapons could assume the mission of the submarine force if the latter became vulnerable or technically disabled.

In short, the current official U.S. nuclear modernization plan is excessive. The vulnerable land-based Minuteman missile force is unnecessary and should not be replaced, and almost all other nuclear-weapon programs can be safely dismantled or canceled without weakening deterrence and stability. Indeed, deterrence and stability would be much strengthened by shifting to a much more survivable SSBN force. After dismantling all these forces, the United States would still possess more weapons than necessary to deter Russia, China, and North Korea combined under all plausible conditions.

The fundamental challenge and priority for U.S. nuclear modernization is building a survivable, reconstitutable, and highly capable C3 and early-warning network. The United States has done far too little to minimize risks of mistaken launches, prevent escalation and

ensure that U.S. nuclear and conventional forces can be directed to coherent purposes under the stressful conditions of enemy nuclear attack. If C3 fails, nothing else matters.

Russia and the United States must re-build their security relationship on a firm foundation of cooperation. Russia possesses no less nuclear overkill and shares responsibility with the United States to move toward low numbers of nuclear weapons, take them progressively off of launch-ready alert, abjure their first use, and otherwise reduce, as much as possible, nuclear weapons as a source of fear, tension, and confrontation.

This path reducing the role and salience of nuclear weapons until they are eliminated is clearly lit. This study offers an alternative to the path outlined by the official 2018 Nuclear Posture Review. It is up to U.S. policy makers to judge which one offers the most promising escape from nuclear danger.

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