Proportionate Deterrence:

A Model Nuclear Posture Review

George Perkovich and Pranay Vaddi

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ABBREVIATIONS

ABM Treaty	Anti-Ballistic Missile Treaty
ALBM	air-launched ballistic missile
ALCM	air-launched cruise missile
A2/AD	antiaccess/area denial
BAAD	bomber assurance and deterrence
DCA	dual-capable aircraft
DIA	Defense Intelligence Agency (U.S.)
DPRK	Democratic People's Republic of Korea; North Korea
DUA	decide under attack
ETP	existential threat policy
GBSD	Ground-Based Strategic Deterrent
GMD	Ground-Based, Mid-Course Defense System
HGV	hypersonic glide vehicle
ICBM	intercontinental ballistic missile
INF Treaty	Intermediate-Range Nuclear Forces Treaty

ISR	intelligence, surveillance, and reconnaissance
JASSM-XR	Joint Air-to-Surface Standoff Missile–Extreme Range
kps	kilometers per second
kt	kiloton
LRSO	Long-Range Standoff weapon
LUA	launch under attack
LYD5	Low-Yield D5 Trident
MDR	Missile Defense Review (U.S.)
MIRV	multiple independent reentry vehicle
NATO	North Atlantic Treaty Organization
NC3	nuclear command, control, and communication
New START	New Strategic Arms Reduction Treaty
NFU	no first use
NORAD	North American Aerospace Defense Command
NPR	Nuclear Posture Review (U.S.)
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NSNW	nonstrategic nuclear weapons
PLA	People's Liberation Army (China)
SEAD	suppress enemy air defenses
SLBM	submarine-launched ballistic missile
SLCM	sea-launched cruise missile
SLCM-N	nuclear-armed sea-launched cruise missile
SM	Standard Missile
SSBN	ballistic missile submarine
THAAD	Terminal High Altitude Area Defense
UAV	unmanned aerial vehicle
UN	United Nations
USSTRATCOM	U.S. Strategic Command

SUMMARY

Ever since the election of Bill Clinton in 1992, every U.S. presidential administration has published a Nuclear Posture Review (NPR) that explains the rationales behind its nuclear strategy, doctrine, and requested forces. These reviews have helped inform U.S. government personnel, citizens, allies, and adversaries of the country's intentions and planned capabilities for conducting nuclear deterrence and, if necessary, war. The administration that takes office in January 2021 may or may not conduct a new NPR, but it will assess and update nuclear policies as part of its overall recalibration of national security strategy and policies.

Ever since the election of Bill Clinton in 1992, every U.S. presidential administration has published a Nuclear Posture Review (NPR) that explains the rationales behind its nuclear strategy, doctrine, and requested forces.

Nongovernmental analysts can contribute to sound policymaking by being less constrained than officials often are in exploring the difficulties of achieving nuclear deterrence with prudently tolerable risks. Accordingly, the review envisioned and summarized here explicitly elucidates the dilemmas, uncertainties, and tradeoffs that come with current and possible alternative nuclear policies and forces. In the body of this review, we analyze extant declaratory policy, unclassified employment policy, and plans for offensive and defensive force postures, and then propose changes to several of them. We also will emphasize the need for innovative approaches to arms control.

THE OBJECTIVES OF U.S. NUCLEAR POLICY (INTRODUCTION)

The best nuclear *doctrine* and *force* posture would be one that—

- is credible enough to deter adversaries and reassure allies and partners;
- is least likely to provoke escalation if deterrence fails but could survive adversary escalation if it occurred; and
- would not cause more destruction than necessary in the event of nuclear war, bearing in mind the law of armed conflict, and would engender deescalation.

That said, the best nuclear *policy* is one that encourages stable deterrence relationships among political adversaries, helps to preserve and strengthen international cooperation in preventing nuclear weapons proliferation and possible use, all while promoting the reduction of threats and arsenals. Recognizing that best outcomes are rarely achievable in the real world, this review highlights some of the challenges that must be overcome to bring U.S. nuclear policy closer to the ideal. In all of this, premium is placed on striving for proportionality between the threats that the United States and its allies face and the ends and means they pursue to deter or defeat them.

THE THREATS THAT U.S. NUCLEAR POLICY MUST ADDRESS (CHAPTER 1)

Nuclear weapons should be reserved for deterring threats of a scale and type that cannot be deterred or defeated by other means. Russia, China, and the Democratic People's Republic of Korea (DPRK; North Korea) are the only potential sources of such threats today.[1] These countries possess nuclear weapons and growing non-nuclear capabilities, including perhaps biological weapons in some cases, and have antagonistic relations with the United States and their U.S.-allied neighbors. The challenge is to dissuade Russian, Chinese, and North Korean leaders from believing that their nuclear and non-nuclear capabilities could enable them to successfully prosecute regional conflicts while deterring the United States from escalating as necessary to defend its allies.

Russia drives most U.S. nuclear requirements to the extent that its nuclear arsenal threatens the survivability of the U.S. nuclear deterrent and comprises the largest set of targets for U.S. forces. Russia seeks to weaken its adversaries through the lowest level of violence necessary and has developed a range of means to do so, including information warfare and cyber attacks, political subversion, and economic coercion. As chapter 2 describes, Russia also has deployed or is developing sophisticated conventional strike weapons and new nuclear systems for theater and intercontinental missions. Russia has not acquired these new capabilities in a vacuum,

but rather as part of an action-reaction dynamic with the United States and other NATO (North Atlantic Treaty Organization) states.

To deter or defeat Russian threats below the level of armed conflict, NATO and the United States must bolster their resilience, unify their polities, and enhance conventional military and other coercive capabilities. And, because Russia derives coercive value from nuclear weapons, U.S. and NATO policymakers must deploy nuclear capabilities and defenses sufficient to credibly counter and thereby deter potential Russian attempts to prevail in escalatory armed conflict. This can be done while making clear that mutual threat reduction would be more beneficial to all concerned.

To deter or defeat Russian threats below the level of armed conflict, NATO and the United States must bolster their resilience, unify their polities, and enhance conventional military and other coercive capabilities.

China also poses numerous and growing challenges to the United States and its allies and partners. Many of these challenges are economic and diplomatic, and therefore not central to nuclear deterrence. More pertinently, China continues to acquire a wide range of kinetic and nonkinetic capabilities to prevail in conflicts around its periphery while deterring the United States from escalating in defense of its allies and partners, particularly Japan and Taiwan. China also is increasing the sophistication, number, and survivability of its relatively small nuclear force, though compared with Russia (and the United States) it has not placed nuclear weapons in the forefront of its rhetoric, doctrine, and threat projection.

As with Russia, the priority of the United States and its allies and partners must be to strengthen their non-nuclear deterrence and defense capabilities in ways that do not exacerbate risks of inadvertent nuclear escalation with China, and to deploy nuclear weapons in ways that discourage destabilizing arms racing and potential escalation of war that neither side can plausibly win.

North Korea, too, poses conventional and nuclear threats to South Korea and by extension the United States. However, these threats do not require nuclear capabilities beyond those which the United States would deploy to deter or defeat escalatory conflicts with Russia or China, in part because efforts to acquire new capabilities to threaten the DPRK's mobile nuclear weapons likely would exacerbate instabilities in U.S.-China relations.

This review highlights that the central overall challenge for U.S. nuclear policy is how to deter or counter adversary escalation of regional conflict and avoid catastrophe for all. Escalation can occur through calculation and/or inadvertence, especially as new cyber and kinetic technologies become entangled with nuclear force operations. Beyond the prospect of tens or hundreds of millions of people dying in a nuclear war, some scenarios of nuclear war produce the real possibility of an extinction-class event caused by the climatic

and environmental harm of the atmospheric particulates produced by a nuclear exchange. Policymakers in all nuclear-armed countries have neglected this danger in recent decades even as recent modeling indicates it is irresponsible to ignore.

DECLARATORY POLICY (CHAPTER 2)

States generally put more stock in each other's capabilities and actions than their declared intentions. At the same time, a state's nuclear policies and forces require rationales to guide them. Declaratory policy articulates such rationales and intentions to one's population and defense establishment, and to allies and adversaries, reflecting when the government thinks it could be prudent and justifiable to use nuclear weapons. Even if decisionmaking on capabilities sometimes has a logic of its own, declaratory policy should guide the acquisition and posturing of forces, as well as efforts to reduce unnecessary or destabilizing capabilities.

There is no perfect or nonproblematic declaratory policy. It may be tempting to issue blustery or vague threats of nuclear war in hopes of deterring all forms of aggression. Yet, because deterrence could fail, it would be folly to make threats that would be self-defeating to carry out, just as it would be imprudent to promise not to use nuclear weapons when there might be no better alternative to doing so.

U.S. declaratory policy since 2010 posits that the United States "would only consider the employment of nuclear weapons in extreme circumstances to defend the vital interests of the United States, its allies and partners."[2] This formulation—by not defining extreme circumstances or vital interests—does not adequately convey the importance of proportionality. As the *Department of Defense Law of War Manual* declares, "the overall goal of the State in resorting to war should not be outweighed by the harm that the war is expected to produce."[3]

One policy alternative favored by many is no first use (NFU), in which the United States would pledge to never use nuclear weapons first in a conflict. However, some U.S. allies in Europe and in East Asia would perceive a declaration of NFU as a weakening of U.S. resolve to defend them. Meanwhile, Russia and China would not trust or rely on an NFU declaration if the United States did not remove or significantly reduce the nuclear and conventional forces and missile defenses that they perceive to be part of U.S. plans to preemptively strike their nuclear deterrents. Yet the political capital that a president would expend to instate NFU as a central policy in the face of the objections from domestic opponents and key allied governments could leave little left to overcome traditional resistance to altering the offensive and defensive force posture (as we recommend).

Another alternative is to declare that the "sole purpose" of U.S. nuclear forces is to deter or defeat adversaries' uses of nuclear weapons. This would be well advised if nuclear attack were the only adversarial threat that could not be defeated by non-nuclear means. However,

if Russia or China were defeating U.S. and allied non-nuclear forces and threatening to inflict massive harm on their populations, then it would be imprudent to rule out proportionate use of nuclear weapons. It would be especially imprudent to do so if the United States, NATO, and U.S. allies and partners in Asia were not significantly improving their conventional military capabilities, the resilience of their military forces and societies, and their overall cooperation and cohesion.

Thus, we recommend that the United States adopt an existential threat policy (ETP), declaring that it would "use nuclear weapons only when no viable alternative exists to stop an existential attack against the United States, its allies, or partners." No one knows whether and how the use of nuclear weapons against another nuclear-armed state would be kept limited and would not escalate. It would not make sense to use nuclear weapons unless the immediate threat was more dangerous than the likely consequences of nuclear war would be. The proportionality of an existential threat policy would uphold the United States' commitment to comport with the law of armed conflict and demonstrate a more realistic appreciation of the risks and consequences of escalatory nuclear war.

Ambiguity is unavoidable in any declaratory policy, including the current "extreme circumstances" formulation. This review goes further than official U.S. or other states' policy documents in discussing threats that could rightly justify nuclear use. We believe international debate over these issues is educational to all concerned and international pressure should be mobilized to push other governments, particularly Russia and China, to clarify whether and how national and international law will guide their conduct.

EMPLOYMENT GUIDANCE AND DAMAGE REDUCTION (CHAPTER 3)

Employment policy directs how U.S. nuclear forces should be used in the event that deterrence fails and an adversary undertakes military action—most obviously nuclear attack—that cannot be stopped by non-nuclear means.

The primary challenge in today's security environment is to disabuse Russian, Chinese, and North Korean leaders from thinking that they could severely threaten U.S. allies and partners and then deter or prevent the United States from deploying and using forces necessary to defeat them. In such contests, the United States needs to be able to deter or defeat adversary plans to use nuclear weapons in ways that would compel the United States to stop fighting and accept defeat.

One way to do this is to attack adversary nuclear forces before they can be used—preemptive damage limitation. During the early years of the Cold War, the United States and Russia could plausibly attempt to accomplish this only with nuclear weapons. Over time, both sides came to accept the reality of mutual assured destruction, though this realization did not

The potential global destructiveness of nuclear war can be reduced by mutually lowering the number and explosive yields of U.S. and Russian nuclear weapons, especially silo-based ones that are the most feasible targets for preemptive damage-limiting strikes.

cause them to stop preparing for counterforce strikes. Today, they also develop and deploy non-nuclear precision-strike weapons and perhaps cyber capabilities that could be employed for this purpose. Yet the quest for preemptive capabilities not only drives arms races and the procurement of excessive arsenals; it also increases pressures on adversaries to launch nuclear weapons preemptively or on warning of incoming attack. This increases the risks of mistaken or inadvertent nuclear use. In addition, large-scale nuclear counterforce attacks themselves could cause fires sufficient to produce the catastrophic worldwide climatic effects associated with nuclear winter, along with widespread radioactive fallout. Thus, the strategic imperative to prevent self-destructive escalation of war requires the pursuit of alternative force postures, policies, and plans.

The potential global destructiveness of nuclear war can be reduced by mutually lowering the number and explosive yields of U.S. and Russian nuclear weapons, especially silo-based ones that are the most feasible targets for preemptive damage-limiting strikes (as discussed in chapters 4 and 6). More immediately, the United States could abandon plans for preemptive strikes on Russian (and Chinese) nuclear forces, and instead focus U.S. nuclear attacks on targets necessary to deny Russia and China the prospect of winning a regional conflict or escaping unacceptable damage in a general nuclear war with the United States.

In all of this, the United States requires upgraded nuclear forces and command, control, and communication systems (NC3) that could survive adversary attacks and/or (partial) technical malfunction and still provide adequate confidence that presidential nuclear employment orders would be executed. The Defense Department has long prepared to give the president the option to launch within minutes the intercontinental ballistic missiles (ICBMs) that sit vulnerably in silos in the Midwest, so that a detected incoming attack would not destroy them. This practice is known as launch under attack (LUA). However, if the sensors and systems intended to detect a potential incoming attack on these land-based installations erred in their calculations, or inaccurately assessed the magnitude of the incoming attack, the United States would risk starting or escalating a nuclear war by mistake.

Several options exist for dealing with these challenges. The top priority, which must be pursued vigorously for many reasons, is to strengthen NC3 survivability. If U.S. leaders are confident in the survivability of submarine and air forces and command and control links to them, they could then exercise the option to more reliably assess a detected attack on vulnerable land-based forces before ordering U.S. counterattacks. This could mitigate risks of mistaken warning and assessments of incoming attacks.

To redress risks of launching vulnerable ICBMs on mistaken or false warning of a large, incoming attack, former vice chairman of the Joint Chiefs and NORAD commander James Winnefeld has suggested developing plans and capabilities to decide under attack (DUA). Under DUA, a president could transmit preplanned orders for U.S. strikes with a time delay on their execution.[4] This delay would allow an authorized U.S. strike to be canceled or adjusted, and also would enable surviving forces (likely bombers and ballistic missile submarines [SSBNs]) to be positioned to carry out orders at the appropriate time. Unlike the immediate response programmed into a LUA scenario, if the detected attack were proven to be false or mistakenly assessed, under DUA the president could cancel or adjust the preplanned orders. To be sure, under wartime conditions there is no guarantee that the president or a successor would survive and be successful in canceling or modifying a delayed launch order. However, if LUA were the order of the day, there would no possibility of doing so.

NUCLEAR FORCE POSTURE AND NUCLEAR COMMAND, CONTROL AND COMMUNICATIONS (CHAPTER 4)

U.S. and Russian nuclear forces remain much larger and more destructive than those of any other country. They are still excessively driven by Cold War notions of counterforce nuclear warfighting and arms racing, made more ominous now by the unraveling of arms control. The advent of precision-strike non-nuclear weapons further complicates deterrence and arms control diplomacy between these two countries and prospectively China. This review analyzes arguments for and against each of the main weapons systems in current and planned elements of the U.S. nuclear triad of air, sea, and land-deployed forces. This summary focuses on the four most controversial systems.

B-61 nuclear bomb. This nuclear bomb deployed in Europe is militarily unnecessary and will be even more superfluous if the Long-Range Standoff cruise missile is deployed, and/or the Low-Yield Trident D5 (LYD5) remains deployed. But until NATO requests this weapon's removal, the political and deterrence consequences of withdrawing it to the continental United States would be more costly than the disarmament gain, unless Russia reciprocated in some meaningful way.

Low-Yield W76 warhead for Trident D5 submarine-launched ballistic missiles (SLBM). The United States recently replaced twenty 90-kiloton (kt) W76-1 warheads with 5–7 kt variants, called W76-2.[5] (For comparative perspective, a 5–7 kt warhead is approximately ten times more powerful than various estimates of the yield of the chemical explosion that destroyed the port of Beirut in August 2020.[6]) The Defense Department switched warheads without adequate congressional briefing and debate that could answer the important questions explored on pages 58–62. Nevertheless, we do not recommend removing these warheads from service now if they would be replaced with their much higher-yield predecessors.

Nuclear weapons should have yields no larger than necessary to destroy legitimate targets—both for legal and strategic reasons and for the purposes of reducing potential climatic effects of nuclear war.

Nuclear-armed sea-launched cruise missile (SLCM). Former president Donald Trump's administration sought to develop this weapon to provide a "non-strategic regional presence, an assured response capability, and an INF-Treaty compliant response" to Russia's violation of the now-defunct 1987 Intermediate-Range Nuclear Forces (INF) Treaty. However, this weapon could detract from the vital conventional war-fighting missions of the attack submarines that would carry it, especially in Northeast Asia. U.S. naval forces should retain their conventional focus and the nuclear-armed SLCM should be canceled.

Ground-Based Strategic Deterrent (GBSD) ICBM. Silo-based nuclear-armed ICBMs are the most vulnerable element of the U.S. strategic nuclear deterrent because their locations are fixed and well known. The United States has redressed the stability problem in part by limiting its ICBMs to carry only one warhead, rather than several, in order to require Russia (or any other adversary) to disadvantageously expend more than one weapon to target each U.S. ICBM warhead. Still, the vulnerability of silo-based ICBMs creates pressures on leaders to launch these weapons in the minutes before an incoming Russian attack could destroy them, with attendant risks as described above.

The Defense Department now proposes to spend an estimated $264 billion (in lifetime costs) to develop a new ICBM, the Ground-Based Strategic Deterrent, with the Air Force awarding an initial $13.3 billion contract to Northrup Grumman in October 2020. We recommend pausing this currently unnecessary program (with its assuredly underestimated costs). Instead, the United States should extend the lifetime of the current Minuteman force, which is feasible if their numbers are reduced and certain aging components undergo improvements. If efforts to negotiate bilateral strategic force reductions with Russia fail, then the United States could reconsider procuring a new ICBM.

BALLISTIC MISSILE DEFENSES (CHAPTER 5)

U.S. missile defense policy and deployments should be considered in the context of deterring adversaries from escalating conflicts, reassuring allies, and avoiding destabilizing and excessively costly arms races.

U.S. missile defenses come in various forms, and have different capabilities, technical reliability, objectives, and costs. They also produce different reactions from allies and adversaries. Forward-deployed missile defenses play a role in regional deterrence. If they perform as intended, they will protect allies, U.S. forces, and critical military and civilian installations on allied territory. Missile defenses on and near U.S. territory are supposed to defend the U.S. homeland from ballistic missile attacks of the scale that North Korea might be able to

launch. The key policy question is whether the deployment of such defenses can be done without provoking destabilizing arms racing and escalatory pressures with Russia and/or China that would leave the United States and its allies and partners less secure.

To date, the United States has insisted that regional defenses intended to deter or block North Korean and/or Iranian attacks do not pose threats to Russian and Chinese *strategic* nuclear deterrents. Moscow and Beijing, however, profess not to believe these statements. To the extent that Russia and/or China add strategic offensive capabilities to counter such defenses, would the benefits of defenses against regional Iranian and/or North Korean missiles outweigh the costs?

The United States also seeks increased capabilities to defend its regional forces and allies and partners from shorter-range Russian and Chinese conventionally armed and nuclear-tipped missiles. This is especially important in East Asia where China's military power projection capabilities continue to grow. Yet it is easier and cheaper for China to add missiles of this range than it is for the United States to add defenses to feasibly counter them.

Current U.S. missile defense policy will suffice if policymakers believe that an unconstrained competition in offensive and defensive weapons is preferable to potential agreements that would limit some elements of U.S. missile defenses in exchange for Russian and Chinese concessions.

Another conundrum involves U.S. homeland defenses against ballistic missiles. Today, these defenses are scaled to defeat and thereby deter North Korean launches of nuclear weapons against U.S. territory. But if Chinese leaders genuinely perceive such defenses to threaten the viability of their second-strike long-range deterrent force of around 180 missiles after that force has been attacked by U.S. conventional or nuclear weapons, they would have an incentive to build up or hasten the launching of China's nuclear force. Russia is already developing and deploying additional long-range nuclear delivery systems to defeat current and expected future U.S. missile defense capabilities.

Current U.S. missile defense policy will suffice if policymakers believe that an unconstrained competition in offensive and defensive weapons is preferable to potential agreements that would limit some elements of U.S. missile defenses in exchange for Russian and Chinese concessions. However, U.S. interests—and those of allies and the rest of the world—would be better served by exploring what possible trade-offs could be negotiated between transparency and potential limitations on *some* U.S. missile defense capabilities, on one hand, and Russian and Chinese reductions and/or constraints on some of their current and prospective offensive capabilities, on the other. The most promising way to assess these possibilities would be to explore whether and how regional and homeland missile defenses could be designed and deployed to protect against the missile threats posed by Iran and North Korea,

without creating the realistic prospect of the United States successfully negating Russia's and China's deterrence of disarming first strikes, which would perpetuate arms racing.

ARMS CONTROL AND DISARMAMENT (CHAPTER 6)

Adversaries "pursue" arms control when they recognize mutual interests in reducing the costs and risks of competition in building and deploying weapons, especially those that exacerbate risks of inadvertent or accidental escalation. Arms reductions can also lower the level of damage that could be done if deterrence failed. Additionally, by improving predictability for years at a time, arms control helps participants reduce the costs and risks of arms racing and misperceptions about forces that can increase risk in crises.

The old arms control agreements that helped contain and end the Cold War were hard to make. The task of reinventing arms control in the twenty-first century will prove harder. There are new players—most importantly China—all of whom compete with and respond to one another. Escalation risks no longer come exclusively from familiar missiles but also from new technologies with multiple uses that are harder to count and monitor from afar. These new technologies, which may be more tempting to use, will be entangled with nuclear systems in ways that severely complicate the challenge of deterring conflict and its escalation to and through nuclear war.

Rather than be guided by deterrence logic alone, the organizing principle of arms control should be to reduce the probability of escalatory warfare *and*, with Russia and eventually China, to physically bound the potential collateral damage and long-term consequences that would occur if deterrence fails. No two antagonists should wield weapons whose number and explosive power could not only destroy their own nations but also have catastrophic effects on innocent bystander societies.

Deterrence theory posits that the United States should threaten to destroy enough of what adversary leaders value that they will choose not to take actions that could cause U.S. leaders to strike these targets. No one knows for certain what number of targets suffices to deter Russia and China; in any case, the United States should plan to use nuclear weapons only against targets that cannot be destroyed or disabled by non-nuclear means. The number of such targets likely would decrease depending on how many nuclear weapons Russia, and subsequently China, were willing to eliminate through negotiation. Moreover, the global security gain from reducing the probability that nuclear war would produce climatic catastrophe needs to be factored along with deterrence theory in deciding "how much is enough." The overall risk of negotiating reductions to the minimal level Russia would accept—with parallel limits by China—is less than the risks in both countries' retaining larger arsenals. By making an offer to pursue such reductions, the United States would benefit in international politics by shifting the burden of debate on nuclear arms control and disarmament to Russia.

Legally binding treaties are unlikely to be the only modality for arms control in the foreseeable future. Beyond the complicating need to account for new technologies, political dynamics in Washington make it difficult to ratify treaties. China's skepticism about American intentions in arms control forestalls even the beginning of treaty negotiations. Absent major political change in Washington and Beijing, sustained strategic dialogues, executive agreements, and reciprocal confidence-building measures all will be required to make progress on arms control.

Russia

For the United States and Russia, the most feasible way to serve mutual interests in arms control is to extend New START (Strategic Arms Reduction Treaty), which is set to expire in February 2021. For all its criticisms of what New START does not cover, the Trump administration failed to persuasively explain how the United States would be better off without it.

Assuming New START is extended, the next shared objectives for the United States and Russia should be

- broad-based discussions of strategic stability and escalation risks;
- negotiation of a follow-on agreement to New START; and
- negotiation of non–legally binding confidence- and security-building measures (see three options discussed on pages 87–89).

China

For years, Chinese leaders have resisted arms-control-inflected dialogue, let alone negotiations. Beyond political, bureaucratic, and perhaps cultural factors, a central problem is that Chinese leaders doubt that the United States is prepared to accept and articulate that its strategic competition with China is predicated on mutual vulnerability to nuclear retaliation, which cannot be escaped through first strikes or missile defenses. The United States should acknowledge this fact and test whether Beijing will reciprocate by engaging in sustained, productive strategic dialogue that generates greater transparency regarding China's future development and deployment of nuclear forces and other capabilities that could challenge strategic stability.

U.S. allies and partners will fret that clarifying a relationship of mutual U.S.-China vulnerability would weaken deterrence and increase Chinese assertiveness. Yet the benefits of drawing China into a process that could lead to mutually beneficial transparency, confidence-building, and eventually arms control are greater than allowing current trends to continue. If attempted engagement with China fails, then the United States and its allies

and partners will be on firmer political ground to bolster the range of capabilities needed to counter Chinese coercion.

The following three topics are potential foundations for dialogue on U.S.-China stability:

- exploring the feasibility of bilateral or regional limits on aggregate numbers of missile delivery systems with ranges greater than 500 kilometers;
- demarcating regional missile defenses; and
- exploring risks of cyber operations against nuclear command and control systems.

Advancing Nuclear Disarmament

As a co-creator and longtime champion of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the United States (along with other nuclear-weapon states) must take seriously its obligation to pursue good-faith negotiations on effective measures relating to the cessation of the nuclear arms race and to nuclear disarmament.

To demonstrate its commitment to the disarmament principles expressed in Article VI of the NPT, the United States should design a prototype nuclear disarmament regime that would encompass all states and should invite international discussion and debate over it. Designing effective and sustainable nuclear disarmament of any nuclear-armed state requires much more than dismantling warheads and controlling fissile material stocks. Specialists from all relevant U.S. government agencies should contribute to this effort. Having demonstrated its thinking on the potential requirements for implementing and enforcing verifiable nuclear disarmament, the United States should invite all other nuclear-armed states to do the same if they do not concur with the U.S. model.

Finally, the new administration of Joe Biden and Kamala Harris should commission the National Academy of Sciences to evaluate extant studies on the possible climatic effects of nuclear war. The national security imperative here is to enable U.S. decisionmakers and citizens to better understand the potential consequences of nuclear weapons use, as well as the likelihood that reductions in weapon numbers and yields, and changes in target selection, would reduce prospects of unnecessary suffering if deterrence fails. The United States should call on other nuclear-armed states to conduct and publish similar studies or critiques of the U.S. study.

THE OBJECTIVES OF U.S. NUCLEAR POLICY

Since 1994, four U.S. presidential administrations have published Nuclear Posture Reviews (NPRs) that have served to—

- clarify and publicly articulate, for domestic and international audiences, the threats that require the United States to retain nuclear weapons;
- articulate for Defense Department personnel, Congress, and others the political leadership's nuclear strategy and policies, including force posture, doctrine, procurement, and related infrastructure requirements;[7]
- reinforce deterrence by conveying to potential adversaries how U.S. nuclear resolve and posture will augment U.S. conventional military forces and other instruments of national power in ways that adversaries cannot reasonably plan to defeat;
- reassure allies that the United States can and will fulfill its security guarantees to them, including by means of nuclear weapons if necessary; and
- satisfy domestic supporters of the administration while seeking to limit opponents' opportunities to criticize it.

Past NPRs explicitly expressed the first four of these purposes but left the domestic political purposes as subtext. This approach reflects each administration's need to simultaneously address multiple international and domestic audiences. Each of the four presidents who

released an NPR did so within the first two years of their administrations, looking to shape domestic and international nuclear policy discourse for the remainder of their time in office.

The model NPR offered here presents both domestic and international contexts more directly than official NPRs have tended to do. It stresses that conventional deterrence and diplomatic prevention of conflicts (and ideally their resolution) must be a priority and that some nuclear policies and postures can make such diplomacy more or less successful. Economic power, when it is growing, can strengthen the United States' leverage and its capacity to bolster conventional and nuclear deterrents. The perceived fairness and wisdom of U.S. policies and leaders can help build or erode international coalitions, which in turn affects adversaries' and allies' calculations of the balance of power and its direction. Success or failure in achieving these larger objectives can reduce or exacerbate the threats that nuclear weapons are suitable to deter or defeat.

The occasionally "meta" narrative offered here is intended to encourage holistic analysis and debate of nuclear policy challenges. Often, partisan politics, ideology, and bureaucratic and financial factors have affected nuclear policymaking as much as theories of deterrence have. Indeed, these factors influence how policymakers define or construct what nuclear postures are "necessary." In making this narrative explicit, this model seeks to widen the range of possible policy deliberations and decisions. Similarly, it explores a wider range of policy dilemmas, uncertainties, and trade-offs than that found in public versions of official NPRs. The conclusions in this report may not please the staunchest advocates of nuclear superiority or of nuclear disarmament, but few domains of national and international governance are as beset with paradoxes and uncertainties as those in nuclear policymaking.

Few domains of national and international governance are as beset with paradoxes and uncertainties as those in nuclear policymaking.

The current moment in U.S. and international nuclear policymaking is exceptionally critical and poses new challenges. The United States and its allies and partners, along with Russia, China, North Korea, India, and Pakistan, perceive that their competitors or adversaries might be less restrained in the use of force than has been the case in recent decades, raising risks of conflict.[8] Most of these countries are modernizing nuclear forces and developing and deploying new non-nuclear technologies—advanced conventionally armed missiles, terrestrial- and space-based antisatellite capabilities, and cyber weapons—that could interact with nuclear forces and their command and control systems in unpredictable ways. Each government wants to bypass its adversaries' strengths and exploit their vulnerabilities. Each competing government says it intends to prevent or deter aggression.[9] Above all, each seeks to prevail by countering its adversaries' escalation within a conflict if deterrence efforts should fail. Yet, the ways in which governments manage these competitions may undermine deterrence and exacerbate risks of instability and escalatory conflict.

The aim of this report is to stimulate current and prospective U.S. officials, foreign governments, and domestic and international civil society actors to think as holistically as possible about the choices they confront.

OBJECTIVES

The authors of the 2010 and 2018 NPRs posited several objectives for U.S. nuclear policies and forces (see table 1).

Table 1: Objectives of the 2010 and 2018 NPRs

2010 NPR	2018 NPR
• preventing nuclear proliferation and nuclear terrorism; • reducing the role of U.S. nuclear weapons in U.S. national security strategy; • maintaining strategic deterrence and stability at lower nuclear force levels; • strengthening regional deterrence and reassuring U.S. allies and partners; and • sustaining safe, secure, and effective nuclear arsenals.	• deterrence of nuclear and non-nuclear strategic attack; • assurance of allies and partners; • achievement of U.S. objectives if deterrence fails; and • capacity to hedge against an uncertain future.

Sources: U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: U.S. Department of Defense, 2010), 17, https://dod.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf; and U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: U.S. Department of Defense, 2018), 20, https://dod.defense.gov/News/SpecialReports/2018NuclearPostureReview.aspx (*hereinafter* 2018 NPR).

The differences between these lists of objectives reflect changes in the international environment and in U.S. politics. The lists also reflect who led the NPR drafting process and the broader foreign policy and domestic agendas of two different presidents. Nevertheless, these lists may have more overlap and continuity than appear at first glance.

For example, the 2018 NPR downplayed references to nonproliferation. However, Donald Trump's administration supported nonproliferation efforts and adhered to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The 2018 NPR affirmed its predecessors' conclusions that providing extended nuclear deterrence to allies reduces risks that they might proliferate, notwithstanding Trump's rhetoric denigrating various U.S. allies' contributions to their own defense.[10] Similarly, although the 2018 NPR did not call for

reducing the role of U.S. nuclear weapons, it did say, "The United States remains committed to its efforts in support of the ultimate global elimination of nuclear, biological, and chemical weapons."[11] The 2018 NPR, unlike the 2010 document, referred to the need "to achieve U.S. objectives if deterrence fails," but both envisioned winning escalatory competitions with adversaries by conducting damage-limiting conventional and nuclear operations against them. Both recommended maintaining the appropriate nuclear force structure to pursue such a nuclear strategy.

In 2021, the following objectives should drive U.S. nuclear policies:

- deter nuclear and non-nuclear existential threats to the United States and allies and partners, particularly from Russia, China, and North Korea;
- assure allies and partners of continued U.S. commitments to mutual defense, nonproliferation, and disarmament;
- reduce potential drivers of nuclear escalation;
- limit the level of destruction caused by nuclear use to the lowest levels possible; and
- preserve international stability, prevent proliferation, and facilitate nuclear weapons reductions.

These objectives reflect a shared global interest in preventing warfare, especially warfare between nuclear-armed adversaries. These objectives also acknowledge that if war nevertheless occurs, it is in everyone's interest to limit its destructiveness. International law and, more specifically, the law of armed conflict reflect and serve these interests, as the 2010 and 2018 NPRs stated. This report will highlight the latter three of these five objectives because their policy implications deserve greater attention.

CHAPTER 1

THE THREATS THAT U.S. NUCLEAR WEAPONS POLICY MUST ADDRESS

Given the enormous risks of nuclear war, **nuclear weapons should be reserved for deterring threats of a scale and type that cannot be deterred or defeated by other means.** Since 1945, no threat—including many crises, conflicts, and wars—has caused the United States or any other country or nonstate entity to initiate use of nuclear weapons. The 2018 NPR suggests that the decline in wartime casualties since 1945 is due primarily to the deterrence provided by nuclear weapons.[12] There may be truth to this. But the invocation of World War II and the emergence of nuclear deterrence in 1945 invites at least two other pertinent observations.

First, unlike when the United States used nuclear weapons against Japan in 1945, today the adversary also will possess nuclear weapons in any conflict where the United States conceivably would use them.[13] In other words, the risks entailed in the United States' use of nuclear weapons, in either a first or second strike, are greater. These risks may induce greater caution among all parties, including the United States, but they add to the challenge of protecting U.S. allies and partners in potential regional scenarios where Russia, China, or North Korea might threaten them.

Consequently, **because nuclear war would carry a clear risk of catastrophic destruction for the United States and probably for its allies or partners, American leaders should only contemplate use when the violence and destructiveness of the aggression that must be defeated is of a similar scale.** States with nuclear weapons have been attacked and have lost wars, as the United States and Russia did respectively in Vietnam

and Afghanistan.[14] Nuclear weapons have not enabled states to compel adversaries to stop supporting terrorism, reverse illegal territorial aggrandizement, respect human rights, or desist from cyber attacks. Curbing these activities is a clear national security priority for the United States, but the U.S. nuclear arsenal cannot reasonably be expected to deter these threatening activities or to compel the countries engaged in them to stop. In short, nuclear weapons cannot solve most security problems.

Russia, China, and North Korea pose the few threats that U.S. nuclear weapons are necessary to deter or, if that fails, possibly help defeat. These threats all have histories and reflect action-reaction dynamics between adversaries, including the United States. The drivers and evolution of these threats look different depending how far back in time one rewinds history and whose perspective is taken to assess what happened before. In any case, the prospective Russian, Chinese, and North Korean threats vary. Sound and credible U.S. deterrence strategies require individual consideration of all three countries' unique military capabilities and national goals—which are of course debatable. Table 2 presents estimates of the nuclear forces of the United States and its three immediate nuclear concerns.

Table 2: Estimates of U.S. and Potential Adversaries' Nuclear Forces

	United States	Russia	China	DPRK
Warheads				
Deployed strategic warheads	1,750	1,572	0	0
Nondeployed warheads, strategic and nonstrategic	2,050	2,740	~low 200s	35
Total warhead stockpile	3,800	4,312	~low 200s	35
Delivery Systems				
ICBMs	400	302	81	N/A
SLBMs	240	160	48	0
Long-range bombers	66	68	20	0
Nonstrategic nuclear warheads*	230	1,870	87	0
Dual-use theater-range missiles	0	90	~108	<150**

*Warheads associated with short- and intermediate-range delivery systems but not necessarily deployed day-to-day in peacetime. ** Public estimates vary; this total is based on the approximate number of missile launchers.

Note: "Strategic" refers to warheads on non-forward-based weapons with ranges that are capable of reaching adversaries' homelands. New START defines their range as greater than 5,500 kilometers.

Source: Data drawn from Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* 76, no. 1 (2020), 47; Hans M. Kristensen and Matt Korda, "Russian Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* 76, no. 2 (2020): 103–4; Hans M. Kristensen and Matt Korda, "Chinese Nuclear Forces, 2019," *Bulletin of the Atomic Scientists* 75, no. 4 (2019), 172; Hans M. Kristensen and Robert Norris, "North Korean Nuclear Capabilities, 2018," *Bulletin of the Atomic Scientists* 74, no. 1 (2018), 42; Hans M. Kristensen and Matt Korda, "Status of World Nuclear Forces," *Federation of American Scientists*, September 2020, https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/; and Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China*, 2020, Annual Report to Congress (Washington, DC: Department of Defense, 2020).

RUSSIA

As was the case in the Cold War, Russia drives most U.S. nuclear requirements. Russia's nuclear capabilities have set the upper bound of threats that U.S. nuclear policy must deter or defeat. If Russia did not have nuclear weapons but all other nuclear-armed states maintained their current levels, U.S. nuclear requirements would be substantially reduced. Alternately, if Russian nuclear forces were comparable in size to China's, the United States would not need the postures called for in the 2010 and 2018 NPRs. This would be so even if China doubled its stockpile to approximately 500 warheads—as the Department of Defense warns could be the case in ten years.[15]

Russia's competitive strategy is to weaken its adversaries through the lowest level of violence necessary (or preferably no violence at all). Among other reasons, Russia seeks to avoid the mobilization of the West's superior economic and military potential.[16] Actors with various affiliations to the Russian state have engaged in political and economic interference and nonkinetic military actions at various levels of conflict. At the same time, Russian leaders welcome the deterring psychological shadow that nuclear weapons cast over any potential conflict with Russia.[17]

The U.S. nuclear deterrent is relevant only for those threats that involve large-scale armed conflict, as a war between Russia and the North Atlantic Treaty Organization (NATO) would. U.S. nuclear policy will not plausibly compel Russian leaders to curtail coercive or subversive actions against the United States and its allies below any reasonable threshold of armed conflict.[18] Scenarios for analyzing nuclear escalation generally posit Russian forces or proxies advancing into a NATO state and/or taking coercive control over it before NATO mustered the resolve and capacity to stop them and compel them to exit.[19] A recent RAND Corporation simulation of a NATO-Russian conflict in Estonia highlights NATO's vulnerability to such a scenario. The report concludes that "NATO lacks the conventional forces required to slow or stop the rapid Russian advance. NSNW [non-strategic nuclear weapons] alone cannot substitute for NATO's lack of those conventional forces. . . . This problem will not be solved by new means of basing or delivery of low-yield nuclear weapons alone."[20]

Russia is modernizing its nuclear forces in order to disabuse the United States that it could initiate limited nuclear operations against Russian forces in Europe and then, through offensive strikes and/or missile defense interceptions, deny Russia the capability to escalate against the U.S. homeland. The Avangard hypersonic glide vehicle (HGV); the Sarmat heavy, MIRV (multiple independent reentry vehicle)-capable silo-based ICBM (intercontinental ballistic missile), which can carry up to ten warheads (or more); the Poseidon autonomous underwater vehicle; the Burevestnik nuclear-powered cruise missile; and the Kinzhal air-launched ballistic missile (ALBM) are all intended to survive U.S. offensive and defensive attacks and ensure an ability to deliver nuclear weapons against the U.S. homeland.

Russian leaders mirror U.S. strategists in thinking about the role of nuclear weapons in deterring or defeating threats.[21] According to a 2020 study by the Center for Naval Analyses, Russian leaders "view nuclear use as defensive, forced by exigent circumstances, and in the context of regional or large-scale conflicts."[22] In this study, Michael Kofman and Anya Loukianova Fink state

> the purpose of Russia's escalation management strategy is to deter direct aggression, preclude a conflict from expanding, prevent or preempt the use of highly damaging capabilities against the Russian homeland that could threaten the state or the regime, and terminate hostilities on terms acceptable to Moscow. . . . Only strategic deterrence forces, armed with conventional capabilities (offensive strike and aerospace defense), nonstrategic nuclear weapons, and strategic nuclear weapons, are effective deterrents in regional and large-scale wars.[23]

Similar to the ways in which an emerging generation of nuclear strategists view U.S. nuclear policy today, Kofman and Fink write,

> the Russian military does not believe that limited nuclear use necessarily leads to uncontrolled escalation. The Russian military believes that calibrated use of conventional and nuclear capability is not only possible but may have decisive deterrent effects. This is not an enthusiastically embraced strategy, but an establishment's answers to wicked problems, in the context of a great-power conflict, which have no easy or ideal solutions.[24]

In confronting these wicked dilemmas, Russian policymakers echo their U.S. counterparts by saying that if they used nuclear weapons first, it would be to prevent further escalation of the conflict (Russia) or restore deterrence at the lowest level of damage possible (the United States).[25] Yet both Russia and NATO seek this outcome on terms favorable to them, not to the adversary, and therein lies the risk of escalation. If nuclear escalation did occur with attacks on their strategic forces, both maintain the option to launch a retaliatory strike with alert nuclear forces before an enemy's nuclear weapons arrive. Both countries also threaten nuclear use to deter an adversary's attack—perhaps by cyber means—against critical nuclear command and control infrastructure.[26] In all of this, both countries acquire and make plans to use incomparably extensive and destructive nuclear and dual-use arsenals and, for the United States, perhaps missile defenses in order to prevent the other from dominating the imagined escalatory process.

More than NPRs traditionally acknowledge, the United States and its allies need to understand how to reassure Russia that NATO poses no *offensive* threat to Russian interests while simultaneously projecting sufficient capabilities and political resolve to deter Russian armed aggression. Such reassurance can foster stability—an overarching goal of U.S. and NATO policy. In doing this, the United States and its allies must demonstrate that Russian

reductions of coercive rhetoric, actions, and forces will beget reductions in NATO rhetoric, action, and forces, that Russia reasonably could find threatening.[27] The United States and its allies also must seek greater clarity on Russia's nuclear doctrine to better understand how Russian political and military officials think operationally about first use—under what circumstances, against what targets. This awareness can help ascertain how NATO could deter or dissuade Russia from undertaking such escalation. It is cliché, but nonetheless true, that the political cohesion and therefore resolve of NATO is vital in all of this.

For deterrence, the greatest threat to the NATO alliance would be if the strength of its conventional forces, cyber defenses, military resilience, and political cohesion declined relative to Russia.

For deterrence, the greatest threat to the NATO alliance would be if the strength of its conventional forces, cyber defenses, military resilience, and political cohesion declined relative to Russia. Western policymakers also must anticipate the possibility that deterrence could fail, and in that case deploy capabilities and plans best suited to end the postulated Russian aggression at costs acceptable to NATO populations and governments. The abovementioned RAND report does not suggest there are any acceptable "nuclear solutions" to this problem—not greater numbers, different yields, alternative basing, or different targeting.[28] However, this does not mean that changes in strategic nuclear capabilities and/or arms control arrangements would not be advisable to counter new Russian forces and deter escalation of conflict in Europe. Chapters 4 and 6, respectively, present recommendations for strategic modernization and new U.S.-Russia arms control arrangements.

CHINA

China poses numerous challenges to the United States and its allies. Many of them are economic and diplomatic and, therefore not elaborated here. In terms of military activity, the U.S. Defense Department asserts "China calibrates its coercive activities to fall below the threshold of provoking armed conflict with the United States, its allies and partners, or others in the Indo-Pacific region."[29] The United States and its allies and partners would like the Chinese state to stop maltreating Uighurs and dissidents, stop using cyber tools to steal intellectual property, and refrain from taking disputed territories (such as islets) and marine resources. U.S. nuclear weapons cannot reasonably be used to accomplish these goals.

Coupled with a long-term effort to diversify and increase the survivability of its nuclear arsenal, China is pursuing kinetic and nonkinetic capabilities to frustrate U.S. efforts to come to the aid of its allies and Taiwan in a regional crisis.[30] The key challenge for U.S. and friendly defense policymakers is to counter these capabilities and related Chinese intentions to prevail in conflicts around its periphery and to exert hegemonic power in Asia.

The integrity of Taiwan is probably the gravest concern. Chinese President Xi Jinping has staked his government's credibility on doing whatever is necessary to prevent Taiwan from declaring and implementing independence.[31] The military challenge of conventionally defending Taiwan from a concerted Chinese attack is becoming more difficult over time.[32] The second and perhaps more imminent challenge derives from territorial disputes between China and several U.S. allies—Japan most prominently—over maritime claims. To date, China has been careful to keep its exertions below the level of armed conflict. However, these disputes could stimulate purposeful or accidental military confrontations that could then escalate and involve a wider number of U.S. allies and partners, including Australia, members of the Association of Southeast Asian Nations, and India.[33]

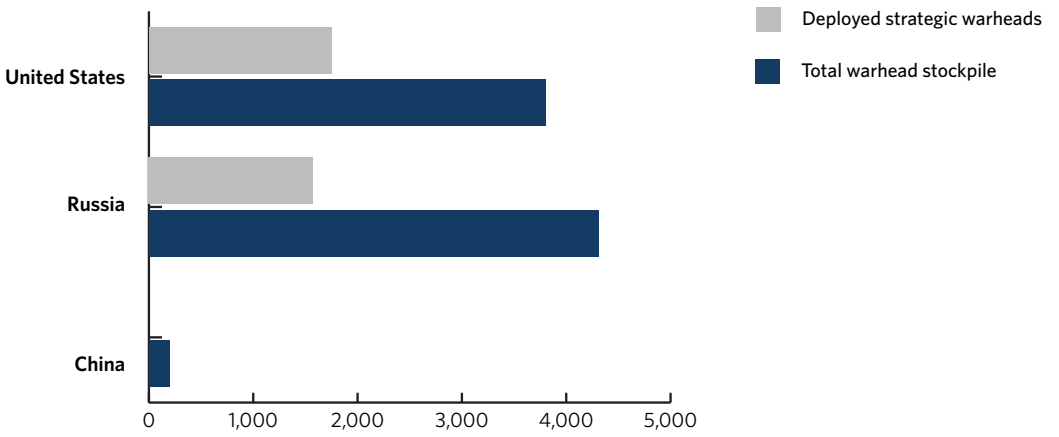
U.S. nuclear capabilities and policies contribute to deterring China from initiating or escalating large-scale military conflict with U.S. allies and partners and the forces that would defend them. The complex nature of U.S. alliances in Asia and the varied capabilities of allies and partners to defend themselves complicate U.S. deterrence policy toward China. The lack of a NATO-like decisionmaking structure makes it more difficult to ensure effective political and military coordination among all governments, and ultimately to assure U.S. allies that the United States will not involve them in a war of its own making, and vice versa.

China has traditionally been restrained in its deployment of nuclear forces and in its no-first-use (NFU) doctrine.[34] According to former Defense Intelligence Agency (DIA) director Lt. Gen. Robert Ashley, China possesses a nuclear warhead stockpile in the "low couple hundreds."[35] Approximately 180 of these would be paired with intercontinental-range (or "strategic") delivery systems, and roughly 100 would be paired with short- to intermediate-range weapons capable of hitting regional targets.[36] The Department of Defense reports that China's nuclear warhead stockpile is projected to "at least double in size" in the next ten years.[37] (By comparison, Russia is estimated to have 6,490 active and inactive warheads in its stockpile, of which 1,600 are deployed on strategic delivery vehicles, and the United States has 5,800, of which 1,750 are deployed on strategic delivery vehicles.[38]) See figure 1 for a comparative inventory of U.S., Russian, and Chinese strategic nuclear warheads.

The Department of Defense states that China "almost certainly" does not integrate warheads with delivery systems in peacetime, but believes that China may take steps to adopt a "high alert posture conceptually comparable to the claimed high alert posture kept by portions of U.S. and Russian nuclear forces."[39] However, China's posture today is consistent with Beijing's declared intentions not to initiate nuclear war or counterforce operations against the United States.[40]

In recent decades, China has sought to increase the survivability and effectiveness of its nuclear forces. It has fielded an array of mobile land-based missiles that can range regional and intercontinental targets, and has developed a new generation of SSBNs (ballistic missile submarines) and SLBMs (submarine-launched ballistic missiles). China has also built

Figure 1: Deployed and Total Strategic Nuclear Warheads in U.S., Russian, and Chinese Nuclear Forces



Sources: United States: Hans Kristensen and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of Atomic Scientists* 76, no. 1 (2020): 46–60. Russia: Hans Kristensen and Matt Korda, "Russian Nuclear Forces, 2020," *Bulletin of Atomic Scientists* 76, no. 2 (2020): 102–17. China: Hans Kristensen and Matt Korda, "Chinese Nuclear Forces, 2019," *Bulletin of Atomic Scientists* 75, no. 4 (2019): 171–8.

extensive underground facilities to shelter its mobile land-based nuclear forces from a potential U.S. attack. It is developing and testing new maneuverable hypersonic delivery systems to overcome U.S. missile defenses. Chinese experts explain that the enhancement of China's nuclear forces—largely to make them more resilient—are driven by advances in U.S. and other states' capabilities to threaten China's nuclear deterrent with new non-nuclear kinetic weapons, cyber operations, and ballistic missile defenses.[41]

U.S. military leaders openly doubt that China's policies have been or will be as restrained as Beijing claims. In reference to China's NFU policy, the head of U.S. Strategic Command (USSTRATCOM) remarked before the Senate that he "could drive a truck through that no-first-use policy."[42] The question of NFU in relation to China continues to present a paradox. Some U.S. commentators say that U.S. and allied security would be diminished by adopting NFU, and that the United States should continue to seek a combination of offensive strike capabilities and missile defenses to threaten China's second-strike deterrent.[43] Yet these same U.S. commentators then denounce any suggestion from China's own experts that their country might be better served by hedging NFU in order to deter a potential U.S. non-nuclear first strike against China's nuclear forces.

China is pursuing nuclear, kinetic, and non-kinetic capabilities to frustrate U.S. efforts to aid allies and Taiwan.

The absence of meaningful sustained dialogue between senior U.S. and Chinese defense officials and military officers regarding issues related to nuclear and missile defense policies impairs both countries' capacity to avoid conflict or to prevent any potential conflict from escalating. Chinese leaders—especially the top officials of the PLA (People's Liberation Army) Rocket Force—traditionally have been averse to engaging transparently in such dialogue, even though they may be able to represent Beijing's genuine strategic perspectives.

China's nuclear force modernization could improve stability by reassuring China's leaders that their second-strike nuclear forces will survive. But some warn that China will seek to become a nuclear peer of the United States and then more assertively project its power in Asia and beyond.[44] Here the most practical worry is that China could forcibly take disputed territory or inflict other harm on a U.S. ally or partner and then use explicit or unstated nuclear threats to deter the United States and its ally or partner from using their full capabilities to contest China's action. Combined with China's political, economic, and other military influence augmented by increasingly capable conventional forces, the threat of nuclear escalation can create coercive pressure on U.S.-allied relationships, particularly in the case of a crisis involving Taiwan.[45] The key policy question for U.S. and allied policymakers is which additional nuclear or non-nuclear capabilities would most effectively deter and, if necessary, counter Chinese escalation of regional conflict.

NORTH KOREA

The DPRK poses the threats that are most likely to lead U.S. decisionmakers to first use of nuclear weapons. North Korea could rapidly inflict extensive nuclear and non-nuclear damage on Seoul and other regional targets. U.S. and Republic of Korea conventional weapons alone may not be sufficient to destroy hardened North Korean targets, including some of its nuclear forces. Moreover, U.S. and allied missile defenses could interdict at least some of the relatively small number of nuclear weapons with which North Korea could retaliate after a U.S. first strike. If North Korea were inflicting heavy damage on Seoul with conventional artillery and missile barrages, and intelligence indicated that the North was readying its nuclear weapons for use, the situation could well stimulate the most urgent-ever U.S. leadership considerations of launching nuclear weapons.

U.S. military leaders are confident that they and their allies ultimately can defeat North Korea without recourse to nuclear weapons. The presence of U.S. Forces Korea, other U.S. forces in the region, and the military strength of South Korea provide a conventional force posture that credibly deters a North Korean attack on South Korea. If North Korean leaders

are not rational actors there is no reason for thinking that greater U.S. and South Korean forces would deter them more effectively.

South Korean military capabilities and operational thinking have advanced greatly in the past several years. They have focused on modernizing conventional strike and missile defenses to destroy and defend against the North Korean missile threat.[46] However, some U.S. analysts argue that preemptive U.S. nuclear strikes on the DPRK could significantly reduce the level of damage that a North Korean conventional attack might inflict on South Korea and local U.S. forces.[47] Theater and national missile defense theoretically could blunt any nuclear retaliation from the North. Yet in considering such an operation, and the policies required to enable it, other factors would need to be considered. How would fallout from potential U.S. nuclear strikes affect South Korea, Japan, and other nations in the region? What are the probabilities that regional and national U.S. missile defenses would blunt attacks by surviving North Korean nuclear weapons? Would capabilities to preemptively strike North Korean nuclear forces stimulate its leadership to deploy more nuclear weapons and adopt risky policies to enhance their survivability?

It is important to recognize that additional capabilities the United States might pursue to locate and destroy mobile North Korean nuclear forces could exacerbate crisis and arms race instabilities with China and perhaps Russia. Forward-deploying U.S. nuclear weapons in South Korea could ameliorate some problems but would create or exacerbate others. The U.S. arsenal deployed for the primary mission of deterring Russia and China is more than adequate if the DPRK is deterrable. Again, if North Korean leaders are not rational or deterrable, then there is no way to assess whether and how various U.S. nuclear postures would make a difference and thus little foundation from which to suggest changes to current U.S. nuclear posture.

Unforeseen Threats

National security strategists, including authors of past NPRs, naturally caution that new adversaries and/or threatening capabilities will emerge to threaten the United States. Some analysts and officials then immediately conclude that nuclear weapons—of newer types or in greater numbers—will be needed to deter or defeat these potential new threats.[48] The designers and producers of nuclear weapons systems reinforce these impressions for obvious material reasons; so, too, do the congressional delegations from districts where such weapons systems are developed, built, and deployed. This line of thinking, complete with special interests, reflects the traditional U.S. approach to nuclear posture and policy and general planning for future military requirements. Yet

Washington must take more care to examine second- and third-order ways in which developing new nuclear weapons would affect competitions with adversaries and other security and diplomatic objectives. Here, the U.S. defense establishment reinforces a similar predilection in Russia. (Judging by the much smaller sizes and varieties of their arsenals, other nuclear-armed states do not fall into similar predilections.)

Prudence does require the United States to maintain an unsurpassed research and development base to be able to anticipate and respond to emerging threats, including through the maintenance and development of nuclear weapons. It must also maintain advanced intelligence gathering and reconnaissance capabilities to detect threats that could require nuclear or other responses. Confidence in detecting and countering emergent threats would be all the greater if arms control and other international security regimes were in place to foster transparency, aid in the early recognition of hostile intent, limit military forces designed for rapid attacks against targets of national importance, establish norms against weapons of mass destruction, and so on.

The combination of research and development, state-of-the-art intelligence collection and analysis, and durable arms control measures offers the most cost-effective and stabilizing way to manage risks of unforeseen existential threats (and perhaps prevent those threats from materializing). Given that the United States will retain a nuclear arsenal scaled to that of its largest nuclear competitor, it is difficult to see circumstances in which additional nuclear capabilities should be retained or developed as a hedge against invisible future threats.

THE CENTRAL CHALLENGE: PREVENTING ESCALATORY REGIONAL CONFLICT

Preventing and managing escalation is central to all the threats or challenges just discussed. Escalation can occur inadvertently or purposefully. It can transform conventional war into nuclear war, and limited nuclear war into all-out nuclear war.

Inadvertent escalation is not a new problem in the Atomic Age. It was analyzed comprehensively in the 1980s.[49] However, the risks may have grown significantly in recent decades as nuclear-armed states have developed and deployed advanced non-nuclear weapon technologies that could target both nuclear and conventional forces and their associated command and control systems.

U.S. nuclear forces and command, control, and communication systems (NC3) capabilities increasingly are entangled with those used to manage conventional military operations. Components include space- and ground-based early warning and reconnaissance systems that Russia or China would be interested in disabling in a conventional or a nuclear conflict. Similarly, Russian and Chinese missiles and their command and control systems may employ either conventional or nuclear warheads. In some cases, nuclear-armed and conventional-armed missiles are co-located. These three countries also assume that adversaries are increasing cyber capabilities to target their command and control systems.

U.S. nuclear forces and command, control, and communication systems capabilities increasingly are entangled with those used to manage conventional military operations.

Early in a conventional conflict, Russia or China could use various means to penetrate and/or attack U.S. command and control systems. Cyber penetrations, for example, could gather intelligence on or simply attack these systems. U.S. military operators and political leaders would naturally be inclined to think the worst and assess that Russia is preparing nuclear attacks on U.S. nuclear capabilities.[50] Similarly, the United States, early in a conflict, would plan to conduct cyber and conventional attacks to disable adversary conventional military command-and-control systems. To the extent that such U.S. attacks were directed against Russian, Chinese, or North Korean assets with both conventional and nuclear functions, these adversaries could perceive them to be the early stages of U.S. nuclear attack, even if the United States in fact was not planning to escalate to nuclear use. Russian and Chinese analysts have expressed deep insecurity about such scenarios.[51] The United States' resistance to NFU and its long-standing plans to target these adversaries' nuclear forces could reinforce adversary perceptions of imminent nuclear attack. Adversaries, in turn, could escalate tensions by targeting U.S. NC3 assets in space in a bid to disrupt such attacks, or issue potentially destabilizing orders to raise the alert level of their nuclear forces. The circular dynamic of perception and possible misperception here adds to the overall risk of inadvertent escalation.

Even before attacks, activities by American, Russian, or Chinese units known to operate both conventionally and nuclear-armed missiles could be perceived as preparations for nuclear attacks. After known dual-capable missiles were fired, the targeted state may be unable to determine whether the released weapons are carrying nuclear or conventional warheads. Leaders of states facing such attacks would thus have to choose to either launch their own nuclear weapons in the possibly incorrect belief that the adversary is initiating or escalating nuclear war, or to hold their fire even in the face of an actual nuclear attack. The first would risk creating nuclear war from a situation where neither side intended it. The second would run the risk of being wrong and then hobbled in an escalatory contest. The second option is obviously the saner one, especially for large states like the United States, Russia, and China, but this situation would be unprecedented.

In an ideal situation, this cautious thinking could strengthen deterrence. If military and civilian leaders of the United States, Russia, and China understand the risks of inadvertent escalation, they could be more inclined to dampen crises, avoid initiation of armed conflict, or deescalate before nuclear weapons are unleashed. (It is more difficult to assess North Korean intentions and thinking in this regard.)[52]

New nuclear warheads and delivery systems, however, cannot unilaterally solve the risks of inadvertent escalation. The relevant actors across multiple agencies and departments in the United States, Russia, and China must first fully understand the problem and then create venues for bilateral or trilateral dialogue on it. Such dialogue—if more sustained and detailed than has been the case heretofore between the United States and Russia and, especially, the United States and China—could help clarify whether and how alternative force postures, procurement decisions, and confidence-building measures could mitigate dangers of inadvertent escalation.

Purposeful escalation is most likely to occur when a state is failing to achieve its objectives in conventional war. It could then conclude that it must employ nuclear weapons to compel the adversary to reverse course. The same escalatory dynamic can occur after nuclear weapons have been employed when one or both (or more) adversaries decide to increase nuclear attacks to compel the other(s) to desist from further warfare. For instance, if Russia or North Korea were losing a conventional conflict with the United States and its allies, leaders in Moscow or Pyongyang would at least contemplate employing nuclear weapons to reverse the U.S. advantage or at least to deter the United States from pressing on to inflict greater loss. If Russia or North Korea did unleash nuclear weapons on U.S. forces, allies, or the U.S. homeland, U.S. policymakers would face the excruciating judgment of whether nuclear reprisals would be necessary and likely to reverse the escalatory dynamic.

Such scenarios with China are more difficult to predict insofar as Beijing insists it would not be the first to use nuclear weapons and has not to date deployed nuclear forces well suited for engaging the United States in limited nuclear war. Indeed, Beijing has strengthened a suite of kinetic and nonkinetic capabilities to deny the United States and its allies and partners from being able to defeat it in a regional conventional conflict. In any case, to avoid situations of nuclear escalation, realistic and prudent nuclear policy requires serious planning for diplomatic signaling and non-nuclear military options to pursue war termination.[53] If nuclear weapons are exchanged even in limited numbers, none of the belligerents would be likely to accomplish its favored outcome. For belligerents as well as the rest of the world, preventing further nuclear escalation would be better than the alternative.[54]

The more difficult scenario would arise if Russia or China gained significant territorial or other advantages early in a conventional conflict with the United States and its allies. If these potential adversaries managed to negate U.S. and allied conventional capabilities to reverse such losses, the United States would then consider nuclear *first use* to compel them

to stop the fighting (and more quixotically return to the status quo ante). Indeed, some theorists regard the threat of U.S. first use in these scenarios as a critical component of deterrence.[55] This is why deploying capabilities and operational plans to conduct limited nuclear war has become central to U.S. (and Russian) policymakers in recent years, even if grave doubts remain that nuclear escalation would be controllable.

Reflecting the salience of regional war scenarios, a recent State Department analysis notes the relative unlikelihood that Russian, Chinese, or North Korean leaders would be able and willing to conduct "bolt-out-of-the-blue" nuclear strikes on the United States or its allies. Political conditions, U.S. intelligence and warning capabilities, and surviving U.S. nuclear and other forces practically guarantee that such strikes would result in devastating U.S. countermeasures of the exact sort all three countries seek to avoid.[56] The greater risk, which warrants the most attention by nuclear experts, is escalation from a regional conventional war. To prevent such scenarios or to achieve satisfactory outcomes in them, U.S. and allied policymakers must answer four key questions:

1. What, if any, diplomatic initiatives could ameliorate sources of potential conflict?

2. What conventional, cyber, and information warfare capabilities would deny adversaries their hoped-for advantageous conventional options?

3. What sorts of nuclear operations—against which targets, with what numbers, types and yields of weapons, and using what delivery systems—would predictably cause the adversary to cease further aggression and would be consistent with the law of armed conflict and other interests? Relatedly, what capabilities are redundant for these purposes?

4. What sorts of nuclear operations would probably cause the adversary to retaliate against allied and U.S. territory and interests in ways that would leave allies and/or the United States worse off than if they had not initiated nuclear use?

Clearly, there is a world of difference between the dangers implied in the third and fourth questions. Only with North Korea does escalation dominance with nuclear dimensions still theoretically stand a chance of succeeding on tolerable terms, given the limited nature of the North Korean nuclear capabilities to date and the overwhelming U.S. and allied military advantages that Pyongyang faces.

The current debate about limited nuclear war repeats decades of failed attempts by the United States and the Soviet Union (and then Russia) to resolve the unresolvable dilemma of "how to plan a nuclear attack that [is] large enough to terrify the enemy but small enough to be recognized unambiguously as a limited strike, so that, if the enemy retaliated, he'd keep his strike limited too."[57] And, if neither side is willing to back down after the first round of limited nuclear attacks, how plausibly could they move up the escalation

ladder without destroying each other and much of the rest of the world?[58] Eventually, both countries learned that it was impossible to win a nuclear war against an adversary that could maintain a survivable second-strike capability. They may now need to relearn this as emerging nuclear and non-nuclear capabilities may tempt one or the other to undertake preemptive counterforce strikes.

The United States and China heretofore have avoided such contests for escalation dominance but may be verging toward one. The United States is increasingly concerned that the geography of the West Pacific may align with China in possible regional conflicts. Exchanging attacks on each other's homeland with large numbers of nuclear weapons would be suicidal and therefore not credible as a deterrent. However, either could be tempted to deploy suites of lower-yield, shorter-range weapons that conceivably would make the adversary stop fighting (that is, deescalate) before mutual suicide is achieved. This temptation to find nuclear solutions to the overall challenge will grow, even if such solutions may be Pyrrhic.

CHAPTER 2

DECLARATORY POLICY

States generally put more stock in each other's capabilities and actions than in their declared intentions. Still, a state's nuclear policies and forces require rationales to guide them. Declaratory policy articulates such rationales and intentions to one's population and defense establishment, and to adversaries and allies, reflecting when the government thinks it could be prudent, effective, and justifiable to use nuclear weapons. Even if decisionmaking on capabilities sometimes has a logic of its own, declaratory policy should guide the acquisition and posturing of forces and the reduction of unnecessary capabilities.

There is no perfect or nonproblematic declaratory policy.

There is no perfect or nonproblematic declaratory policy. It may be tempting to vaguely set a low threshold for when one would consider using nuclear weapons. However, experience shows that nuclear weapons do not deter all forms of aggression or coercion. If they did, additional states would want to acquire these weapons. Worse, **overreliance on nuclear deterrence can create a strategic and moral hazard of decreasing leaders' and polities' resolves to prevent conflicts in the first place and to acquire conventional and other defenses to deter or defeat less-than-existential threats.**

Because deterrence could fail, it would be folly to posit using nuclear weapons in situations where ensuing action-reaction dynamics would probably leave one (and one's allies and partners) worse off than if nuclear weapons were not used. Conversely, it would be imprudent to promise not to use nuclear weapons when there might be no better alternative to

doing so. **The destructiveness of nuclear weapons and the uncertainty over whether and how escalation can be limited mean that nuclear use can be justified strategically and legally only when the threat to be deterred or stopped is proportionate to the likely consequence of their use.** As the *Department of Defense Law of War Manual* declares, "the overall goal of the State in resorting to war should not be outweighed by the harm that the war is expected to produce."[59]

CURRENT POLICY

Since 1994, NPRs have stated that the primary purpose of U.S. nuclear weapons is to deter nuclear attacks against the United States and its allies and partners, while contributing to deterrence of other extreme threats. According to the 2010 and 2018 NPRs, the United States "would only consider the employment of nuclear weapons in extreme circumstances to defend the vital interests of the United States, its allies and partners."[60]

This formulation does not specify what interests are vital enough to warrant employing nuclear weapons in conflicts with Russia, China, North Korea, or anyone else, outside of a partial discussion of "extreme circumstances" or "vital interests" in the 2010 and 2018 NPRs. The 2018 review says extreme circumstances "could include significant non-nuclear strategic attacks," including but not limited to "attacks on the U.S., allied, or partner civilian population or infrastructure, and attacks on U.S. or allied nuclear forces, their command and control, or warning and attack assessment capabilities."[61] The vagueness is purposeful, as the 2018 NPR states: "It remains the policy of the United States to retain some ambiguity regarding the precise circumstances that might lead to a U.S. nuclear response."[62]

Ambiguity may help deter adversaries from actions less extreme than nuclear attack. It also spares presidents from making commitments based on hypothetical scenarios and preserves the flexibility to act based on the real-world situation at the time. Further, ambiguity can help alleviate allies' fears that the United States might abandon them when they are under attack, or that Washington might entangle them in conflicts of its making.

Nevertheless, the ambiguity of "vital interests" or "extreme circumstances" paired with perceptions that the United States seeks offensive and defensive capabilities to preemptively attack adversary nuclear forces could make leaders and military commanders in Russia, China, or North Korea think that the United States would initiate nuclear use more readily than it actually would or should. More likely, Russia and China would use the arguably low declared U.S. threshold for first use to justify building up their countervailing nuclear forces. Either way, the result could make it more difficult to achieve crisis stability or arms control.

NO FIRST USE

In recent years, U.S. policymakers, encouraged by other countries and civil society groups, have considered whether to adopt a policy of no first use (NFU). In its most restrictive form, such a policy would pledge the United States to never use nuclear weapons first in a conflict.[63] One reason for selecting this policy option is to reduce the salience of nuclear weapons nationally and globally.

Some of the most informed and thoughtful advocates of NFU argue that there are "few, if any" scenarios in which U.S. first use would constitute a credible threat.[64] The authors agree with this line of thinking. However, allies, partners, adversaries, and U.S. policymakers understandably will (and should) focus on the word "few." Does it mean that there are indeed some scenarios in which first use of nuclear weapons would be a viable last option for the United States to defeat an adversary's strategic non-nuclear aggression or imminent nuclear attack? If so, what would Washington plan to do in these contingencies if it subscribed to NFU? For example, if North Korea, which has a handful of nuclear weapons that might or might not be able to penetrate U.S. missile defenses, were detected preparing to carry out orders to launch nuclear weapons against U.S. allies or the homeland, should the United States forswear the option of using nuclear weapons first to interdict such an attack if there was no other way to do so? Beyond the North Korean scenario, a few other hypothetical cases are evident, involving Russia and European allies and China and East Asian allies.

Allies are an important audience for U.S. declaratory policy. They are more likely than adversaries to believe U.S. policy statements and plan accordingly. But allies are not uniform. Some may oppose any nuclear weapons use, particularly in and around their countries. Others may see NFU more broadly as a sign of U.S. withdrawal from its historic commitments to alliances. Still others—privately, at least—think NFU would weaken collective deterrence of Russia or China without securing any compromises or guarantees from them in return. Any consideration of declaratory policy change must involve sustained wide-ranging consultations with allies and examination of the significant potential for nuclear detonations occurring on or upwind from allied territory.

A no-first-use declaration without reduction of the weapons that are most tied to first use would be relatively meaningless to Moscow and Beijing.

Perhaps more importantly, Russia and China, like the United States, pay more attention to capabilities than declared intentions. An NFU declaration without reduction of the weapons that are most tied to first use would be relatively meaningless to Moscow and Beijing. Yet the political capital that a president would expend to push NFU through the U.S. system and allied governments would leave little left to overcome traditional resistance to alter the force posture. The single most effective way to reduce destabilizing dynamics among

the United States, Russia, and China, including risks of inadvertent escalation, would be to eliminate the types of weapons that increase predilections to undertake first strikes with or against nuclear forces. Silo-based ballistic missiles, especially those carrying multiple warheads, are prime examples of such first-strike capabilities. The political capital expended to persuade the U.S. system to accept NFU would be wasted if the ICBM force posture remained the same. This is one reason why changes in the U.S. force posture (as discussed in chapter 4) and an alternative formulation for a restrained U.S. declaratory policy are critical components of this assessment.

SOLE PURPOSE

Another alternative is to declare that the "sole purpose" of U.S. nuclear forces is to deter or defeat adversaries' uses of nuclear weapons. This formulation would leave open the possibility of employing nuclear weapons if it were the only way to preempt an imminent nuclear attack by a country like North Korea, for example. But if Russian or Chinese conventional forces were defeating U.S. and allied non-nuclear forces and threatening to inflict massive harm on their populations, then it would be imprudent to rule out proportionate use of nuclear weapons to stop them. Thus, a U.S. administration that adopted sole purpose would need to demonstrate that NATO and U.S. allies and partners in Asia were significantly improving their conventional military capabilities, their resilience, and their overall cooperation and cohesion.

EXISTENTIAL THREAT POLICY

Despite the flaws of alternatives such as NFU and sole purpose, U.S. declaratory policy should not remain the same. It needs to be clarified and made more consistent with international legal commitments made most recently by the Barack Obama and Donald Trump administrations.[65] "If deterrence fails," the 2018 NPR declares, "the initiation and conduct of nuclear operations would adhere to the law of armed conflict."[66] The threshold of "extreme circumstances" posited in the 2010 and 2018 NPRs is too ill-defined to adhere to the law of armed conflict.

We recommend that the United States should declare an existential threat policy (ETP). With this policy, the United States would consider the use of nuclear weapons "only when no viable alternative exists to stop an existential attack against the United States, its allies, or partners." This formulation further defines "extreme circumstances" and "vital interests," clarifying the magnitude of danger that would make it justifiable to counter with nuclear weapons.

Some ambiguity remains unavoidable—in this case, regarding what constitutes an existential attack. However, ETP would bring U.S. policy more in line with the law of armed conflict and demonstrate a more realistically restrained approach to the conduct of nuclear deterrence and war. This declared restraint could improve international security by encouraging U.S. and allied publics to deploy and rely on non-nuclear means to defeat all-but-existential threats.[67]

To clarify this thinking within the limits of a broad declaratory policy, the phrase "no viable alternative" is central to the concept, because the **law of armed conflict requires that nuclear weapons employment must be necessary to defeat a given threat. If less destructive alternatives, such as conventional strike capabilities, are available, then they must be pursued first.[68] Such an approach is prudent given the risks of escalation following any actor's use of nuclear weapons.** If there is no viable alternative, then the president and his or her advisers should be expected to prudently weigh political objectives they hope to achieve and choose a nuclear or non-nuclear attack accordingly.

The prudential threshold for nuclear use should be an aggression that threatens the existence—the viable functioning—of the United States or its allies or partners. No one, including the United States, would be wise and justified to use nuclear weapons in response to an injury that is less grave than a potential nuclear war. Obviously, nuclear attack on populations meets this criterion, as would a genocidal non-nuclear aggression. Other existential thresholds are harder to define. Any threat deemed existential obviously would meet the more ambiguous criterion of "extreme circumstances," but lesser threats could too. Whatever criterion is used, it should involve threats that are proportionate to the existential risks of nuclear war.

A conventional occupation would be a complicated case. States have often survived such occupations, even by murderous regimes. In the most extreme example, Poland persisted as a state despite Nazi occupation in World War II and the loss of 15 to 17 percent of its 1939 population.[69] If France or Poland had possessed nuclear weapons in 1939 or 1940, it is likely that a non-nuclear Germany would not have invaded either country. But if Adolf Hitler also had nuclear weapons, the probability of a German invasion would have been higher. And if a nuclear-armed Germany had invaded France or Poland, their decisionmakers would have faced excruciating choices. Depending on the number and yields of weapons in their possession, any initiator of nuclear use could have invited escalatory exchanges that could have left the victims of the initial aggression and Germany worse off than they were at the end of the war in 1945.

The Trump administration's 2018 NPR highlighted the possibility of "significant non-nuclear strategic attacks" that could cause the United States to "not a priori rule out" using nuclear weapons.[70] The administration provided some illustrative examples of such attacks,

without clarifying a threshold of damage that must be met for the United States to consider a nuclear response. Well-connected observers suggest that a massively disruptive cyber attack on critical civilian infrastructure could meet the standard.[71] Yet, cyber attacks are strategically attractive to adversaries and to the United States in part because they do not necessarily cause destruction or even irreversible damage, let alone widespread death.

To give a potential scenario, consider a cyber attack that was able to shut down the U.S. (and therefore international) economy on a scale commensurate to the economic damage wrought by the coronavirus pandemic. If the United States could with 99.9 percent certainty attribute the cyber attack to the Kremlin, would it be legally and strategically justified in responding to the attack by ordering a nuclear strike against Russia? What if China or North Korea were the villain in the same scenario? Nuclear retaliation would not stop the cyber attack or undo its damage, but it could trigger more death and destruction among belligerent and nonbelligerent nations alike. Even the threat to use a nuclear response to such a cyber attack against civilian infrastructure—one that did not cause damage commensurate with that caused by nuclear weapons—could "normalize" other states' or nonstate actors' use of nuclear weapons, including in response to U.S. cyber operations. Blurring cyber and nuclear thresholds also could encourage some states or nonstate actors to conduct "false flag" cyber attacks—for instance, by using leaked U.S., Russian, or Chinese malware—to catalyze conflict between the United States and Russia or the United States and China.

Would a non-nuclear attack that removed a government's leadership pose an existential threat warranting nuclear retaliation? Intuitively, many would say "yes." Certainly, leaders of nondemocratic governments who equate themselves with their state would. For that matter, if those leaders unleashed nuclear weapons to defeat such an attack, the United States and other victims of this nuclear action could be justified in using nuclear weapons in response. But law and common sense argue that nuclear use should be predicated on the *scale of violence and destruction* inflicted by an adversary, not merely on the "damage" to one's own government.

Threats that do not harm societies on a scale proportionate to the destruction caused by even a limited nuclear war should be countered by non-nuclear means, even if procuring such means would be more costly than acquiring additional (or different) nuclear weapons.

Threats that do not harm societies on a scale proportionate to the destruction caused by even a limited nuclear war should be countered by non-nuclear means, even if procuring such means would be more costly than acquiring additional (or different) nuclear weapons. To try to invoke nuclear threats to deter such attacks amounts to a bluff and a moral hazard, insofar as belief in the power of nuclear deterrence could lead governments to avoid spending on more usable defensive capabilities. A society whose government was removed or whose constitution was subverted without massive destruction of

life and property could survive and reform itself more readily than one whose population, resources, and infrastructure were decimated by nuclear war.

However, ETP should make clear that nuclear or extensive non-nuclear attacks on U.S. NC3 assets (on land or in space) could open the way for U.S. leaders to consider nuclear use. The judgment would depend crucially on whether the attacker was perceived to have the intention and capability to inflict further destruction on the United States and/or allies of a scale warranting nuclear response.

Critics may claim that ETP would invite Russia or China to act maliciously up to this declared nuclear threshold, which is higher than "extreme circumstances." The prudent response here is to enhance non-nuclear defenses and NC3 rather than to expand the role of nuclear weapons, especially with the risks that regional conflicts could escalate inadvertently to nuclear war.

Of course, bolstering U.S. capabilities, whether nuclear or non-nuclear, often prompts alarm and countervailing reactions in Russia and China. To forestall these reactions and build international support for its position, U.S. declaratory policy should make clear its willingness to negotiate arms control and disarmament arrangements that enhance stability for all concerned. Chapter 6 explores this arms control challenge in greater detail.

Ultimately, if the United States wishes to retain or restore its international leadership in a global nuclear order, its declaratory policy should be one that Americans and others would find (relatively) acceptable if other states adopted it. If other states adopted an existential threat threshold, the United States and the international community would judge this to be more acceptable than a lower threshold would be.

THE LAW OF ARMED CONFLICT

Recent administrations have clearly declared that the United States would conduct all nuclear operations in accord with the law of armed conflict, but have not elaborated why or how they would do so. These important issues require further discussion.

Legal considerations affect decisions regarding the instances when it would be legal and appropriate to employ nuclear weapons during a conflict, targets against which nuclear weapons may be employed, and the types of nuclear weapons to be used. The law of armed conflict is primarily intended to protect civilians from the conduct of war between states. Such considerations date from the Hague and Geneva Conventions (1899 and 1904, and 1929 and 1949, respectively). This body of law has evolved positively since World War II, even as it has been frequently breached—and not only by states known for their disregard of international law. American military and civilian leaders have recognized the importance of such laws and devoted considerable attention to inculcating them throughout the armed

forces, including in U.S. nuclear planning.[72] Among other considerations, the morale of U.S. personnel who would be asked to conduct nuclear operations requires confidence that they would be asked only to carry out legal orders grounded in international humanitarian principles.

Legal considerations also should inform the yields and targets of nuclear weapons, as well as their numbers. In principle, yields should be no greater than that necessary to destroy a legitimate target. To the extent that using high-yield weapons on a target produces civilian casualties and environmental harm (including fire and radioactivity) in excess of what a lower-yield weapon would have produced, it is extremely difficult to say how the users of those weapons would comport with the law of armed conflict. Further, if the total number of weapons in an arsenal is so large that their detonation would cause global environmental, agriculture, and refugee crises of catastrophic dimensions, how could their use ever be justified as necessary and proportionate?

In practice, the United States and other nuclear-armed states deploy weapons of various vintages and technical capabilities. Most U.S. and Russian warheads, for example, were designed (and in the case of the United States, built) decades ago and have enormous destructive power to compensate for the relatively inaccurate delivery systems on which they originally were deployed. (High-yield warheads can destroy targets even when the weapons themselves do not precisely reach the desired aimpoint.) To replace now-overly destructive warheads with lower-yield but more precise ones would take some time and entail moderate costs. Critics would allege (fairly or not) that such technical changes amount to arms racing and planning for nuclear warfighting. Nevertheless, international law, environmental considerations, and common sense reinforce the basic principle that nuclear arsenals should include weapons with the lowest yields necessary to destroy legitimate targets.

Importantly, **an arsenal and related policies that would be more likely to comport with the law of armed conflict could provide more credible and therefore more effective deterrence.** A state that has worked through and publicly articulated why and how its declaratory policy is legal under the law of armed conflict presumably would be less self-deterred and its deterrent threats would therefore be more credible. This added credibility could inform adversary deliberations in deciding whether to escalate a conflict up to and including nuclear exchanges.

Several, perhaps contradictory, concerns arise from applying the law of armed conflict to the conduct of nuclear operations. Some argue reasonably that any use of nuclear weapons likely would lead to escalation in which the law of armed conflict would be violated. Thus, the established norm should be that any use of nuclear weapons would be illegal, which would help self-deter some actors. Paradoxically, however, such prohibitions could free other leaders and their populations from the progressive restraints that international law is designed to impose on the conduct of war. They could simply conclude that international

law is irrelevant when it comes to situations as dire as nuclear war. This would be especially troubling to the United States and the United Kingdom, which have publicly committed to apply the law of armed conflict to their nuclear conduct. Rather than remove the restraint of law, civilization would benefit from persuading states to apply it and explain how they would do so. That said, the deterring potential of less restrained, illegal use of nuclear weapons would remain a material reality; the point is for governments to indicate in word and deed that they understand the reasons for restraints and to demonstrate as much as possible that they will uphold them.

To prevent the moral and strategic hazard of false adherence to the law of armed conflict, the United States and others, including nongovernmental organizations, should encourage further transparent international analysis and debate of these issues involving all nuclear-armed states.

The contrary argument is that any state that believes in the legal use of nuclear weapons will be more likely to unleash these weapons. This is related to the concern that states would be more likely to use "low-yield" weapons against legal military targets than they would be to use more destructive high-yield weapons. Their adversaries could then fear such use and be more inclined to preempt it with their own nuclear weapons. However, these adversaries—like U.S. leaders—should be expected to consider many factors beyond weapon yields in deciding when and how to use their nuclear weapons. In any case, the benefits of ignoring the restraining imperatives of international law are not likely to be greater than the risks of abiding by these imperatives, including the imperatives of proportionality and discrimination.

Instead of these concerns, the more likely risk is that states would profess to apply the law of armed conflict but would not change their nuclear forces and targeting doctrines to make them more consistent with this body of law. For example, states that plan to deliver high-yield weapons against targets in cities may be reluctant to reduce yields or change targets, especially as neither type of change is verifiable by outsiders. To prevent the moral and strategic hazard of false adherence to the law of armed conflict, the United States and others, including nongovernmental organizations, should encourage further transparent international analysis and debate of these issues involving all nuclear-armed states. Such analysis and debate should extend to whether and how states conducting nuclear war should be held accountable for the consequences, which would vary depending on weapon yields and targets.

This leads to the issue of positive security assurances. In 1995, the five permanent members of the United Nations (UN) Security Council, or P5, specifically committed to direct Security Council action if any NPT party is threatened with nuclear weapons, to "include efforts to settle the dispute and restore international peace and security as well as provision of technical, medical, scientific or humanitarian aid and compensation from the aggressor

for loss, damage or injury from the attack."[73] In 1995, the P5 adopted this commitment in UN Security Council Resolution 984 to persuade non-nuclear-weapon states to agree to an indefinite extension of the NPT. This positive security assurance reflects nuclear-weapon states' responsibility for the unintended consequences of nuclear use, and possibly for assisting unwitting victims of a nuclear conflict.

However, since the passage of Resolution 984, little effort has been made to develop contingency plans or other demonstrations of commitments to uphold its letter and spirit. Official records and the security studies literature show scant evidence that any nuclear-armed states have planned and developed capabilities to conduct such preventive interventions in conflicts to which they are not otherwise a party. Nor have nuclear-armed states said anything about compensation for any loss, damage, or injury that belligerent or nonbelligerent nations might suffer from nuclear war. Many of the roughly 150 states that do not rely on nuclear deterrence—directly or through extension from allies—find this state of affairs deeply unjust.[74] This lack of action has heightened their antipathy toward nuclear-weapon states and made them more likely to support the Treaty on the Prohibition of Nuclear Weapons, which has clear provisions for assisting victims of nuclear attack.

The recent tradition of "P5 solidarity" on such issues has achieved little of value. If Russia, China, or other states are unwilling to clarify commitments they made to non-nuclear-weapon states in 1995, it is in U.S. interests to expose their reticence. All nuclear-weapon states bear responsibility to address the very real potential costs of nuclear use.

The United States should propose that the P5 declare, as the United States and the United Kingdom do, that they would adhere to the law of armed conflict when conducting nuclear operations. If the other members of this group—the five nuclear-weapon states under the NPT—refuse to do so, the international community deserves to know why.

The United States should also continue its 2018 NPR negative security assurance: the United States "will not use or threaten to use nuclear weapons against non-nuclear weapons states that are party to the NPT and in compliance with their nuclear non-proliferation obligations."

The United States should affirm its willingness to offer a positive security assurance to protect and marshal assistance to non-nuclear-armed states that are nonbelligerents in any conceivable scenario in which U.S. nuclear use may occur.

CHAPTER 3

EMPLOYMENT GUIDANCE AND DAMAGE REDUCTION

For deterrence to be credible, the United States must have policies, forces, and operational plans to employ nuclear weapons in ways that would most plausibly meet its objectives in the event that deterrence failed and an adversary undertook military actions that could not be stopped by non-nuclear means. Adversary use of nuclear weapons poses the clearest such existential threat.

The United States and Russia have long searched for capabilities and plans to bolster their conventional and, now, cyber and other non-nuclear capabilities to defeat conventional aggression. They have also considered limited ways in which to utilize nuclear weapons to compel the adversary to terminate conflict on tolerable terms. And, to reinforce this compellence and to deter the adversary from escalating further, both superpowers have searched for ways to destroy (or degrade) as much as possible the adversary's capacity to retaliate.

In the United States, the interest in winning (or at least not losing) potential escalatory war led to the concept and planned practice of counterforce "damage-limitation."[75] Damage-limitation is meant to deter by threatening counterforce strikes and missile and air-defense operations to deny the adversary's capability to win. This concept is distinguished from the more widely practiced and understood concept of "deterrence by punishment."

During the Cold War, nuclear strikes were the primary planned means of conducting counterforce operations. In recent years, precision conventional strike systems, perhaps paired with cyber operations and ballistic missile defenses, could complement or supplement nuclear strikes on Russian, Chinese, or North Korean nuclear forces. Non-nuclear

damage-limiting attacks would be less destructive to the environment and human populations than nuclear strikes would be. Although the United States hopes that such capabilities will strengthen deterrence, they also could be destabilizing. The prospect of non-nuclear U.S. counterforce strikes could drive Russian or Chinese leaders to increase the number and survivability of their forces in ways that could make escalation—inadvertent or purposeful—more likely. This prospect also could drive the North Korean leadership to launch nuclear weapons early in a conflict for fear that United States and Republic of Korea forces otherwise would soon destroy them.

Prudence requires the pursuit of alternative ways to reduce damage beyond preemptive nuclear strikes.

The quest for damage-limiting capabilities and plans is natural for people whose jobs are to deter war by being able to win it.[76] So long as the United States and Russia have had the financial and technical resources to develop and deploy new potentially winning weapons systems, they have been tempted to do so. Arms control agreements have constrained such competition to some extent, but the temptation remains. Yet when American political leaders have learned about these war-fighting or "damage-limitation" strategies, they have found them untenable at best and extremely dangerous at worst, although they often have been unable to change them significantly.[77] The probability is too high that Russian and (less so) Chinese nuclear weapons would survive in numbers sufficient to devastate the United States. This conclusion reinforces mutual deterrence of nuclear use and the general value of arms control to constrain (if not lower) the costs and instability of nuclear competition.

Even if it were feasible for the United States to destroy so much of Russia's nuclear arsenal that Russia would be unable to devastate the United States in response, large-scale U.S. (or Russian) nuclear counterforce attacks themselves could cause fires sufficient to produce climatic effects dubbed "nuclear winter," along with widespread radioactive fallout.[78] The resultant loss of agricultural productivity could severely harm the United States and the rest of the world for years at minimum. For reasons that deserve further investigation, it is doubtful that U.S. nuclear planners (along with Congress, among others) have factored such damage into policy analyses and deliberations. This omission is noteworthy as advances in computing power and climate modeling have made such studies more insightful.[79] (Chapter 6 presents a clear argument for the United States and others to conduct new studies on probable climatic effects of various nuclear war scenarios.)

Prudence requires the pursuit of alternative ways to reduce damage beyond preemptive nuclear strikes. If the effects of successful damage-limiting strikes against adversary forces would *themselves* be catastrophic—to the food chain, to nonbelligerent third countries, to other global common goods, and in terms of humanitarian law—then alternatives would

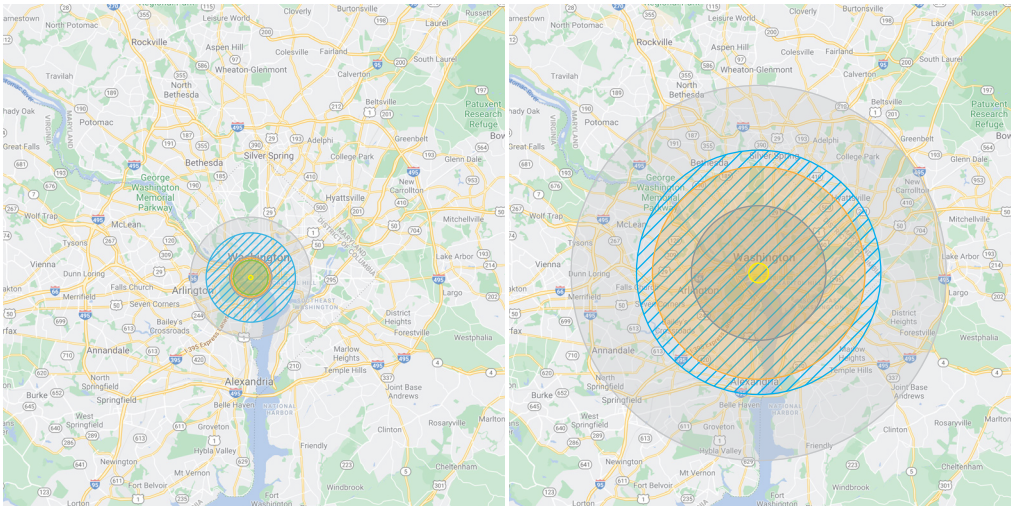
be in everyone's interest (consider the effects of low- and high-yield nuclear detonations as illustrated in figure 2). Moreover, if use of conventional or cyber weapons to kill hardened targets such as nuclear weapons and command and control systems would be likely to exacerbate crisis instability and escalatory pressures, the planned conduct of preemptive attacks on Russia's or China's core strategic deterrents should be reconsidered. This would be consistent with the philosophy expressed in the 2013 Department of Defense report to Congress on the U.S. nuclear employment strategy: "[the] United States seeks to improve strategic stability by demonstrating that it is not our intent to negate Russia's strategic nuclear deterrent, or to destabilize the strategic military relationship with Russia."[80] U.S. and international security will be best served by applying the same guidance to China.

U.S. planners should explore how variations in numbers, explosive yields, targets, and weather conditions would reduce the immediate and indirect harm to civilians and the environment. Such exploration should specifically consider shifting away from preemptive nuclear attacks on hardened Russian and Chinese strategic nuclear weapons and command and control facilities. (Negotiating reductions in U.S. and Russian silo-based missiles and warheads is another way to pursue damage-limitation, as discussed in chapter 6.) In eschewing or greatly diminishing plans to attack hardened nuclear targets, planners would focus instead on the other targets in current war plans. These legally vetted targets are supposed to represent what adversary leaders hold most dear. By not concentrating on preemptively attacking hardened nuclear force and command and control targets, the United States would reduce pressures on its own leadership and those of Russia and China to escalate from regional nuclear exchanges to all-out nuclear war.

Some will argue that a U.S. nuclear posture designed around lower yields would increase the chance that in a regional conflict the United States would choose to escalate from conventional to nuclear forces. They contend that the lower yield would reduce a president's inhibitions. Even though this position could help deter adversaries (with the thought that a president could plausibly use these weapons), it also could make adversaries conclude they would fare better by using nuclear weapons before the United States strikes them. This prospect could alarm allies and partners, which could then raise questions about alliance resolve. Russia and China could be tempted to make provocative moves to test (or demonstrate) whether U.S. alliances will crack over fears of U.S. nuclear use and ensuing escalation.

These paradoxes probably are inescapable so long as nuclear weapons exist. However, it bears emphasis that even low-yield nuclear weapons are breathtakingly destructive. For instance, the 5–7 kiloton (kt) "low-yield" warhead recently deployed on twenty Trident D5 SLBMs would be ten times more powerful than estimates of the chemical blast that destroyed the port of Beirut in August 2020. If low-yield weapons were used, the risks of escalation would still be grave even if the upper bounds of destruction in the first phase of nuclear war were significantly reduced.

Figure 2: Comparing the Destructive Effects of Low- and High-Yield Nuclear Weapons



Low-Yield Firestorm
HIROSHIMA-SIZE 15 KT WEAPON

- **Fireball radius:** 120 m (0.04 km²)
- **Radiation radius (500 rem):** 0.97 km (2.97 km²)
- **Thermal radiation radius (3rd degree burns):** 1.11 km (3.84 km²)
- **Moderate blast damage radius (5 psi):** 1.2 km (4.54 km²)
- **Light blast damage radius (1psi):** 3.38 km (35.9 km²)
- **Potential mass fires radius:** 2 km

High-Yield Firestorm
STANDARD RUSSIAN 550 KT WEAPON

- **Fireball radius:** 0.71 km (1.56 km²)
- **Moderate blast damage radius (5 psi):** 5.41 km (91.9 km²)
- **Thermal radiation radius (3rd degree burns):** 8.62 km (233 km²)
- **Light blast damage radius (1psi):** 15.2 km (726 km²)
- **Potential mass fires radius:** 9.65 km

Note: Some studies on the effects of nuclear explosions include estimations of damage and deaths from mass fires—also a key contributor to long-lasting, disastrous nuclear winter effects. Although such estimates are necessarily highly speculative, the potential extent of fires for these two scenarios have been included to more fully represent the potential damage of a nuclear attack.

Sources: Alex Wellerstein, "NUKEMAP," Nuclear Secrecy, https://nuclearsecrecy.com/nukemap/; M. Anjali Sastry, Joseph J. Romm, and Kosta Tsipis, "Nuclear Crash: The U.S. Economy After Small Nuclear Attacks," Program in Science and Technology for International Security, June 1987, https://apps.dtic.mil/dtic/tr/fulltext/u2/a359603.pdf; Frank N. von Hippel, Barbara G. Levi, Theodore A. Postol, and William H. Daugherty, "Civilian Casualties From Counterforce Attacks," *Scientific American* 259, no. 3 (September 1988), https://sgs.princeton.edu/sites/default/files/2019-10/vonhippel-1988.pdf.

Incoming presidents often have been relatively unversed in the effects of nuclear detonations, targeting, and doctrine and operational plans.[81] **A new president and his or her civilian advisers should be briefed early in their term on the list of targets, and the damage calculations used to determine civilian casualties and overall damage, including through environmental effects.**

The military officers and civilians who provide this briefing should be required to give the president alternative plans focused on minimizing the level of overall destruction while meeting targeting requirements at lower levels of certainty. These plans should include the use of lower yield, conventional, and other non-nuclear weapons, and should explain how the usage of less-destructive weapons changes the likelihood of destroying targets and may reduce climatic and humanitarian consequences. The fidelity of this briefing should be such that a president and his or her advisers can issue detailed guidance on the employment of nuclear weapons early in an administration, to facilitate a nuclear posture or other strategy review.

U.S. LAUNCH STRATEGY

The United States maintains an ability to launch its ICBMs quickly after detecting an incoming attack. This LUA (launch under attack) option exists because of the vulnerabilities of NC3 and silo-based ICBMs.

Russia maintains the only nuclear force theoretically capable of a disarming first strike against the United States. Russian ICBMs are maintained on alert, and Russia's large number of deployed warheads means there are enough weapons to attack U.S. silos, air and naval bases, and other leadership or command and control targets. The LUA option (in addition to second-strike forces) is intended to deter any rational Russian leader from attempting a first strike, knowing that U.S. ICBMs will be rapidly launched to avoid destruction, preventing any potential gains from a surprise attack. The less vulnerable U.S. nuclear-armed submarine and aircraft fleets further bolster deterrence.[82]

Under LUA, an important objective is to enable a president to make and communicate a retaliatory launch decision before his or her weapons or NC3 networks are destroyed, or before he or she could be incapacitated by an incoming attack. By some estimates, the president would have approximately eight minutes from the time of being notified that an attack is incoming to decide to launch U.S. ICBMs before they could be destroyed.[83] Before this

decision could be made, the incoming attack would need to be identified, assessed as real (based on two separate ground-based and space-based sensors that rely on different physical principles), and analyzed. Then military leaders must present a series of response options for the president to consider as the eight-minute clock begins.[84]

The time pressure under LUA causes two risks: that the United States would (1) conduct nuclear retaliation based on false warning, and thereby escalate a nuclear war mistakenly; or (2) risk launching an unintentionally disproportionate and escalatory counterattack because the incoming attack was not accurately assessed.[85]

The possibility of false warning is not hypothetical. Internal failures in the U.S. command and control systems generated a false warning in 1978, and at least on two other occasions.[86] Soviet (later Russian) early warning systems generated false alarms in 1983 and 1995 that too easily could have led to mistaken launches.[87] Of course, any retaliation based on false warning would be an unmitigated disaster and could lead to further purposeful adversary escalation.

Opting for LUA also may commit the United States to an inflexible response in a potential war with Russia. In order to make LUA effective, military planners have developed preplanned options that vary in numbers and targets. However, these established options would not be particularly responsive to the specific scenario which unfolds. Since ICBMs are not recallable, any LUA attack plan option involving ICBMs could risk launching a disproportionate, ill-configured response leading to unwanted escalation.

Emerging trends increase these risks.[88] Notably, the potential for non-nuclear cyber and/or kinetic attacks against NC3-related assets could reduce the information available to the president. This could exacerbate the risk of either failing to respond to a real attack or responding mistakenly to a false warning. Counter-NC3 attacks could also increase the chance of a disproportionate, escalatory response based on false information. Hence, efforts to strengthen U.S. command, control and communication systems should receive top priority and full resources.

Ultimately, the problem that LUA attempts to solve—a massive incoming Russian attack that could knock out U.S. command and control and/or nuclear forces before they can be launched—is increasingly less likely (and was never likely in the first place).[89] During a growing crisis or regional conflict, U.S. intelligence and surveillance capabilities, including its early warning system, should readily detect an adversary's *preparations* to conduct a disarming attack. U.S. air and sea-based forces would be dispersed to preserve a still potent deterrent. Technical threats to U.S. space-based intelligence, surveillance, and reconnaissance (ISR) and early warning systems are increasing, but this adds to the imperative to improve the resiliency of these systems, as USSTRATCOM should be doing today.[90] LUA is not the solution to this problem.

Fortunately, U.S. posture now relies much less on ICBMs than it did when LUA options were first put in place during the Cold War. Most operational warheads are deployed on SSBNs at sea without the risk of decapitation. The shift in recent decades toward a more survivable U.S. strategic deterrent means that LUA makes less sense. Further reductions of silo-based nuclear weapons (recommended in chapters 4 and 6) would extend this positive trend. Possessing a greater number of survivable nuclear forces allows for safer, more reliable launch options.

RECOMMENDATION

Ending any dependence on LUA to deter Russia should be a U.S. priority as part of a general strategy to reduce the probability and potential destructiveness of all-out nuclear war.

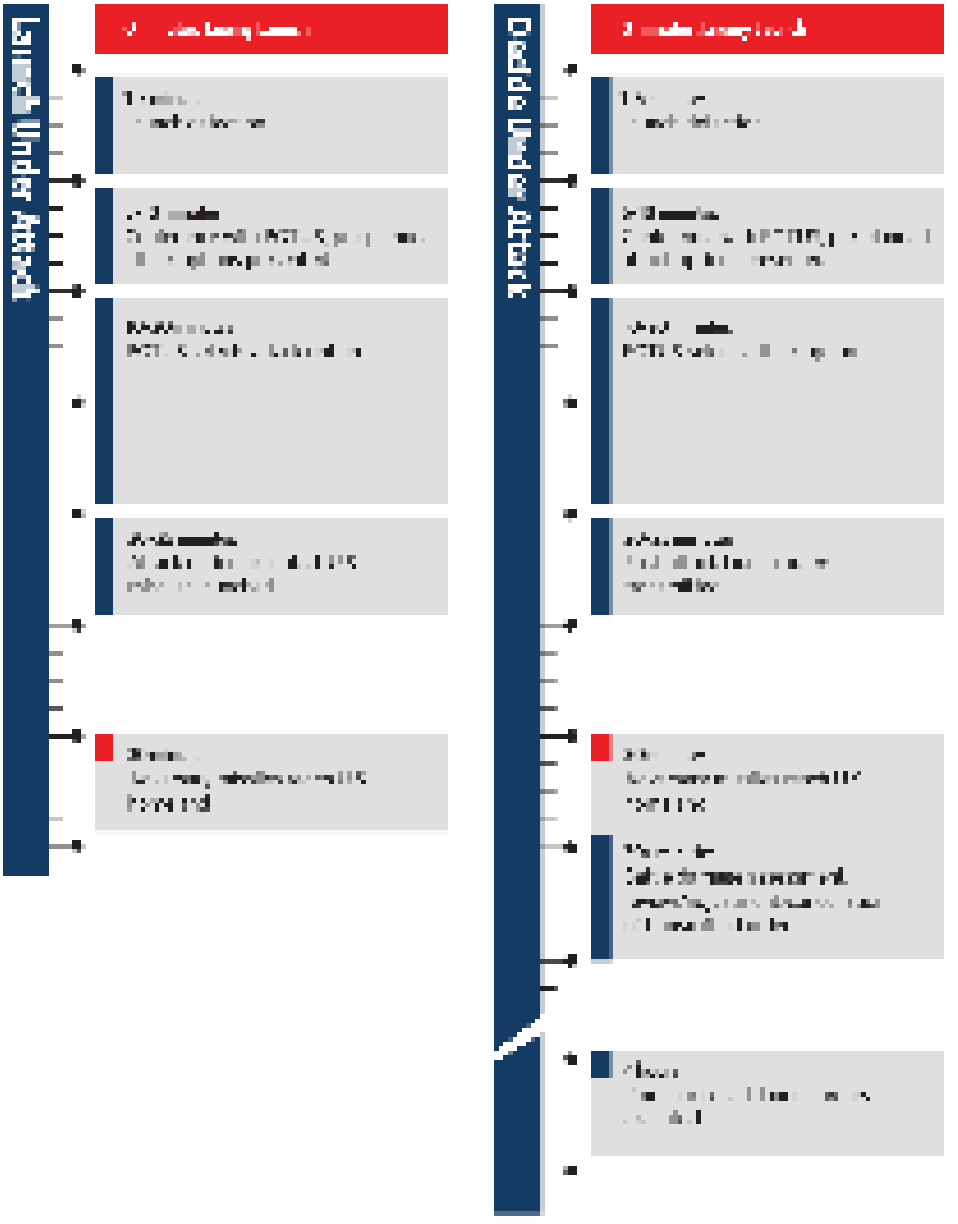
Several options would move the United States in this direction.

> **The most important priority, which must be pursued vigorously, is to strengthen the survivability of command, control, and communication systems.**

If U.S. leaders are confident in the survivability of submarine forces and command and control links to them, they could then exercise the option to verify and assess an attack on vulnerable land-based forces before irreversibly releasing U.S. weapons in response. This could mitigate risks of mistaken warning and assessments of incoming attacks. In the meantime, before U.S. command and control systems are upgraded, the concern would remain that a Russian attack could incapacitate U.S. leadership and command and control systems and put into doubt the United States' capacity to counterattack after withstanding the Russian attack.

To redress this risk, without the hazards of launching ICBMs under attack, former vice chairman of the Joint Chiefs and NORAD commander James Winnefeld has suggested that the United States should develop plans and capabilities to decide under attack (DUA). Unlike the immediate LUA option, with DUA, upon detection of an incoming attack, a president could transmit preplanned orders for U.S. strikes with a time delay on their execution.[91] A several-hour delay in executing the strike would allow cancelation or adjustment, but also allow commanders of forces most likely to escape an adversary's attack—generated bombers and at-sea SSBNs—to carry out orders at the appropriate time. If the detected attack were proven to be false or mistakenly assessed, the president could cancel

Figure 3: Launch Under Attack vs Decide Under Attack



or adjust the preplanned orders. In the event the detected attack were confirmed as correct, surviving nuclear forces could carry out the preplanned retaliation orders. To anticipate the possibility that the president could be incapacitated or unable to communicate to adjust or cancel earlier authorized launch orders, designated successors would need to be "attached" to the NC3 network. To be sure, under wartime conditions there is no guarantee that the president or a successor would survive or be able to cancel or modify a delayed launch order. Under LUA, however, there would be no possibility of doing so regardless of the senior leadership's survival.

The DUA recommendation complements the recommendation to reduce reliance on silo-based ICBMs, discussed in chapters 4 and 6.

The President's "Sole Authority"

The president of the United States has sole authority to employ nuclear weapons. He or she can order the use of nuclear weapons without the concurrence of anyone else. This has recently become the subject of debate and legislation in Washington. The issues involved are vitally important and transcend the character or behavior of any one president. Bipartisan analysis, debate, and policymaking should consider the question of whether to adjust nuclear launch authority. Should any president have the sole authority to employ nuclear weapons, under any circumstance? Are there circumstances in which time and prudence would allow for such decisions to be made in consultation with designated members of the cabinet and Congress, and if so, should this be the policy? Would changes in nuclear posture along the lines considered above—especially a DUA policy—facilitate a shift toward a system of shared authorization?

We recommend that the U.S. Congress create a bipartisan commission including former presidential national security advisers, secretaries of defense, and military leaders to analyze and make recommendations on this set of issues.

CHAPTER 4

NUCLEAR FORCE POSTURE AND NUCLEAR COMMAND, CONTROL, AND COMMUNICATIONS

The best nuclear force would be one that is:

- credible enough to deter adversaries and reassure allies and partners;
- least likely to provoke escalation if deterrence fails but could survive adversary escalation if it occurred; and
- would not cause more destruction than necessary to meet wartime objectives.

Such a force is hard to design in theory and harder to maintain in practice. Nuclear weapons systems take years to fund, design, develop, produce, and deploy. Once they are deployed, they are expected to remain in the arsenal for decades unless they are eliminated through arms reductions or obsolescence. The longevity of the arsenal may impede its adaptability to changing global security dynamics.

And so, the triad. For five decades, the United States has had a triad of nuclear weapon delivery systems, based on sea, air, and land. This arrangement developed through competition between the Air Force and the Navy for a share of the nuclear mission, and the evolution of available delivery technologies thereafter.[92] Only after the triad was in place did strategists and officials enshrine its virtues.[93] It gradually became sacrosanct and vital to the Air Force, the Navy, the eleven states that host triad delivery systems, and the many

other states and enterprises that produce these systems. Alongside it, an NC3 system was designed to survive the stresses of nuclear conflict.

In 2021, the executive and legislative branches will continue to debate whether and how to pay for, produce, and deploy delivery platforms and warheads. The current plan started with a commitment from the Obama administration in 2009 to "modernize or replace" the strategic triad and its constituent delivery platforms and warheads nearing the end of their operational lives. Since then, the services have mostly proposed plans to replace old systems with new ones, rather than modernize extant systems. These plans include the development of new nuclear warheads to be deployed on new delivery platforms in the next two decades.[94]

In order to evaluate these plans, this chapter proceeds through each component (sea, air, and land) of the triad, analyzing arguments for and against changes that have been proposed within each category. It then offers recommendations and closes by discussing NC3 and offering principles to guide its modernization effort.

Summary of main force structure recommendations:

- **Continue the B-21 Raider, LRSO (Long-Range Standoff weapon), B61-12, and Columbia SSBN programs, and maintain the current B61 posture in Europe.**
- **Extend the life of the Minuteman III ICBM and seek bilateral reductions with Russia in ICBM forces before further development of a replacement ICBM.**
- **Cancel the nuclear-armed sea-launched cruise missile (SLCM-N).**
- **Maintain the low-yield version of the Trident SLBM pending answers to questions detailed below.**

AIR

Bombers

Strategic bombers are well suited for the types of nuclear crises the United States is likely to face—emanating from major conventional war in Europe or Northeast Asia. These bombers provide visibility, flexible attack trajectories, and multiple long-range conventional and nuclear employment capabilities suited to modern deterrence requirements. (Bombers are the only triad leg to provide substantial conventional capabilities.) The new B-21 Raider will provide a stealthy, modernized replacement for conventional B-1B bombers and a small, expensive fleet of stealth B-2s built in the 1990s, complementing the aging fleet of B-52s that dates from the 1960s. (The B-52s will undergo a modernization in the near future to extend their life until 2050.[95])

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The ability to flexibly deploy bombers is important for allied assurance.[96] Aircraft are the politically visible representation of the U.S. nuclear arsenal (even when stealthy in flight). Indeed, the United States has extensively used nuclear-capable bombers in peacetime extended deterrence signaling through bomber assurance and deterrence (BAAD) missions flying over or traveling near allied territory.

Bombers have some downsides. First, their effectiveness may be degraded by adversaries' improving air defenses. The United States has long recognized that the B-52H will have to operate as a standoff weapon and employ long-distance cruise missiles. However, the B-2s retain substantial capabilities to reach targets deep in adversary territory. A key unanswered question is how U.S. nuclear, conventional, cyber, or other nonkinetic operations could be used to reduce the potential of an adversary's air defenses such that U.S. bombers would be effective. Attacks to suppress enemy air defenses (SEAD operations) may themselves be escalatory if their physical destructiveness were extensive.

Second, bombers are not on day-to-day alert with weapons deployed. Thus, they are theoretically vulnerable to surprise attack before being prepared for nuclear operations. Some experts argue therefore that bombers should not count as part of the deployed strategic deterrent. However, it is practically inconceivable that the U.S. homeland would face a strategic attack from Russia, China, or North Korea in peacetime with such short warning that the bomber force could not be made ready for quick mobilization and dispersal. Instead, the potential need to conduct nuclear strikes would arise from crises and, more likely, major armed conflict in which the bomber force would already be at least in heightened readiness. Bombers, when alert and conducting operations, are less susceptible to surprise attack.

The B-21 Raider should be fully funded for the currently requested fleet of 100 aircraft.

Given the B-21's conventional capabilities, it is possible the Air Force will increase the number of B-21 bombers it requests. The commander of the Air Force Global Strike Command, which manages the nuclear and conventional long-range strike missions for U.S. bombers, has stated his interest in growing the bomber force for conventional missions.[97] To satisfy the nuclear mission, there is no need to increase the current request for 100 aircraft—34 more than the current number of nuclear-capable bombers in the U.S. Air Force—which will be certified for nuclear operations within two years of deployment.[98]

One concern of some analysts is that adversaries would be unable to discern whether B-21 bombers threatening them were carrying conventional or nuclear weapons. This concern can be addressed by basing nuclear bombers separate from conventional ones and utilizing well-known arms control, transparency, and confidence-building procedures to confirm that conventional bombers are indeed being sequestered from nuclear operations. As the United States continues to pursue dual-capable bombers, it is in its interests to be unambiguous to Russia, China, and North Korea regarding bomber operations in peacetime and especially during crises.

If concerns grow that B-21s could be preemptively destroyed by nuclear or conventional attack against air bases, creative basing arrangements should be the priority. At one time, the Strategic Air Command operated nuclear-capable bombers from dozens of bases in the continental United States and abroad.[99] Although this number shrank at the end of the Cold War, the U.S. Air Force could explore the feasibility of operating B-21s in rare contingencies from more bases, with a capability to deploy to them rapidly if needed. This could be a way to increase the current target set of three strategic bomber air bases to complicate an adversary's first strike planning.[100]

LRSO

The United States has maintained an air-deliverable nuclear-armed cruise missile for decades. The planned LRSO will replace the current AGM-86B air-launched cruise missile (ALCM), which dates from the 1980s. The LRSO is designed to preserve the standoff capabilities of the entire nuclear bomber force, including legacy B-52H bombers. It will provide a stealthy means to penetrate air defenses. When bombers are generated for nuclear operations, the share of survivable weapons increases.

Some analysts have expressed concern that if a conventional variant of LRSO were fielded simultaneously with a nuclear version, its use would be destabilizing.[101] An adversary—Russia or China—detecting a bomber would not be able to discern whether it is carrying nuclear-armed or conventional cruise missiles. Russian or Chinese officials could then be tempted to assume the former and be more likely to unleash their own nuclear weapons. For now, official U.S. government sources plan for this weapon to be exclusively nuclear. The fiscal year 2020 National Defense Authorization Act repealed a prior congressional requirement for the Air Force to develop a conventional variant.[102]

As with the current nuclear air-launched cruise missiles, it is possible that Russia or China could mistake the radar signature of the future conventionally armed long-range air-launched JASSM-XR (Joint Air-to-Surface Standoff Missile–Extreme Range) cruise missile for that of a nuclear-armed LRSO. The United States has used such conventional cruise missiles numerous times in other conflicts in recent decades without triggering alarm in Russia or China. Of course, in a direct conflict with Russia or China, their militaries could mistake an incoming U.S. conventional long-range cruise missile for a nuclear-armed ALCM. However, given the JASSM and LRSO's stealth capabilities, any ambiguity likely would derive from the use of bombers (particularly B-52s) that can and perhaps would carry nuclear weapons as well as conventional ones. Beyond avoiding war in the first place, this problem needs to be managed by direct military-to-military communication, arms control transparency measures to distinguish nuclear-capable from non-nuclear bombers, and bomber preparation ("generation") as means to signal U.S. intentions. Chapter 6 covers these issues in greater detail.

The LRSO should be fully funded as an exclusively nuclear-armed weapon (as is the ALCM it would replace).

B61 Bomb

The B61 has two roles—a gravity bomb delivered by B-52H and B-2A bombers based in the United States, and a forward-based weapon for NATO dual-capable aircraft (DCA). A program is underway to improve the bomb's capabilities, including accuracy and earth penetration, and consolidate most of its various forms into one type, the Mod 12. (One variant, the B61 Mod 11, a specialized earth-penetrating gravity bomb, will remain in service.) The B61 has a variable yield, including low-yield options.[103]

Within NATO, the main argument for keeping B61s is that they embody the alliance's commitment to maintain nuclear deterrence. Indeed, the B61 is the only nuclear weapon under NATO's nuclear-sharing arrangement. Any move to remove B61s could disrupt NATO

unity and hearten Moscow. B61s are most controversial in Germany, where a domestic political debate has erupted over the continued presence of U.S. nuclear weapons in the country, triggered by Germany's April 2020 decision to replace its aging DCA.[104] NATO Secretary General Jens Stoltenberg has argued that the B61s should be maintained in the current basing locations and has sought to keep the NATO consensus on nuclear sharing.[105]

Other experts question the military utility of the B61. The forward-based weapons and DCA are based in five well-known locations, demated from nonalert aircraft. This arrangement leaves them vulnerable to attack—especially by short- or intermediate-range missiles from Kaliningrad or near the Eastern European border—if they have not been alerted and readied for use. It also may be difficult to deliver weapons to target against modern Russian air defenses. The NATO DCA mission is currently fulfilled by F-16s and PA-200s (Panavia Tornados), which were built in the 1970s and 1980s and do not have stealth capabilities. The addition of the F-35 as a NATO DCA will somewhat improve its military utility against modern air defenses but may not credibly guarantee NATO's ability to rely on the B61 in a conflict. However, all DCA options utilize short-range fighters, raising questions regarding what targets they may be able to strike and adding the complication of aerial refueling to the DCA mission. This increases doubts about the B61's utility and informs advocacy of the LRSO and/or the low-yield warhead for the submarine-based Trident D5 missile.

From a military perspective, this weapon is not optimal. It is a legacy of Cold War–era NATO deterrence planning. But the political and deterrence consequences of withdrawing the B61s to the continental United States without NATO's concurrence would be more costly than the disarmament gain *unless* Russia significantly reduced its regional nuclear arsenal.

We recommend keeping the B61s forward-deployed under current nuclear sharing arrangements with European allies, until NATO requests its removal with reciprocal arms control or confidence-building steps by Russia.

SEA

SSBNs

Ballistic missile submarines will remain the mainstay of the U.S. nuclear deterrent for decades to come. The current Ohio-class submarines with Trident D5 SLBMs provide a reliable and survivable second-strike capability, with at least eight submarines at sea at all times.[106] The first of the current operational SSBNs was deployed in 1984 and is planned

to reach the end of its service life in 2027. The last Ohio is scheduled to retire in 2040. Both the Obama and Trump administrations decided to proceed with a replacement, the Columbia-class.[107] The Columbia is intended to ensure the sea-based second-strike force for the foreseeable future.

SSBNs are vital because they are the most survivable basing mode for the strategic deterrent force. Ever since submarines began carrying ballistic missiles in the 1960s, they have become quieter and evolved techniques for avoiding detection.[108] Moreover, with several SSBNs at sea on alert at all times, U.S. nuclear forces remain ready for any potential contingency.

The United States should take all steps necessary to ensure that the Columbia-class is introduced at the pace required to maintain the at-sea deterrent capability while the Ohio-class submarines are decommissioned.[109] To hedge against future antisubmarine warfare breakthroughs, the Navy and relevant research organizations should prepare alternative operational practices.

Trident SLBMs

The Trident D5 SLBM is highly accurate—capable of holding at risk an adversary's nuclear forces—and can penetrate missile defenses. These characteristics enable it to perform nuclear counterforce attacks, which are central to traditional U.S. damage-limitation plans. In the past decade, enhancements have bolstered the D5 W76 warheads' capacity to kill hard targets.[110]

Tridents could substitute for vulnerable ICBMs as effective counterforce weapons. Depending on the launch location, they may have shorter flight times and, unlike ICBMs, varied trajectories.[111] Maintaining close proximity to an adversary's territory, launching from unseen locations, and utilizing depressed flight trajectories would make D5s more capable of destroying targets such as silo-based missiles, missile launchers, and bombers before an adversary employs them in counterattacks.[112] Because these submarine-launched weapons are invulnerable, unlike with silo-ICBMs there would be no "use-them-or-lose-them" pressure to launch. The missiles offer yield flexibility: 90 kt (W76) or 475 kt (W88) warheads can be deployed on them. (As discussed further below, the much lower-yield W76-2 is also available for D5 now.)[113] The Trump administration also announced it will pursue the W93 warhead, a "higher-yield" warhead that will help reduce the Navy's "excessive reliance on less destructive W76s."[114] In contrast, the ICBM only deploys warheads with greater than 300-kt yields.[115]

If new strategic threats to the United States or its allies require additional deployed nuclear weapons to deter or defeat, the Trident D5 provides upload potential—that is, additional warheads can be added to each deployed missile.[116] This could be done, for example, if New START (Strategic Arms Reduction Treaty) were to expire and Russia responds by deploying additional warheads, or if China decides to radically increase its number of nuclear warheads.

Finally, the D5's long range—almost that of Minuteman ICBMs—enables it to be launched from locations far away from Russia's and China's improving coastal defenses and concentrated antisubmarine warfare capabilities. This range helps mitigate potential advances in adversary antisubmarine warfare and maintain survivability for the SSBN fleet.

A life extension program is underway to modernize the D5's components and existing warheads.[117] These activities should continue, and the Navy should continue the second life extension program—D5LEP2—to prolong the missiles' service life past the 2040s.[118]

The arguments for the new W93 SLBM warhead are unclear, given the ongoing modernization of the W88 warhead. Further study of the rationale for the W93 is warranted before making a final decision on whether to add a third SLBM warhead to the U.S. stockpile.

Low-Yield Trident D5 (LYD5)

The 2018 NPR described a need to "supplement" the triad in order to respond to a potential limited nuclear attack by Russia. It then said that the United States would modify a "small number" of the W76 warheads designed for SLBMs to have a lower yield of approximately 5–7 kilotons.[119] The weapons were deployed in late 2019 and are designated "W76-2."[120]

The Low-Yield Trident D5 is intended to fill a perceived gap in U.S. nonstrategic nuclear weapons (NSNW), sometimes referred to as low-yield nuclear weapons, against Russia. Its advocates highlight two potential indicators of this gap. First, Russia has (and is modernizing) a large stockpile of NSNW. The exact number is not publicly known, but the 2018 NPR said it could be "up to 2,000."[121] Second, Russian military writings over the past two decades have suggested that attacking NATO targets with a small number of low-yield nuclear weapons could motivate NATO to stop an ongoing aggression into Russian territory.[122]

To counter these Russian battlefield weapons, and thereby deter or defeat Russian aggression, the United States has long retained limited nuclear options intended for theater use, including in Europe. These weapons usually had lower destructive yields than the weapons

based on ICBMs and SSBNs. If Russia initiated use of nuclear weapons against NATO territory, NATO could respond in kind. The demonstrated resolve and capability to respond to a Russian limited nuclear attack, the theory posits, would deter Russia from escalating. If the scenario were different, and NATO were losing a conventional conflict with Russia and NATO leaders decided that only a nuclear strike would cause Russia to stop, using low-yield weapons would be the least escalatory way for NATO to cross this threshold. In both scenarios, U.S. and NATO leaders would seek to use types of nuclear weapons that they think would be least likely to cause Russian leaders to escalate a conflict to all-out nuclear war.

The United States possesses air-based NSNW suitable for limited nuclear war or regional deterrence. These include ALCMs from strategic bombers based in the continental United States and the B61 Mod-12 gravity bomb carried by NATO DCA.[123] Proponents offer several arguments why the LYD5 is better than these alternatives.

First, unlike NATO-based aircraft, the D5 missile can deliver its warhead to target without a risk of interception by advanced Russian air defenses. The F-35, which will be certified in 2024 as a replacement DCA to carry the B61 bomb, will help redress (though not eliminate) NATO concerns about Russian air defenses.[124] In the meantime, however, the B61 will be without a modern, forward-deployed, effective delivery system for several years.

Second, even before NATO DCAs could be launched, their bases could be attacked by Russian conventional or nuclear weapons. Indeed, these air bases and aircraft would be prime targets in an escalating conventional war, and their locations are publicly known.[125] If Russia wanted to signal that NATO military actions had crossed its nuclear threshold, it would contemplate attacking such bases with low-yield nuclear weapons, as in its Cold War–era plans.[126] Russia may legitimately view attacks on DCA bases in the early stages of a conventional war as justified, as the aircraft may be involved in conventional operations below the nuclear threshold.

Third, compared to an ALCM that would have to come from bomber bases in the continental United States, an SLBM provides a prompter option. Launch orders could be given, and targets could be hit within an hour by at-sea SSBNs.

Fourth, compared with air-delivered weapons, the use of D5 missiles would not require destructive attacks to "pave the way" through air defense systems if electronic countermeasures or cyber attacks could not disable or circumvent these systems. SEAD operations could require a substantial number of offensive long-range conventional cruise missile strikes on air defenses, radar installations, and command and control. These strikes could lead to a greater loss of life and render the adversary's national territory more exposed to later attacks. The use of a single or limited number of LYD5s could help limit overall destruction and theoretically could better contain escalation than massed conventional strikes (alone or as precursors to DCA delivery of B61 nuclear bombs).

Lastly, offshore limited nuclear options are politically preferable to additional land-basing in Europe, which would be unpalatable to European allies. With the U.S. withdrawal from the INF Treaty in August 2019, NATO has explicitly stated its intention not to deploy land-based nuclear missiles.[127] Submarine-based low-yield weapons provide greater flexibility and survivability, and do not exacerbate domestic political strife in NATO basing countries.

Notwithstanding these arguments, formidable questions remain about the advisability of the low-yield submarine-launched warhead. The basic argument critics make is that a U.S. president would be more likely to use this weapon than he or she would be to use a much more destructive high-yield one. Critics worry that Russian leaders therefore would become more inclined to initiate nuclear strikes in order to beat U.S. leaders to the punch—perhaps perceiving that such actions would deter the United States from undertaking larger "damage-limiting" attacks on strategic forces to follow. The overall effect would be to "lower the threshold" of nuclear war. Though this argument must be taken seriously, it neglects the fact that NATO and the United States already deploy low-yield weapons for such scenarios. These weapons have not been particularly controversial within NATO or elsewhere. Moreover, deterrence of Russian aggression would be less effective if NATO and the United States had no options other than 100, 300, or 400-plus kt strategic weapons. Furthermore, in terms of international humanitarian law, the low-yield W76-2 should be preferred over the more indiscriminately destructive W76-1.

Offshore limited nuclear options are politically preferable to additional land-basing in Europe, which would be unpalatable to European allies.

The LYD5 raises more specific questions that should have been answered before it was deployed and which were not adequately addressed by the Trump administration to Congress and the public. The answers to these questions should determine whether to retain it in the long term.

First, is it necessary for deterrence today or in the future?[128] The State Department recently published a paper clarifying the U.S. government's arguments in favor of the low-yield D5. The paper lists a series of attractive "distinct attributes" of the new weapon—promptness, survivability, and day-to-day presence.[129] However, the United States has other means of delivering limited low-yield nuclear strikes against Russian, Chinese, and North Korean targets. The B-2A stealth bomber can penetrate advanced air defenses carrying B61 and B83 gravity bombs which provide multiple yield options. The B-2 also benefits from continual upgrades to ensure the aircraft can better detect and avoid ever-advancing air defenses.[130] Further, the B-52H bomber can deliver the nuclear-armed ALCM, which the LRSO is planned to replace. As discussed above, the LRSO, which would be deployable on the B-52H, B-2A, and eventually the B-21, will significantly enhance the air leg's ability to penetrate ever-advancing air defenses. In a crisis, bombers will likely be sortied and closer

to potential targets, cutting down on the amount of time it would take for cruise missiles to reach their targets. However, the LRSO is not planned to be available until approximately 2030, which contributes to the case for developing more immediately available options, such as the LYD5.

Second, assuming that the United States would not plan to detonate 5–7 kt W76-2 warheads on allied territory, what circumstances and targets in Russia would require delivery of one or a few of these weapons at ballistic missile speed?[131] Proponents have not, at least publicly, specified categories of such targets or employment plans for the W76-2. The "clarifying" State Department paper of April 2020 pointedly does not describe any possible targets. "Our strategy for deterring limited nuclear war," it declares, "is not target-based; it is capability based."[132] Yet without a sense of likely targets, it is extremely difficult for officials and analysts in the United States and elsewhere to assess whether these weapons are more likely to stabilize or destabilize crises and escalate or deescalate nuclear exchanges.

Third, what are the probabilities that Russian early warning systems and personnel, and Russian decisionmakers, would accurately discern a detected incoming D5 missile as carrying only one warhead and that the warhead was a 5–7 kiloton W76-2, and not the 90 kiloton W76-1 or the 475 kiloton W88 warhead? The April 2020 State Department paper correctly notes that a "foe's early warning system . . . would not be able to determine the yield of the weapons on a U.S. bomber or air-launched cruise missile either."[133] While valid, this statement is hardly reassuring given the real risks of inadvertent escalation.

Fourth, are there steps that the United States could take unilaterally, or explore with Russia, in advance or during a conflict, that would significantly mitigate risks of Russian misperception or mistake in assessing whether a LYD5 or high-yield weapon is being used? Here, too, the State Department acknowledges the issue. It has discussed this concern with Russian officials. But in the absence of meaningful strategic dialogue and revived arms control diplomacy, the best the State Department offers is that "there is no strategic rationale for an adversary . . . to launch a massive nuclear attack upon detection of a single SLBM, triggering the unlimited war it is trying to avoid."[134] This is reasonable and an improvement on the 2018 NPR's case for the weapon, but the challenge remains.

Fifth, is there any basis for concluding that LYD5 use would not be escalatory—specifically, that Russian military and Kremlin leaders would not respond to attacks by LYD5 with further nuclear escalation?[135] The point at which the State Department suggests a LYD5 may be useful—during an acute crisis where Russia may be "backed into a corner" and considering nuclear use—may instead trigger a large response by alert Russian nuclear weapons.[136] If proponents for LYD5 conclude the risk of further escalation is low, what is the basis for this assertion, especially if the United States refuses to indicate targets for the weapon? If not, then what are the implications? How would U.S. decisionmakers and nuclear operators plan to keep escalation short of all-out nuclear war?[137]

Sixth, what is the probability that launching one or a few LYD5s would reveal the launching submarine's location in ways that would enable Russian forces then to successfully attack the submarine and thereby remove up to 10 percent of the U.S. deployed strategic nuclear force?[138] What probability of such an outcome would or should make U.S. decisionmakers eschew this option?[139]

Finally, does the lower yield of the W76-2 make it more likely for U.S. leaders to consider using nuclear weapons first in a conflict, or is it purely a retaliatory weapon given its basing on SSBNs and the U.S. military's labeling of the weapon as enhancing "deterrence of limited nuclear use?"[140] Russia and China may view the LYD5's combination of lower-yield, promptness, and day-to-day readiness as supporting a first-use role, though this concern should be obviated by the low number of such weapons.

Obviously, answering these questions would involve extremely sensitive information and analysis, much of which understandably would need to remain secret. However, the questions raised here are vital. To date, notwithstanding the April 2020 State Department paper, there is no indication that relevant U.S. political leaders, including in Congress, have been briefed and comprehend these issues. Nevertheless, the W76-2 warhead is now deployed on Trident D5 missiles. This does not remove the need for answers to these questions. Without such analysis and rigorous debate over its conclusions, it is impossible to determine the balance of risks and benefits that this weapon entails, and how to minimize such risks. Thus, in 2021, the Department of Defense, the Department of State, and the intelligence community should conduct such analysis and briefings to better inform future decisionmaking about this weapon and others.

Pending conduct of such analysis and briefings to Congress and (as feasible) to the public, allies, and Russia, **we support retaining the LYD5 at least until the nuclear variant of the F-35 is deployed and perhaps until the LRSO is also available. When these new low-yield weapons are deployed, U.S. policymakers should examine the continuing utility of the LYD5. Removing these warheads without clarifying how they are unnecessary, or whether other systems could better serve their purpose, could undermine NATO and Asian allies' confidence in U.S. leadership and extended deterrence.[141] Moreover, we see no gain in removing W76-2 warheads if they would be replaced by their unnecessarily higher-yield predecessors.**

SLCM-N

The previous U.S. nuclear-armed SLCM—the TLAM-N—was retired in 2010. At the time, the 2010 NPR described it as a redundant capability. Like the SLCM, bombers and nuclear-capable fighter aircraft can be forward deployed in times of crisis. Also, as with the SLCM, ICBMs and SLBMs provide the ability to strike any point on the globe.

The 2018 NPR proposed a new SLCM-N to provide a "non-strategic regional presence, an assured response capability, and an INF-Treaty compliant response" to Russia's violation. Defense officials believe deploying SLCM-N on elusive attack submarines—which have only carried conventional cruise missiles for nearly three decades—will begin to shift the current U.S.-Russian balance in limited nuclear deterrence options to favor the United States.[142] Yet the military role of this system still appears to be redundant. Other forward-deployed and deployable nonstrategic systems also provide a regional presence; these include the B61 bomb and ALCM-armed bombers, as well as the new LYD5. It is difficult to see the unique value of a SLCM-N in a regional crisis or any targets for a SLCM-N that a LYD5, ALCM, or B61 could not address equally well. Certainly, these distinguishing characteristics, if they exist, have not been explained publicly, and a series of questions regarding the intended delivery platform, targets, and capabilities of the missile have yet to be answered.[143]

Politically, some allies may see value in adding nuclear capability to SLCMs. Others may not. Stationing nuclear weapons on attack submarines or even surface ships could preclude some allies (for example, New Zealand and Japan) from allowing these vessels access to their ports.[144] This would reduce the value of nuclear-armed SLCMs for signaling resolve to Russia, China, and North Korea, or for reassuring allies. Moreover, the utility of the SLCM-N as a regional deterrence tool depends on it being aboard forward-deployed naval assets, which would be impossible if the ships are not permitted access to allied ports. It would weaken alliance cohesion if the prospect of deploying such ships stimulated intense political discord in allied countries.

This weapon would have further downsides: deploying nuclear-armed cruise missiles on attack submarines could detract from these ships' other missions, such as tracking enemy SSBNs and nuclear-armed surface ships; protecting U.S. carrier groups; and conducting conventional attacks on priority land targets such as air defenses, naval bases, and air bases. Policymakers have yet to clarify that adding regional nuclear strike missions would not undermine performance of attack submarines' priority conventional missions, including antisubmarine warfare.

It has been suggested that the SLCM-N would be valuable as a potential bargaining chip for future Russian NSNW reductions—for instance, to reduce nuclear-armed antiship and land-attack SLCMs deployable on Russian naval vessels.[145] However, there is no reason to

suspect its introduction will not result in a Russian buildup as opposed to negotiated reduction. We do not advise prolonging the development program for this purpose.

The SLCM-N program is unnecessary and should be canceled.

LAND

ICBMs

The ground-based leg of the U.S. triad is composed of 400 ICBMs deployed in Colorado, Montana, Nebraska, North Dakota, and Wyoming.[146] The Minuteman III missiles in these silos were deployed in 1970 as the first MIRV-capable ICBM, but today they carry only one warhead each. The service life for the oldest Minuteman ICBMs in the missile force will begin to end in 2029, at which point new Ground-Based Strategic Deterrent (GBSD) missiles are planned to begin replacing them. Procuring the missiles is now estimated to cost between $93 and $111 billion, with a decades-long life-cycle cost of $264 billion.[147] These financial estimates are problematic insofar as only one company—Northrop Grumman—bid for the job and faced no competition. Given how costs of nuclear systems historically have exceeded initial estimates, this cost estimate is unrealistically low. Indeed, the costs were recently revised upward from 2017 estimates.[148]

The highly accurate missiles are on a day-to-day alert and can be launched within minutes of a missile crew receiving an order. Yet because the silos are in fixed, known locations, enemy intercontinental-range nuclear weapons (and potentially long-range precision-strike conventional weapons) can destroy them or the equipment required to operate them. Given a choice, few would construct a force structure with vulnerable silo-based ICBMs, as opposed to mobile ICBMs. Unfortunately, to be survivable, mobile ICBMs require expansive open land areas for the missile launchers to "roam" in order to minimize risks of being destroyed by Russian forces.[149] Domestic politics have precluded the United States from deploying mobile ICBMs.

The primary targets for U.S. ICBMs are Russian ICBM bases, both fixed-silo and mobile. Destroying these targets would require a combination of high accuracy and/or yield—a hard target kill capability.[150] ICBMs also could target air and naval bases and command and control facilities, but these installations are also susceptible to cruise missiles and SLBMs. The quick-launch capacity of the U.S. missiles and their accuracy make them especially relevant for targeting Russian silo-based ICBMs. The competition with Russia here is circular. Russian ICBMs are primary targets of massive first strikes by U.S. ICBMs. Russia then cites

this threat from the U.S. ICBM force as the primary rationale for maintaining its own silo-based first-strike capability with multiple high-yield warheads and a LUA/launch on warning capability. (In the Russian military lexicon, this is known as "reciprocal counterstrike.") Bureaucratic and military-industrial interests motivate both countries to continue investing heavily in these forces.

The combination of quick-launch, accuracy, and vulnerability suggests that ICBMs could conduct a preemptive (first) strike on opposing nuclear forces. The idea would be to limit the damage that Russia could inflict on the U.S. homeland. The lives that hopefully would be saved (compared to the alternative of not attacking Russia's nuclear forces) would make such a massive first strike justifiable, affirming the value of ICBMs.[151] The second and perhaps more likely scenario for employing ICBMs would be in rapid response upon detection of a Russian nuclear attack on these missiles. In this case, U.S. ICBMs would not target already-launched Russian ICBMs (mobile or silo-based), but rather other assets.

Recognizing the mutual danger and futility of these scenarios, the favored rationale today for silo-based ICBMs is that they deter Russia by requiring it to use so much of its nuclear arsenal to destroy them that Russia would not have enough left to counter U.S. submarine and air-based forces. For whatever number of ICBMs the United States deployed (400 today), Russia would need to expend more of its own warheads to try to destroy them.[152] This math, plus the doubt that Russian weapons would in fact destroy U.S. ICBMs before they were launched, provides robust deterrence. However, as noted above, there are significant dangers and liabilities in retaining silo-based ICBMs and planning to launch them in a first strike or before Russia's presumed incoming nuclear weapons can reach them.

A large-scale U.S. nuclear first strike to disarm Russia would be the riskiest and most cataclysmic attack ever made by any leader in wartime.

A large-scale U.S. nuclear first strike to disarm Russia would be the riskiest and most cataclysmic attack ever made by any leader in wartime. It would have to rely on exquisitely timed attacks on Russia's early warning capabilities (by cyber, conventional, and/or nuclear means) to ensure that Russia could not launch its own ICBMs on warning. It also would require near-perfect intelligence of the locations of Russia's mobile missile force. Both assumptions are dubious to say the least.

The second risk, as discussed above, stems from the vulnerability of ICBMs and the consequent plans to retain options to launch under attack (discussed in chapter 3). Technical malfunction or human error in detecting and assessing Russian attacks could lead the United States to launch its ICBMs unnecessarily or in disproportionate numbers, both of which could cause massive escalation. This risk is now compounded by the United States' reliance on launch-detection and attack-assessment satellites and communications satellites

that Russia (and China) could target by cyber or kinetic means in a conventional conflict, even if such attacks were not intending to threaten U.S. nuclear command and control. The United States could misperceive their intent or, in any case, interpret such an attack as a precursor to nuclear strikes, and act accordingly to prepare and/or launch U.S. nuclear forces.[153] The ICBM force is more vulnerable to such destabilizing entanglement than other legs of the triad.

ICBMs also seem to be the least compliant strategic delivery system with respect to the law of armed conflict. The warheads currently deployed on U.S. ICBMs, the W78 and W87, both have yields of at least 300 kilotons. If these warheads detonate close to hard-to-kill targets like missile silos and buried command sites, the blasts would loft large amounts of radioactive debris into the atmosphere. Given the location of Russia's ICBM bases, this is likely to create mass civilian casualties and have extremely pernicious long-term environmental and humanitarian consequences. None of these outcomes seem compatible with the law of armed conflict's principles of military necessity, distinction, and limiting unnecessary suffering. Further, the high yields and intended targets for ICBMs give them little capability to address the regional deterrence scenarios that are most likely to engage U.S. nuclear forces in the foreseeable future. Use of an ICBM would signal a major escalation. This adds to the central deterrence value of the ICBM but also limits its utility in most likely conflict scenarios.

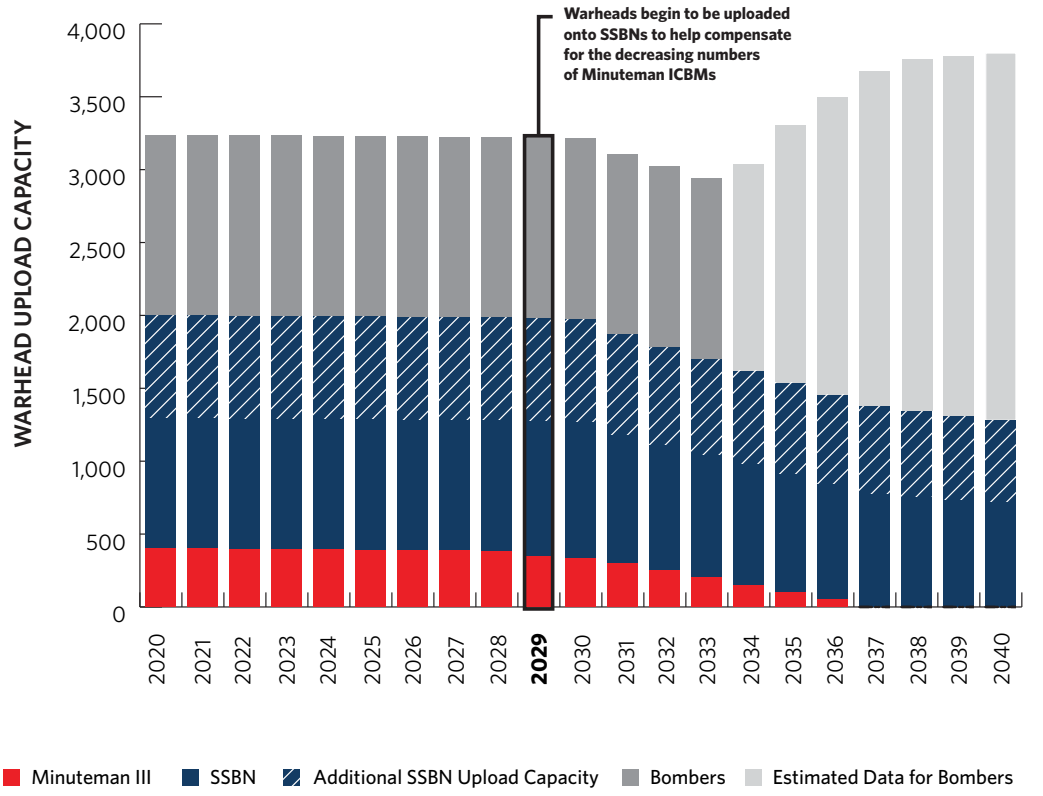
Possible Alternatives

If retaining silo-based ICBMs entails significant risks, what are the alternatives?

One option would be to *unilaterally* eliminate all or a significant fraction of the 400 Minuteman missiles and to rely more heavily on the more survivable SSBN and bomber forces. The 2013 review of U.S. nuclear employment strategy concluded that a reduction of deployed strategic warheads to approximately 1,000 to 1,100 would still allow the United States to fulfill current targeting requirements, whether or not Russia reciprocated.[154] Though there is little reason to think that Russia would not remain deterred by a U.S. arsenal of 1,000 sea- and air-based weapons, political realities in the United States and the intensified confrontation between the United States, NATO, and Russia make this option infeasible and probably unwise. Even debate over such a unilateral move could jeopardize tenuous bipartisan congressional support for a linked approach to nuclear modernization and arms control negotiations and exacerbate partisan conflict and stalemate in Washington.

Another alternative would be for the United States to eliminate as many ICBMs as could be substituted for by adding warheads to the bomber and submarine forces while keeping under New START's warhead ceilings (figure 4 illustrates the hypothetical upload capabilities of the air and sea legs as Minuteman missiles are slowly phased out).[155] The downside would be that this force structure would rely more heavily on the eight or nine submarines on patrol at any given moment. As Russian and Chinese antisubmarine capabilities improve,

Figure 4: Uploading Warheads to U.S. Bombers and SSBNs While Reducing Minuteman ICBMs



Sources: Todd Harrison and Evan Linck, "Options for the Ground-Based Leg of the Nuclear Triad," Center for Strategic and International Studies, 2017, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/170925_Harrison_OptionsGroundBasedLegNuclearTriad_pages.pdf; Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* 76, no. 1 (2020); Ronald O'Rourke, "Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress," R41129, Congressional Research Service (updated October 7, 2020), https://fas.org/sgp/crs/weapons/R41129.pdf; Amy F. Woolf, "U.S. Strategic Nuclear Forces: Background, Developments, and Issues," RL33640, Congressional Research Service (updated December 10, 2020), https://crsreports.congress.gov/product/pdf/RL/RL33640/65; Tyler Rogoway, "USAF's Controversial New Plan to Retire B-2 and B-1 Bombers Early Is a Good One," *The Drive*, February 12, 2018, https://www.thedrive.com/the-war-zone/18410/usafs-controversial-new-plan-to-retire-b-2-and-b-1-bombers-early-is-a-good-one.

the theoretical risk to a much larger portion of the United States' deployed nuclear deterrent could grow too. These risks could be mitigated as described above, and the deployment of the Columbia SSBN replacement will also improve the survivability and viability of the submarine force far into the future.

Some express concern that the two SSBN bases—in Kings Bay, Georgia, and Bremerton, Washington—could be destroyed by an adversary with only a small number of nuclear or conventional munitions. (These sites are defended by air and missile defenses, though that

may be of little comfort to U.S. nuclear strategists.) Thus, if the United States reduced its ICBM force, a Russian disarming first strike could plausibly threaten the U.S. nuclear deterrent.[156] However, this scenario is unlikely for two reasons. First, attacking the two submarine bases would still leave the United States with a large portion of the SSBN fleet at sea when the attack is carried out. (Eight submarines at sea could carry approximately 1,000 nuclear warheads, if SLBMs carry the additional warheads suggested here.) Second, in terms of deterrence, Russian experts know that if they attacked a U.S. SSBN base (including with non-nuclear weapons) the United States would take it as an extreme form of escalation and could respond accordingly. As the 2018 NPR states, "Significant non-nuclear strategic attacks include, but are not limited to . . . attacks on U.S. or allied nuclear forces."[157] If the United States reduces its ICBM capacity in favor of SSBNs, the U.S. Navy would be expected to enhance the survivability of the base infrastructure and nondeployed SSBNs at Kings Bay and Kitsap.

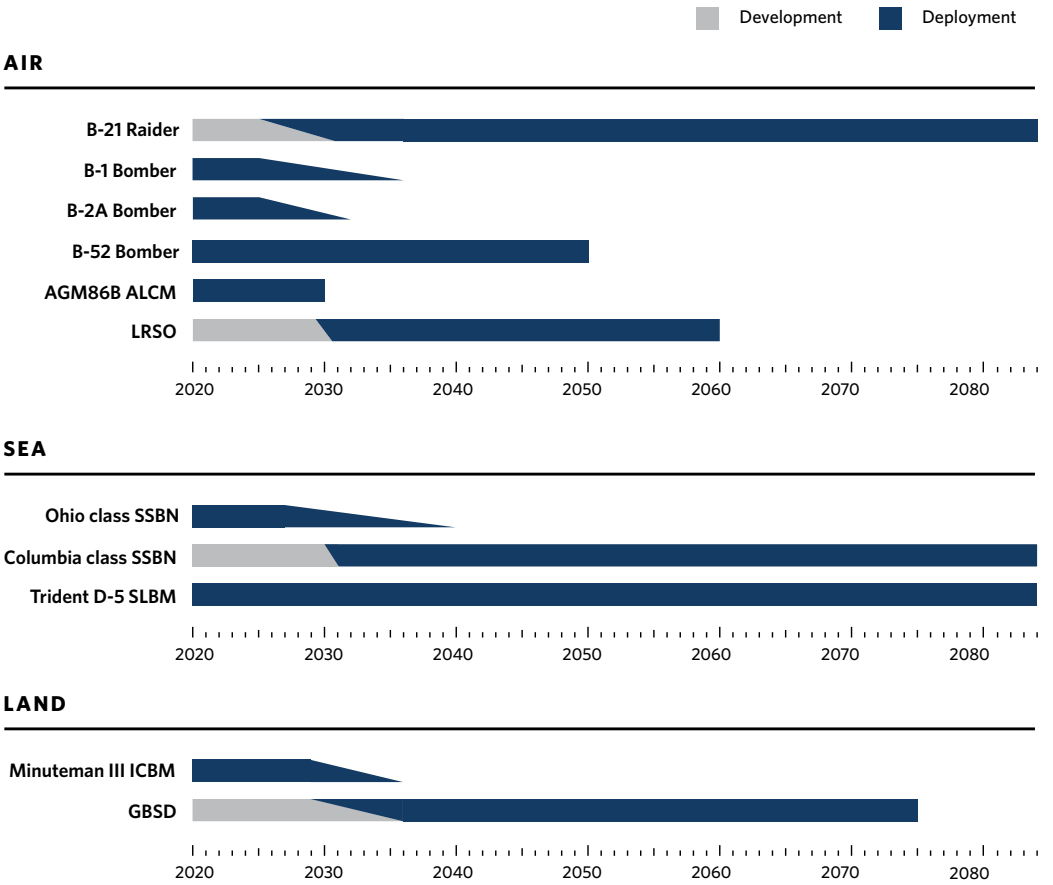
The better and more politically feasible option is to pause the GBSD program, and meanwhile retain (and update) the Minuteman ICBM force while seeking negotiation of an agreement with Russia to mutually reduce the total number of warheads and silo-based nuclear missiles and launchers.[158]

The Minuteman remains effective and launch-ready. If the main value of vulnerable ICBMs is to soak up a large portion of Russian nuclear forces, an expensive new system is not necessary. The U.S. Air Force can maintain a sizable Minuteman arsenal for a longer period by reducing the number of *deployed* ICBMs. If the deployed ICBM force were 300 or 200 missiles instead of 400, it is difficult to imagine Russian leaders becoming less deterred from attempting a disarming first strike against the United States. Missile bodies and parts from withdrawn missiles can be used to keep the retained ones operational.[159] The feasibility of extending the life of Minuteman III is explored in Appendix A.

Reducing the size of the U.S. ICBM force may be necessary regardless of the GBSD deployment. The Air Force plans to deploy the B-21 in greater numbers than the aircraft it is intended to replace, the B-1B and (eventually) the B-2. If a new administration intends to extend New START for five years, as recommended here, B-21 bombers likely will be deployed while the treaty remains in force. (The B-21, along with other major nuclear modernization programs will certainly be relevant to negotiations after New START expires, even if that date is in 2026—see figure 5.) Thus, more "room" will need to be created in the U.S. nuclear force to comply with numerical ceilings.

At a time of growing competition among defense programs, with Republicans and Democrats alike calling for ruthless or "smart" spending prioritization, the U.S. nuclear program must come to grips with the archaic deterrence logic that underpins the land-based leg of the strategic triad, as well as the arms control opportunities it may present. As U.S. nuclear modernization programs enter an expensive, technically difficult stretch, these considerations should not be overlooked.[160]

Figure 5: Development and Deployment Timelines for the Major Nuclear Modernization Programs



Sources: Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* 76, no. 1 (2020); Ronald O'Rourke, "Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress," R41129, Congressional Research Service (updated October 7, 2020), https://fas.org/sgp/crs/weapons/R41129.pdf; Tyler Rogoway, "USAF's Controversial New Plan to Retire B-2 and B-1 Bombers Early Is a Good One," The Drive, February 12, 2018, https://www.thedrive.com/the-war-zone/18410/usafs-controversial-new-plan-to-retire-b-2-and-b-1-bombers-early-is-a-good-one; Amy F. Woolf, "U.S. Strategic Nuclear Forces: Background, Developments, and Issues," RL33640, Congressional Research Service (updated December 10, 2020), https://crsreports.congress.gov/product/pdf/RL/RL33640/65; Kingston Reif, "U.S. Nuclear Modernization Programs," Arms Control Association, August 2018, https://www.armscontrol.org/factsheets/USNuclearModernization; Megan Eckstein, "Navy Beginning Tech Study to Extend Trident Nuclear Missile Into the 2080s," USNI News, November 14, 2019, https://news.usni.org/2019/11/14/navy-beginning-tech-study-to-extend-trident-nuclear-missile-into-the-2080s.

NUCLEAR COMMAND, CONTROL, AND COMMUNICATIONS (NC3)

Nuclear weapons are only as reliable (physically) as the command, control, and communication systems that inform and implement the decisions to employ or not employ them. These systems (known as NC3) are supposed to:[161]

- guarantee effective monitoring and exclusive control at all times over all nuclear forces and strategic operations;
- support decisionmaking, planning, and operations in all scenarios;
- provide timely warning of imminent attack;
- supply situational awareness to the various command levels;
- assure effective and secure communications to and from national command authority;
- accommodate and support required maintenance, upgrade, safety and surety operations;
- withstand efforts to undermine or subvert the reliable transmission of information and guidance between and across command levels; and
- sustain high standards of safety, security, and secrecy commensurate with the sensitivity of nuclear weapons.

The U.S. NC3 system includes space- and terrestrial-based sensors and communications platforms, as well as the computer architecture and other hardware that make these platforms work. The Pentagon currently plans to modernize the NC3 system wholesale. The Congressional Budget Office estimates that this effort will cost $77 billion from 2019 to 2028.[162]

NC3 modernization is receiving deserved attention for several reasons. Existing hardware components are numerous and of various historical and technical vintages, which makes it difficult for operators and commanders to understand how the systems work and what their vulnerabilities might be.[163] New threats are rapidly emerging, particularly in the form of cyber espionage and potential attack, as well as innovative antisatellite weaponry.[164] And new technological capabilities provide opportunities to network systems and integrate military operations across domains of combat from cyber to conventional to nuclear.

The first imperative is to make NC3 secure and resilient against attacks that could destroy, degrade, or corrupt its functionality.[165] NC3's vulnerability to advanced cyber, space, long-

range precision-strike weapons, and advanced autonomous weapons systems is an emerging concern. Competition among nuclear-armed states in these areas and the targeting of NC3 heightens risk of nuclear use.[166]

Other, less obvious risks also must be addressed. Command, control, and communication systems that are shared across warfighting domains—for example, by nuclear and conventional precision-strike forces and commands—could exacerbate risks of inadvertent escalation. Adversary attacks intended as part of conventional war could affect U.S. nuclear forces and NC3 as well.[167] U.S. military and political leaders would then face the challenge of interpreting adversary intentions and deciding whether nuclear strikes are imminent or already underway, and how to respond, in the midst of an ongoing conflict. Opportunities for mistakes abound. (Russia and China may face similar risks to the extent that they too have entangled NC3 systems.)[168]

Improving the functionality, security, and resilience of NC3 and understanding how to address possible modes of failure are noncontroversial priorities. In doing this, policymakers also should be expected to recognize that certain force postures place more stress on different elements of NC3.[169] For example, the maintenance of an alert, silo-based ICBM force creates compressed time for presidential decisionmaking. U.S. nuclear forces and operational planning centered on survivable nuclear forces may increase decision time and reduce burdens on the NC3 system.

Deterrence also can help reduce or channel threats to NC3. The 2018 NPR and subsequent remarks by U.S. officials warned that "any harmful interference with or attacks upon such components of our space architecture at any time, even if undertaken only with non-nuclear tools, thus starts to move into 'significant non-nuclear strategic attack' territory, and would lead to a significant and potentially drastic escalation of a crisis or conflict."[170] Therefore, an adversary's attack on space-based command and control hardware—whatever its purpose—may, in the view of the U.S. government, warrant nuclear retaliation.

The Pentagon has recently recognized the urgency of building a resilient and adaptable NC3 system and has put USSTRATCOM in the lead of the NC3 modernization program. USSTRATCOM is well positioned to determine the best course of action for NC3 modernization within the broader context of U.S. nuclear modernization and changes to posture and policy. This report cannot credibly describe how NC3 modernization should proceed. Doing so will require extensive classified review and analysis. However, several basic principles should guide this process:

- Modernization must carefully navigate the inevitable trade-off between redundancy and cutting-edge capability. In light of the growing threats to NC3, the United States should prioritize building a more resilient if less technologically capable NC3 architecture.

- Resilience and redundancy will be necessary. For example, communication/early-warning payloads hosted on other constellations of U.S. military satellites could be deployed as alternatives or supplements to a small number of highly capable dedicated satellites. The Pentagon should consider developing survivable emergency backup capabilities such as high altitude, long endurance UAVs (unmanned aerial vehicles).

- Traditionally, U.S. NC3 assets have been designed to survive for as long as possible in a nuclear war. For example, they have been hardened against electromagnetic pulse attacks, at great financial costs. However, U.S. NC3 may not be sufficiently resilient today to emerging kinds of non-nuclear attacks, such as the jamming or spoofing of communications satellites or "dazzling" through ground-based lasers.[171] An adversary could use such techniques at the outset of a *conventional c*onflict. Yet, in attempting to disrupt U.S. conventional military operations, the adversary could disrupt co-located *nuclear* command and control functions, which could increase the risk of escalation. To better manage such risk, the NC3 systems must be able to survive a broader range of non-nuclear attacks to ensure the viability of U.S. nuclear forces during an ongoing and potentially escalating conflict.

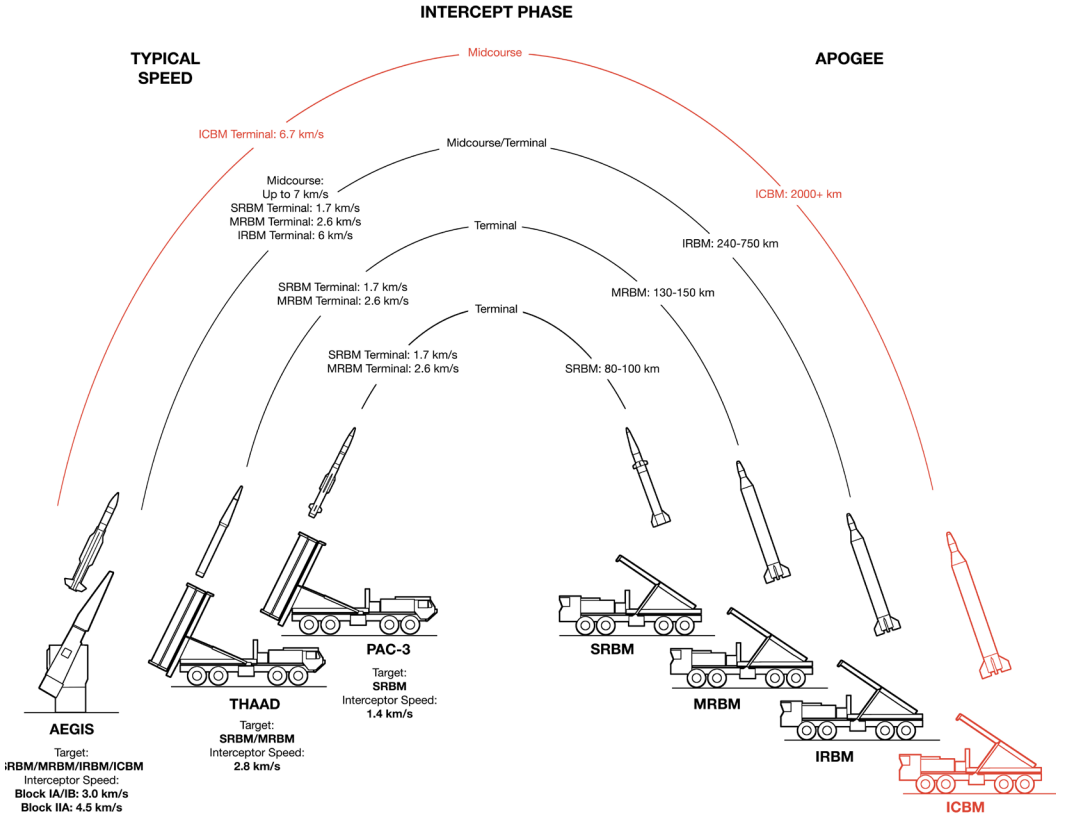
CHAPTER 5

BALLISTIC MISSILE DEFENSES

U.S. missile defenses, like nuclear forces, come in various forms, with different capabilities, objectives, costs, and reactions from allies and adversaries. The capabilities and footprint of U.S. missile defense have expanded continually over the past twenty years. Today, they have attained a global reach, increased technological capability, priority in defense budgets, and adoption by U.S. allies. (Appendix B contains a record of U.S. missile defense tests for Aegis and Ground-Based Midcourse Defense systems, perhaps the most relevant defensive systems to adversary nuclear postures.) Still, the technical functionality of missile defenses against modern missile forces is unknown. The United States has not used missile defenses against a nuclear-armed adversary. Nor have Israel's vaunted air defenses been used against advanced cruise or ballistic missiles.

Forward-deployed missile defenses—interceptors based on land and on ships with warning and communications assets—play a role in regional deterrence, defending allies and partners, U.S. forces, and critical military and civilian installations on foreign territory. The United States uses basing arrangements and foreign military sales to encourage interoperability and information-sharing among allies to improve the effectiveness of their missile defenses.[172] Missile defenses on and near U.S. territory are supposed to defend the U.S. homeland from ballistic missile attacks of the scale that North Korea might be able to launch. In both scenarios, U.S. missile defense can contribute to defeating and deterring conventionally and nuclear-armed missile attacks, whether targeted at American cities or U.S. nuclear and military forces. Because the focus of this review is nuclear policy, its analysis and recommendations focus on three conundrums that missile defenses could pose to managing and reducing nuclear threats.

Figure 6: U.S. Missile Defense Capabilities and Roles



The Aegis system was tested against an ICBM target in November 2020.

Note: Image is meant to describe the intended roles of U.S. interceptors, not their reliability or successful intercept rate.

Sources: "Fact Sheet: Ballistic Missile Defense Intercept Flight Test Record," Missile Defense Agency, December 2018, https://www.defense.gov/Portals/1/Interactive/2018/11-2019-Missile-Defense-Review/ballistic-missile-defense-intercept-flight-test-record-UPDATED.pdf; Shervin Taheran, "U.S. Conducts 'Salvo Engagement' GMD Test," *Arms Control Today*, Arms Control Association, May 2019, https://www.armscontrol.org/act/2019-05/news/us-conducts-%E2%80%98salvo-engagement%E2%80%99-gmd-test; Ronald O'Rourke, "Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress," RL33745, Congressional Research Service (updated December 23, 2020), https://fas.org/sgp/crs/weapons/RL33745.pdf; Hans M. Kristensen and Matt Korda, "US Ballistic Missile Defenses, 2019," *Bulletin of the Atomic Scientists* 75, no. 6 (2019); "Fact Sheet: Ballistic vs. Cruise Missiles," The Center for Arms Control and Non-Proliferation, April 27, 2017, https://armscontrolcenter.org/fact-sheet-ballistic-vs-cruise-missiles/; Major General (Ret.) Khalid Abdullah Al Bu-Ainnain, "Proliferation Assessment of Ballistic Missiles in the Middle East," INEGMA, November 2009, http://www.inegma.com/Admin/Content/File-29122013111330.pdf; "Missile Threat," Missile Defense Project, Center for Strategic and International Studies, https://missilethreat.csis.org/.

U.S. regional missile defense arrangements include theater missile defense systems, such as Patriot and THAAD (Terminal High Altitude Area Defense), that are designed for terminal and "point" defense. These systems are better suited for protecting smaller areas where important military installations and critical infrastructure may be located. Longer-range systems, such as Aegis, also contribute to regional missile defense architectures, operating off the coasts of U.S. allies in Europe and Asia. In Europe, NATO allies host a radar site in Turkey, a command center in Germany, and an Aegis Ashore site where Aegis SM-3 interceptors are deployed on land in Romania with a planned second site in Poland, as part of the European Phased Adaptive Approach.[173] In Asia, the United States has deployed THAAD radars and launchers in Guam, Hawaii, and South Korea.[174] All of these systems are intended to protect U.S. allies as well as U.S. forces stationed on allied territories.

Notwithstanding the primary missions of deterring and countering North Korean and Iranian missile threats, U.S. military planners and contractors also envision these systems' potential role in interdicting Russian or Chinese conventional and nuclear attacks on targets in Europe and East Asia. For instance, the 2019 Missile Defense Review (MDR) states that "missile defense is an element of the U.S. effort to counter A2/AD [antiaccess/area denial] strategies that seek to deter or prevent the United States from supporting allies in contested regions," implicitly suggesting that missile defense will blunt Russian and Chinese attacks associated with their strategies for regional conflicts.[175] The November 2020 test of the SM-3 against an ICBM target deepened Russia's and China's suspicions that U.S. missile defenses will be directed against them.[176] As the presence of Aegis ships and land installations increase, Russia and China may further lose confidence in the efficacy of their ballistic missiles. In 2017, China reacted harshly (including an economic boycott) to the deployment of THAAD radars in South Korea, claiming the system could help target Chinese ICBMs.

These dynamics raise two conundrums at the regional level. First, the United States has insisted that regional defenses intended to deter or block North Korean or Iranian attacks do not pose threats to Russian and Chinese strategic nuclear deterrents. But Moscow and Beijing profess not to believe these statements. **To the extent that Russia and/or China add offensive capabilities to counter such defenses, would the benefits of defenses against regional Iranian and/or North Korean missiles outweigh the costs?**

Second, the United States also seeks increased capabilities to defend its forward-deployed forces and allies and partners from Russian and Chinese regional missiles. These capabilities are especially important in East Asia, where China has steadily increased its arsenal of short- to medium-range conventionally armed and dual-capable missiles. Here the major conundrum is that it is easier and cheaper for China to add missiles of this range than it is for the United States to add defenses to feasibly counter them. Moreover, kinetic and perhaps cyber capabilities to target Chinese missiles and their command and control systems could intentionally or inadvertently attack (or be perceived to attack) Chinese nuclear

command and control. This could exacerbate risks of escalating a regional conventional war into a nuclear one. That concern notwithstanding, such antimissile capabilities also could strengthen deterrence.

The third set of conundrums involves U.S. homeland defenses against ballistic missiles, and the likelihood that they drive Russia and China to increase their arsenals of long-range missiles and warheads. When the United States withdrew from the 1972 Anti-Ballistic Missile (ABM) Treaty in June 2002, the stated reason was the need to develop and deploy systems that could defend the U.S. homeland from attack by future North Korean and Iranian ballistic missiles. This reasoning remains the stated objective of homeland missile defenses. Although Iran still does not possess missiles that could reach the United States, North Korea has tested several types of missiles that could improve its capabilities.[177] For its part, to potentially counter this threat, the United States still deploys only a little more than half the number of missile interceptors on its territory that it would have been allowed had it remained under the ABM Treaty's maximum of 100.

The conundrum is whether the benefits of maintaining or adding to such defenses are greater than the costs of doing so, in terms of both expense and the increased likelihood that Russia and China would counter by greater numbers of and/or more capable missiles and countermeasures.

The Ground-Based Midcourse Defense System (GMD) centered on these interceptors in Alaska and California cannot singlehandedly defeat a concerted missile attack from Russia or China. The 2019 MDR acknowledges this fact, stating "the United States relies on deterrence to protect against large and technically sophisticated Russian and Chinese intercontinental ballistic missile threats to the U.S. homeland."[178] Yet the MDR also states "in the event of conflict, it [GMD] would defend, to the extent feasible, against a ballistic missile attack upon the U.S. homeland from any source."[179]

Russia is already developing and deploying new long-range nuclear delivery systems to defeat current and expected future U.S. missile defense capabilities. A major question is whether Chinese leaders genuinely perceive such defenses to threaten the viability of their growing strategic deterrent force of around 180 missiles, after that force has been attacked by U.S. conventional or nuclear weapons. If the answer is "yes," then the conundrum is whether the benefits of maintaining or adding to such defenses are greater than the costs of doing so, in terms of both expense and the increased likelihood that Russia and China would counter by greater numbers of and/or more capable missiles and countermeasures.

There are no clear or easy answers to these conundrums. Since its withdrawal from the ABM Treaty, the United States has acted as if the benefits of pursuing defenses outweigh the risks of arms racing with Russia and China and escalation of regional conflict. These

posited benefits, which will vary based on the actual performance of defense systems, include strengthening deterrence, limiting the damage adversaries can inflict, and reassuring U.S. allies and partners in Europe, the Middle East, and East Asia.

Advocates of missile defense do not fully acknowledge that their programs drive Russia and China to develop and deploy offensive countermeasures. Instead, they cite the modernization of Russian and Chinese offensive nuclear forces as justifications for development of even more modern U.S. missile defenses *and* offensive weapons, continuing the action-reaction cycle. However, the unintended consequences—especially those that impact U.S. nuclear deterrence relationships with each major adversary—are equally important to consider.

Many of the Russian and Chinese nuclear capabilities that U.S. nuclear policymakers and politicians decry are, in part, responses to U.S. missile defense programs and their future potential capabilities. Russia's much-vaunted new hypersonic weapons, including the intercontinental-range Avangard HGV and the regional-range Kinzhal ALBM, are notable not for their speed but their maneuverability, which may more easily circumvent U.S. defenses than traditional ballistic missiles. Similarly, the "exotic" Burevestnik nuclear-powered cruise missile and Poseidon nuclear-powered torpedo could evade interception and reinforce Russia's second-strike capabilities. Russian Iskander deployments in and near Europe, now more than ten years old, were in response to U.S. and NATO Aegis Ashore plans.

For its part, China has developed ballistic missiles capable of delivering multiple warheads and penetration aids, including its newest DF-41 ICBM and the still in-development JL-3 SLBM, and an HGV-equipped medium-range missile, the DF-17. China's growing numbers of warheads and dual-capable (nuclear and conventional) missiles and development of hypersonic boost glide systems reflect a determination to improve the survivability of the country's relatively small nuclear arsenal against U.S. offensive strikes and defensive interceptions.

Perhaps paradoxically, as Russia and China develop maneuverable hypersonic weapons and other capabilities to bypass U.S. homeland missile defenses, they may solve (at least partially) the deterrence and instability challenges that U.S. ballistic missile defenses pose. North Korea and Iran are not (yet) capable of deploying such sophisticated offensive systems. Thus, U.S. homeland defenses predicated on ballistic missiles of the number that North Korea (and perhaps someday Iran) could deploy would not threaten forces as maneuverable as Russia's or China's. However, Moscow and Beijing would still worry and plan against *future* U.S. defense technologies, especially space-based ones.

Current U.S. missile defense policy will suffice if policymakers believe that unconstrained competition in offensive and defensive weapons is preferable to potential agreements that would provide transparency and potentially some limits on U.S. missile defense in exchange for possible Russian and Chinese concessions. However, **U.S. interests and those of allies**

and the rest of the world would be better served by exploring what possible trade-offs could be negotiated between transparency and potential limitations on *some* U.S. missile defense capabilities, on one hand, and Russia and Chinese reductions and/or constraints on some of their current and prospective offensive capabilities, on the other.

The most promising way to assess these possibilities would be to explore whether and how regional and/or homeland missile defenses could be designed and deployed to protect against a lesser scale of missile threats (such as those posed by Iran and North Korea) without creating the realistic prospect that the United States could successfully negate a Russian or Chinese deterrent of U.S. first strikes against either Russia or China.

CHAPTER 6

ARMS CONTROL AND DISARMAMENT

As the 2018 NPR affirmed, U.S. nuclear policymakers can and should identify policies that could help reduce instabilities and the potential damage of a catastrophic war with Russia and China. Such policies could be adopted unilaterally through nuclear force posture changes, or—as arms control—through bilateral or multilateral negotiations.

Adversaries "pursue" arms control when they recognize mutual interests in reducing the costs and risks of destabilizing competition in building and deploying weapons, especially those that exacerbate risks of inadvertent or accidental escalation. Arms reductions can also lower the level of damage that could be done if deterrence failed. By improving predictability for years at a time, arms control also helps participants manage national budgets and defense planning.

The old arms control agreements that helped manage and end the Cold War were hard to make. The task of reinventing arms control in the twenty-first century will prove harder. For one thing, there are new players—China the most important among them, from the U.S. perspective. China's perceived military requirements derive not only from competition with the United States, American allies, and Russia; it factors India into its calculations, too. China's capabilities then weigh heavily on India's perceived requirements for deterrence, which Pakistan in turn seeks to match or surpass. All these states compete with one another in various ways.

New escalation risks also are shaping the arms control landscape. Whereas earlier nuclear arms control focused on nuclear-capable ballistic and cruise missiles, delivery systems

today and in the future carry both conventional and nuclear warheads and move with varying speeds and trajectories from multiple launch platforms. These and other weapons that are harder to monitor, including electronic and cyber variants, may threaten targets ranging from civilian infrastructure and populations to early warning and command and control systems, as well as nuclear and conventional forces. These new weapons may be more tempting to use in ways that could be entangled with nuclear systems, which severely complicates the challenge of deterring conflict and its escalation. Negotiating acceptable and stabilizing balances among such protean weapons and their potential uses will be extremely difficult.

Rather than being guided by deterrence logic alone, the organizing principles and goals of arms control should be to reduce the probability of escalatory warfare *and* to physically bound the potential damage that would occur if nuclear deterrence fails.

Rather than being guided by deterrence logic alone, the organizing principles and goals of arms control should be to reduce the probability of escalatory warfare *and* to physically bound the potential damage that would occur if nuclear deterrence fails. No two antagonists should wield weapons whose number and explosive power could not only destroy their own nations but also cast innocent bystander societies *into catastrophe.*

Deterrence theory posits that the United States should hold at risk enough of what adversary leaders value that they will decide not to undertake actions that would cause U.S. leaders to strike these targets. There can be no certainty as to what type and number of targets suffice to deter Russia and China. In any case, the United States should plan to use nuclear weapons only against targets that cannot be destroyed or disabled by non-nuclear means. The number of such targets would decrease to some degree depending on how many nuclear weapons Russia, and subsequently China, were willing to eliminate through negotiation. Moreover, the global security gain from reducing the probability that nuclear war would produce environmental catastrophe needs to be considered along with deterrence theory in deciding "how much is enough." **The overall risk of negotiating reductions to the minimal level Russia would accept—with parallel limits by China—is arguably less than the risks of both countries' retaining arsenals larger than these minimums.** By offering to match Russia's reductions—with corresponding adjustments by China—the United States would benefit in international politics by shifting the burden of debate on nuclear arms control and disarmament to Russia.

Some policymakers may assert that much less destructive arsenals could fail to deter Russian aggression. However, any nuclear war, beyond very limited attacks on remote targets, would portend devastation of a scale and pace that would be unprecedentedly catastrophic. The United States is now deterred from initiating conflict with North Korea, a country with perhaps a few dozen nuclear weapons. There is no reason to think that the United States

and Russia would no longer be mutually deterred if they each had "only" a few hundred *survivable* nuclear weapons and much less prompt launch postures. The challenge in this scenario is to determine what combination of non-nuclear and nuclear capabilities and arms control constraints would make both sides (and China) confident that their deterrents were survivable.

Treaties cannot be expected to address all these dynamics in any foreseeable future. Political dynamics in Washington make it exceedingly difficult to ratify treaties. China's skepticism about arms control forestalls even the beginning of formal negotiations with the United States. Additional forms of agreements and confidence-building measures will need to be created. The most promising formats for doing this will be in bilateral dialogues between the United States and Russia and the United States and China. China and Russia are now averse to trilateral negotiations. It is difficult to imagine them changing their positions unless they were going to band together against U.S. preferences. (Bringing the United Kingdom and France into the process could rebalance political dynamics, but attempting to do so in the near term would add a host of other complications.)

Progress in any of these dimensions of arms will require adjustments in everyone's approaches. Most fundamentally, Americans will need to recognize that Russia and China will not accept agreements that they perceive to be unfair to them. This may be obvious: U.S. leaders and voters would not endorse agreements that are unfair toward the United States. Yet ever since the end of the Cold War, the United States as the world's most powerful state has frequently sought one-sided advantages. This should not be expected to work with Russia and China in the future.

WHY U.S.-RUSSIA ARMS CONTROL STILL MATTERS

The Trump administration argued that bilateral U.S.-Russian arms control is outdated, and it prioritized negotiating a trilateral treaty that limits China's nuclear forces alongside those of the United States and Russia. Engaging China is a worthwhile goal that deserves real diplomatic efforts, as discussed below. It would, however, be a significant mistake to allow Beijing to veto U.S.-Russian arms control efforts. **Bilateral arms control with Russia remains an important tool for enhancing the security of the United States and its allies. The United States should pursue it *alongside* efforts to engage China.**

The United States and Russia size and posture their nuclear forces to compete against each other. Without arms control, this interdependence could intensify an expensive and dangerous competition in strategic forces—a particularly acute risk, given Russia's development of new "exotic" nuclear weapons. Russia's opaque nonstrategic nuclear forces are of particular concern to the United States and NATO. Russia has many such weapons, deploys them close to the territories of NATO's easternmost members, and maintains options for using them early in a conflict. The United States is moving to counter Russian capabilities with

new air- and sea-based capabilities of its own. Arms control could provide much-needed transparency in this domain and eventually help to cap and roll back the emerging nonstrategic nuclear forces competition.

Basic Strategy

If the United States wants Russia to deal with U.S. concerns, it must be prepared to discuss and help address Russian concerns—in particular, about the survivability of its nuclear forces. These concerns have grown as a result of advances in non-nuclear weaponry, including high-precision conventional weapons and ballistic missile defenses, as well as projected modernization of U.S. nuclear forces.

Before addressing concerns about future arms racing and instability, the United States and Russia will need to deal with each other's deep dissatisfaction over past performance in upholding earlier arms control treaties and international agreements. The United States, with evidence and reason, emphasizes Russia's violations of the INF and Conventional Forces in Europe treaties, as well as problems with Russian practices related to the Open Skies Treaty. It also points to Russia's recent violations of Ukrainian sovereignty and territorial integrity. Russia, for its part, emphasizes the U.S. withdrawal from the ABM Treaty, the INF Treaty, and the Joint Comprehensive Plan of Action with Iran, as well as the U.S. decision to withdraw from Open Skies. The result is that many Americans believe Russia will violate arms control agreements while Russian leaders believe the United States will withdraw from them when an administration believes it is unilaterally advantageous to do so. The moral and legal "superiority" of withdrawing from agreements compared to violating them is clearer to Americans than it is to many others, including U.S. allies that rely on the same accords for their security.

The United States and Russia will be unlikely to undertake new agreements if they do not explicitly agree on measures to reassure each other that their pattern of unilateral noncompliance and withdrawal will not be repeated. Updating verification measures in new agreements is one way to address these concerns.

This report is not the place to suggest detailed terms that negotiators on either or both sides should or likely would pursue in negotiations That said, an obvious and necessary first step would be to extend New START for up to five years, which Russia has offered to do and with which the United States should agree. Nothing would be gained by refusing this step. Without it, any further progress will be more difficult to achieve.

Assuming New START is extended, the next shared U.S.-Russia objectives should be:

- **Broad-based discussions of strategic stability and escalation risks**
- **Negotiation of a follow-on agreement to New START**
- **Negotiation of certain non–legally binding confidence- and security-building measures**
- **Reciprocal inspections of empty nonstrategic warhead facilities**
- **NATO commitment to refrain from modifying Aegis Ashore missile launchers deployed in Europe to contain offensive missiles**
- **U.S. transparency regarding the technical capabilities of SM-3 interceptors based in Europe to demonstrate inability to intercept Russian ICBMs**

Discussions of Strategic Stability

Strategic stability discussions help build security. Understanding an adversary's concerns and redlines could help restrain future conflicts and reduce risks of escalation if conflict does occur. Stability discussions also can map a path toward concrete arms control measures.

Recently, each government has issued nuclear policy documents whose meanings and implications have been interpreted in various, often divergent ways.[180] Sustained dialogue would provide opportunities for each side to better understand the other or to draw more informed conclusions about the sources of nonunderstanding. For example, diplomats and military officials from both countries could describe and explore the risks that they think would follow from limited nuclear use or launching nonnuclear attacks on dual-use command and control systems. Dialogues on these topics, which the Trump administration emphasized, should be continued.

Negotiation of a New START Follow-on

Even if New START is extended, the United States and Russia will be pressed for time to negotiate a successor agreement. It is difficult to imagine that they will be doing so in a decidedly better political relationship. Therefore, **the most feasible objectives would be to:**

> **Use the framework and verification approach of New START to further reduce deployed strategic delivery systems, launchers, and warheads, and to apply limits to new technologies that are strategically significant but not technically covered by New START. The aim should be to enhance stability and, as much as possible, lower the scale of global catastrophe if deterrence fails.**

Specifically, the agenda for follow-on negotiations should address Russia's intercontinental ground-launched boost-glide weapons, nuclear-powered torpedoes, nuclear-powered cruise missiles, and air-launched ballistic and boost-glide missiles.[181] The United States' air- and sea-launched boost-glide missiles now under development also would need to be included. In addition to limiting U.S. ballistic missile defenses, Russian negotiators obviously will posit additional priorities. These would likely include more specifically limiting the number of nuclear warheads that covered aircraft may deploy. (Under New START counting rules, each bomber plane counts as one warhead against the overall limit of 1,550, although each bomber may carry 6 to 20 nuclear weapons when deployed.)[182] Russia also would at the very least demand that the United States redress its concerns over SLBM and B-52H conversions.[183]

Strategists often argue that targeting and operational objectives should be decisive in determining numerical limits for weapons, and that lowering numbers for their own sake is astrategic. Yet somehow, for decades, the target-based logic produced overkill in the quantity of deployed nuclear weapons, and successive new administrations repeatedly sought to correct this issue.[184] Indeed, throughout much of the Cold War, military planners searched for targets to match the growing number of weapons on hand or in the pipeline. In this sense, the number of available weapons set a "budget" for targeting. If the number and explosive yields of weapons that that United States and Russia wield today could produce global climatic (and fallout) catastrophe in an all-out nuclear war, the strategic and legal case can be made to set a "destructiveness budget" to limit the number and yields of their arsenals. The numbers of weapons that the United States and Russia possess and deploy in toto today belie claims that targeting "requirements" are so precise. All treaties to date adopt limits in increments of fifties of weapons, not tens or ones.[185]

In 2013, the Pentagon concluded that the United States could fulfill its strategic deterrent requirements with 1,000 weapons under New START counting rules. In other words, the United States could unilaterally reduce by more than 500 deployed strategic warheads below New START warhead limits. The Obama administration made a political judgment not to pursue this course, and instead to reduce further only with reciprocity from Russia.[186] For their part, unofficial Russian experts also have spoken and written of making a deployed warhead limit of 1,000 an objective for a follow-on agreement to New START.[187]

One reason for making 1,000 an objective is that it would still leave the United States and Russia with strategic weapons numbering in four digits, signifying their strategic superiority compared with the three digits of the next largest nuclear arsenals, France (300) and China (low 200s and growing). The attraction of this symbolism is understandable from several perspectives, but it is a liability from others. The rest of the world, particularly most of the 185 non-nuclear-weapon states under the NPT, are so frustrated with the lack of progress in nuclear disarmament that they support the 2017 UN Treaty on the Prohibition of Nuclear Weapons. To the extent that the nuclear nonproliferation regime remains important for international security, keeping these states invested in that regime is an important objective. A U.S.-Russia agreement that brought both countries' arsenals below the 1,000-warhead threshold could be useful in this regard. It is ridiculous to argue that either the United States or Russia would be less secure with, say, 999 operationally deployed strategic weapons than they would be with 1,000.

Whatever number negotiators would seek, another key strategic objective should be to reduce the weapons that are the greatest source of instability and environmental damage in a potentially escalatory conflict. Those are silo-based ICBMs, especially ones with multiple warheads. (See chapter 4 for the problems associated with these weapons.)

Whatever number negotiators would seek, another key strategic objective should be to reduce the weapons that are the greatest source of instability and environmental damage in a potentially escalatory conflict.

There are roadblocks to negotiating the eventual elimination of silo-based ICBMs. Russia continues to depend on multiple-warhead silo-based ICBMs as a cost-efficient way to deploy large numbers of warheads.[188] The warheads on these large ICBMs ostensibly pose the greatest risk to the geographically vast U.S. ICBM launch facilities. As U.S. missile defenses advance, the Kremlin places more importance on this objective.[189] Even as Russia has shifted more of its deployed strategic nuclear forces to mobile ICBMs over the past ten years, it is replacing the aging SS-18 heavy-silo ICBM with the even larger Sarmat, which will be deployed in the 2020s. The Sarmat and a variant of the SS-19 silo-ICBM also serve as planned delivery systems for the Avangard boost-glide vehicle. Russia chose to advance the Avangard-carrying missiles over certain mobile ICBM systems in its ten-year armament

plan.[190] This decision may reflect a priority on countering U.S. homeland missile defenses. In that case, Avangard—if retained while Russia reduces other multiple warhead ICBMs—could help reassure Russia that U.S. homeland missile defenses will not negate Russia's deterrent.

Both countries' armed forces and military-industrial complexes are attached to silo-based systems.[191] Nevertheless, the United States and Russia also have a shared interest in reducing them. Each side's silo-based ICBM force largely justifies the modernization of the other's. The strategic interactions between the two create incentives to prepare for and possibly use ICBMs in preemptive strikes. This dynamic, while meant to strengthen deterrence, can also weaken crisis stability and create opportunities for inadvertent escalation. Stability could be enhanced instead by increasing the ratio of highly survivable delivery systems in each country's nuclear force and discarding less survivable systems, recognizing that survivability requires a weapon to be able to penetrate adversary defenses.

The timing is right within each country's modernization programs to halt or limit new (or replacement) silo-ICBM deployments. Each country's domestic military budgeting, development, and operational planning for future silo-ICBMs is not finished. Russia's Sarmat is nearing the end of its development cycle, but not deployed yet. The GBSD is still on the drawing board. The development of each missile will advance rapidly in the next two to three years. After deployment, Washington and Moscow (and their respective silo-ICBM stakeholders) will be less inclined to eliminate the new missiles. Before deployment, GBSD and Sarmat represent good starting points for the traditional horse-trading that accompanies preparation for arms control negotiations. An agreement to not deploy, or to reduce newly deployed silo-ICBMs (by replacing older ones on a less than one-to-one basis), could be an early confidence-building measure by the parties while the details of a New START follow-on are jointly pursued.[192]

Finally, the United States and Russia still share an interest in limiting MIRVed silo-based ICBMs. Both countries committed to these limitations in order to enhance strategic stability under the START II Treaty, even though the treaty never entered into force. This goal is still important. Reducing silo-based ICBMs would reduce the most destabilizing type of MIRVs—those that are fixed and therefore prone to strategic instability. Although Russia's interest in MIRVs remains strong—and is well explained by Russian Ministry of Foreign Affairs official Vladimir Leontiev—the possible deployment of a new U.S. ICBM and other modern delivery systems could create incentives to negotiate.[193]

The specifics of an agreement which would reduce silo-ICBMs obviously must be left to arms control negotiators with access to confidential information on U.S. and Russian force structures. **The U.S.-Russian proclivity to seek numerical parity across kinds of delivery systems as well as overall warheads will require creative force-structure planning and negotiating. If either or both governments move beyond demands for parity of numbers and focus instead on stability, more options for agreement would arise.**

Nonbinding Confidence- and Security-Building Measures

The United States and NATO are deeply concerned by Russia's large and technically improving stockpile of NSNW. Russia is agitated by the possibility that the United States could and would modify and use Aegis Ashore launchers to conduct offensive missile strikes against Russia, notwithstanding these launchers' stated purpose of defending Europe from missile threats emerging from the Middle East (for instance, Iran). Russia also is alarmed by the possibility of the United States deploying B61 nuclear bombs in Poland.

Treaties are unlikely to address these concerns, for both technical reasons and the general political difficulty of the ratification process in Washington. This does not mean that nothing can be done. Transparency and other confidence-building measures can be imagined that would redress the concerns of the United States, NATO, and Russia. Given that each side has different concerns regarding different weapons systems, the most feasible way to find mutual satisfaction would be to negotiate a basket of arrangements that would in total and on balance make everyone better off than they are today. Three possible examples of such arrangements are worth a closer examination.

The United States and Russia should consider reciprocal inspections of empty nonstrategic warhead facilities.

To date, the United States and Russia have made little progress in increasing mutual transparency regarding NSNW. An intrusive agreement to inspect active warhead storage facilities is not now politically feasible. However, inspecting empty formerly active warhead storage facilities on NATO and Russian territory would serve several important purposes.

First, it would demonstrate that an inspection regime for NSNW is feasible. Each country would gain valuable information on the types of NSNW storage practices and facilities that the other side possesses.

Second, such inspections could reduce fears that either side has secretly located nondeployed breakout potential in nonstrategic warheads. NATO suspicions that nuclear warheads may be stored in Kaliningrad—creating near nuclear-capable missile forces that could strike Alliance territory with little warning—could increase incentives to strike Russian forces in the enclave early in a conflict. If NATO were able to confirm that Kaliningrad storage facilities did not have these types of warheads, the knowledge could attenuate its worst-case scenario planning for a regional nuclear war. A reciprocal arrangement regarding storage facilities in NATO states could similarly reduce Russian incentives to strike first.

Third, negotiators could adapt an inspection regime for empty warhead facilities into an agreement for inspecting active storage facilities, rather than attempting to negotiate a comprehensive active-warhead storage facility inspection regime from scratch.[194] Such an arrangement could help develop additional transparency measures regarding Russia's NSNW in Europe, which are of particular concern to some NATO members.

NATO should issue a *public* commitment to refrain from modifying Aegis Ashore launchers deployed in Deveselu, Romania, to contain offensive missiles, such as the Tomahawk land attack cruise missile.

Following U.S. and Russian termination of the INF Treaty and subsequent U.S. land-based missile tests, Russia has concerns that Aegis Ashore could be modified to launch nuclear-armed offensive missiles. The United States regularly notes that loading offensive missiles into stationary, easy-to-target Aegis Ashore launchers would be foolish from an operational perspective; however, it has not forsworn the possibility. Yet the United States did confirm in its bilateral agreement with Romania that the Aegis Ashore site can be used only for SM-3 interceptors for defensive purposes.[195] To assuage Russian concerns, the United States, Romania, and NATO could issue a joint statement that the sites will only be used for defensive purposes, and make a commitment to refrain from bringing offensive missiles to the site.

Following the political commitment, NATO should provide transparency into the technical capabilities of SM-3 interceptors based in Europe, to confirm they are technically unable to intercept Russian ICBMs.

U.S. missile defense experts continue to argue that SM-3 interceptors do not have a technical capability to intercept Russian ICBMs from Europe. Currently, the SM-3 Block IB interceptors based in Romania have a burnout speed of 3 kilometers per second (kps) and a range of a few hundred kilometers. The SM-3 Block IIA, when deployed, may have a higher burnout speed of 4.5 kps with a range of thousands of kilometers. The United States tested the new missile against an ICBM target in November 2020. This test reinforced Russian suspicions of U.S. intentions regarding missile defense.

For the reasons discussed in chapter 5, increasing confidence that U.S. missile defenses cannot negate Russia's nuclear deterrent is a prudent step to lessen bilateral arms racing and first-strike pressures. In 2011, the United States offered to allow Russia to observe the test of an SM-3 Block IB interceptor and use its own equipment to measure that interceptor's burnout speed. Although Russia declined then, the United States could revisit this proposal for Block IB and, prior to their deployment, Block IIA interceptors. Initiating the proposal is important for European political reasons regardless whether Russia accepts the offer. The United States should share its deployment plans and schedule for new SM-3 missiles on land and at sea as part of a new strategic arms control negotiation and explore additional transparency steps.[196]

BRINGING CHINA INTO ARMS CONTROL

American and allied interests would be served by meaningful U.S.-China security dialogue. Such dialogue could explore how confidence-building measures and arms control could help avoid a destabilizing and costly open-ended arms competition that could significantly increase catastrophic consequences if deterrence fails. Serious, sustained dialogue leading up to potential confidence-building measures and arms control could lessen the chances that skirmishes could escalate into conflict and armed conflict could escalate to nuclear war.

The United States and its allies and partners also share interests in encouraging China to affirm in words and deeds its long-standing comparatively restrained approach to nuclear weaponry and potential use. For the past five decades, China has maintained a relatively small nuclear stockpile and has committed not to use nuclear weapons first. Furthermore, Chinese eschewal of nuclear arms racing (if credibly continued) would reduce the imperative India feels to build up its nuclear and missile-defense capabilities. This, in turn, should reduce Pakistan's incentives to augment its nuclear capabilities against India.

China has some understandable reasons for being reluctant to engage the United States in dialogue on strategic stability and (potentially) confidence-building and arms control. Chinese leaders note that the U.S. and Russian nuclear arsenals each are roughly 10 to 15 times larger than China's, depending on the means of calculation. For years, Beijing has said that it would consider joining nuclear arms control only when the United States and Russia have reduced their nuclear arsenals to levels much closer to its own.[197] Washington and Moscow have categorically refused even to discuss this prospect.

The United States has affirmed that "it is not our intent to negate Russia's strategic nuclear deterrent, or to destabilize the strategic military relationship with Russia." Chinese analysts note that Washington has not articulated a similar policy toward China.[198] Instead, they perceive that the United States maintains a preemptive counterforce damage limitation strategy, based on expansive conventional and nuclear weapons and missile defense capabilities, to target China's smaller nuclear arsenal. The 2019 Missile Defense Review states that

"The United States relies on nuclear deterrence to address the large and more sophisticated Russian and Chinese intercontinental ballistic missile capabilities," but Chinese analysts retort that the 2018 NPR and other statements by U.S. officials do not indicate that U.S. policy is based on mutual vulnerability.[199] How would arms control serve any state's interests if the counterpart pursues it to maintain or seek unilateral advantage instead of stabilizing mutual deterrence and mitigating the potential for conflict escalation?

In order to motivate China even to explore the possibilities of arms control discussions, Washington must do something that no prior administration has yet publicly done: demonstrate willingness to address China's concerns about certain U.S. offensive and defensive military capabilities and intentions that may be inferred from them.

U.S. officials explain privately that the United States has not publicly acknowledged that mutual nuclear vulnerability is inescapable with China because doing so would complicate the United States' security reassurance of Japan. This consideration is understandable but it does not address the destabilizing consequences with regard to China, which are not in the interest of the United States, Japan, and other allies and partners. Publicly basing policy toward China on mutual nuclear vulnerability, rather than preemptive nuclear counterforce, could motivate Japan and other U.S. allies and partners to join the United States in enhancing non-nuclear capabilities to deter or defeat Chinese offensive military operations. However, domestic politics in Washington impede this prospect. Officials from prior Democratic administrations note privately that explicitly basing nuclear policy toward China on mutual vulnerability would elicit such condemnation from Republicans in Congress that the gains of doing so would not be worth the political cost. Yet this political calculus merely reinforces Chinese skepticism that the United States would be willing to pursue arms control or other equitable arrangements.

Chinese officials and analysts are also chary of the intrusive verification requirements that the United States (and Russia) traditionally demand with arms control. In their view, the United States would use transparency and verification measures to enhance targeting of China's smaller arsenal. As the weaker party—one whose government tightly controls information—China feels that opacity enhances the survivability of its deterrent. This tendency may be exacerbated by the lack of institutional knowledge and experience with verification within the Chinese government, especially at the highest levels. Unlike the United States and Russia, China lacks large cadres of diplomats, military officers, and scientists deeply versed in arms control and verification.

For these and other reasons, it will be extremely difficult to draw China into sustained dialogue and, eventually, negotiations to verifiably limit the growth of its nuclear and other relevant military capabilities. However, as China modernizes and grows its arsenal, it will

have less basis for claiming that its forces are too comparatively imbalanced to allow a fair negotiation.

In order to motivate China even to explore the possibilities of arms control discussions, Washington must do something that no prior administration has yet publicly done: demonstrate willingness to address China's concerns about certain U.S. offensive and defensive military capabilities and intentions that may be inferred from them. Willingness to discuss these issues, informed by sustained consultation with U.S. allies and partners, need not imply commitments to limit or reduce them. However, refusal to address them will confirm Chinese leaders' views that dialogue and arms control are ruses to perpetuate U.S. military superiority.

The United States' willingness to limit its military competition with China, in turn, will depend heavily on China's willingness to demonstrate its understanding that strategic stability requires not using force or physical actions to change the territorial status quo, which could lead to crises with escalatory potential. The United States could facilitate a strategic stability conversation with China that includes these factors along with a discussion of military capabilities. If China is not prepared to reassure the United States and others—particularly Taiwan—of its willingness to refrain from territorial expansion in deeds and not merely words, then the United States should be expected not to constrain deployments of additional non-nuclear capabilities to defend its allies and U.S. forces in Asia.

To reverse the recent downward spiraling in U.S.-China relations, the two governments might begin by encouraging track 1.5 dialogues on these issues. Such dialogues have occurred for years, but often lacked imprimaturs and directives from the highest civilian and military leaderships. As a result, they generally have not led anywhere. **To be productive, civilian and military leaders at the highest levels must encourage such dialogue, meet with participants from their own country to discuss and establish objectives, and then ask to be briefed on results.** This would entail little cost or risk to either side.

The following three topics of substantive value would enable American and Chinese counterparts to assess prospects for further beneficial work.

Limit aggregate numbers of launchers for delivery systems with ranges greater than 500 kilometers.

Seeking mutually acceptable balances in nuclear forces alone—delivery systems and warheads—would work only if both the United States and Russia considered reducing to levels close to China's (or, conversely, would agree to "allow" China to build up close to theirs).

Neither scenario is likely, though U.S. and Russian agreement to further reduce their deployed strategic warheads to 1,000 or less may provide incentive to China to negotiate in other areas.

More realistically, the United States, Russia, and China (bilaterally or trilaterally) could explore how to aggregate heavy bombers and launchers for missiles with ranges greater than 500 kilometers into a common "basket," whether they carry nuclear or conventional warheads. On that more equitable basis, they could negotiate numerical limits. But even if this innovation were accepted, asymmetries in numbers of land-based versus sea- and air-based capabilities, and attendant verification challenges, make this an exceptionally complicated prospect. Missile defenses—especially those of the United States and its allies—add to the challenge.

However, with the demise of the INF Treaty, the potential for an intermediate-range missile race in the Asia-Pacific regions needs to be addressed. Some U.S. and allied experts believe that China has already been "racing" unilaterally. It was never a party to the INF Treaty and therefore has been free to produce and deploy land-based missiles with ranges between 500 and 5,500 kilometers, which the United States—until recently—was prohibited from doing.[200] Ever since the INF Treaty was terminated in 2019, the United States has conducted flight tests for two new land-based missile systems. China recently debuted an intermediate-range hypersonic boost-glide system that may be dual-capable.[201] Russia, for its part, has developed the SSC-8 ground-launched cruise missile and is deploying the dual-capable Kinzhal ALBM.[202]

Though the potential increased deployment of dual-capable (nuclear and conventionally armed) missiles of this range is alarming, it also could create a basis for future limitations. Unlike the huge disparities in both countries' long-range missile arsenals, their numbers of land-, air-, and sea-based missile *launchers* (including heavy bombers) with ranges greater than 500 kilometers are roughly similar.[203] This rough parity could create an equitable political and a military basis for negotiations, which could take into account systems that otherwise would be accountable under New START and the now defunct INF Treaty.

Heuristically, an agreement could establish a single ceiling for U.S., Russian, and Chinese submarine-based ballistic missile launchers, land-based silo and mobile launchers for ballistic and cruise missiles, and heavy bombers based on their definitions in the INF and New START treaties.[204] Each country could be permitted the "freedom to mix" nuclear and conventionally armed missiles on delivery platforms as necessary to satisfy military requirements, so long as the number of total launchers and heavy bombers remains under numerical ceilings. Such an agreement could help curtail an accelerating area of competition and create a basis for further multilateral arms reductions. Even if the complexity of the challenge, especially regarding verifiability, proved insurmountable to negotiators, the process of exploring these issues could point to other ways to mitigate instability.

Demarcate regional missile defenses.

The United States says that its interest in missile defense is primarily to defend against North Korean nuclear-armed missiles that could threaten U.S. and allied bases and forces in the Asia-Pacific region as well as U.S. and allied homeland population centers. China has little interest in North Korea being able to wage nuclear war in the region. Washington and Beijing, then, could explore the desirability and feasibility of conducting a joint technical study of a potential U.S. missile defense system that could defend against North Korean missiles but would not undermine China's second-strike nuclear deterrent by intercepting its long-range missiles.[205] As with Russia, albeit on a smaller scale, China's development of MIRVed and maneuverable boost-glide intercontinental delivery systems to evade U.S. homeland defenses could ameliorate China's concerns, even as they aggravate American worries. In such discussions, all systems can be on the agenda.

Understand risks of cyber operations against nuclear command and control systems.

A third topic for U.S.-Chinese dialogue could be both countries' concerns over potential cyber threats to their NC3 systems. The authors have devoted more attention to this exceedingly complex and sensitive topic elsewhere.[206] Defense leaders in both countries would benefit from sharing views on which types of cyber operations and countermeasures they would find particularly escalatory. Both sides also could benefit from exchanges of information on their internal processes for overseeing cyber capabilities. Cyber operators may not know as much about nuclear dynamics as they should, and political leaders may not know as much about cyber dynamics as they should. Discussing how militaries may plan to respond to cyber threats to one another's NC3 systems can help foster stability.

Neither government's leadership would lose much, if anything, if dialogue on any of these topics (or others) indicated little progress toward developing an agenda for productive further work. Conversely, if the United States and China could agree on an agenda for useful further work, experts in and out of both governments could begin to develop problem-solving approaches that have been absent heretofore. Debate and refinement of such approaches could then prepare the ground for official dialogue and confidence-building measures when broader political conditions allow. There does not appear to be another way to bring China into arms control.[207]

ADVANCING THE BROADER NUCLEAR DISARMAMENT AGENDA

As a co-creator and longtime champion of the NPT, the United States (along with other nuclear-weapon states) must take seriously its obligation to pursue good-faith negotiations on effective measures relating to the cessation of the nuclear arms race and to nuclear disarmament. Remarkably, neither the United States nor any other nuclear-armed state has bothered even to model how they would define nuclear disarmament of their state and others, and how they would expect to verify and enforce such disarmament. Effective, sustainable nuclear disarmament of any nuclear-armed state requires much more than dismantling warheads and controlling fissile material stocks.[208] Disarming states would need to agree (presumably with each other) what types and numbers of delivery systems—especially missiles—would be permitted or forbidden, and how monitoring to ensure compliance with such terms would not encroach on monitored states' legitimate security interests. Both nuclear-armed and non-nuclear-weapon states would need to determine what peaceful nuclear or space activities would remain during and after nuclear disarmament, and under what reassurance and monitoring conditions. At least some states likely will press for monitorable limits on research and development activities that could be vital to reconstituting nuclear arsenals.

To demonstrate that it takes Article VI of the NPT seriously, the United States should design a prototype nuclear disarmament regime that would encompass all states and invite international discussion and debate.[209] Specialists from all relevant agencies in the U.S. government should contribute to this effort—most obviously, the Department of Defense, the Department of Energy and the national laboratories, the Department of State, and the intelligence community. The United States should invite all other nuclear-armed states to do the same if they do not concur with the U.S. model.

The United States should also continue the multilateral dialogue initiative, Creating the Environment for Nuclear Disarmament, and the International Partnership for Nuclear Disarmament Verification. Both multilateral forums provide useful dialogue opportunities for nuclear-weapon states, umbrella states, nonaligned states, NPT parties, and non-NPT parties. These discussions are productive and substantive, and are designed to find solutions to security and technical challenges to nuclear disarmament.

Finally, the next administration should commission the National Academy of Sciences (including its Committee on International Security and Arms Control) to evaluate extant studies on the possible climatic effects of nuclear war. Some studies dating from the early 1980s through 2019 have concluded that nuclear war involving the strategic forces of the United States and Russia would likely produce fires that would loft smoke into the stratosphere sufficient to cause "nuclear winter," with devastating consequences for food production in the United States and globally. Studies of much more limited exchanges of

Indian and Pakistani nuclear weapons (a total of one hundred 15-kt weapons) also would produce severely disruptive global climatic effects.[210] All of these studies can be and are disputed.[211] The national security imperative here is to enable U.S. decisionmakers and citizens to better understand the potential consequences of nuclear-weapons use. It can also raise the question of whether reductions in the numbers and yields of weapons, and changes in target selection, would reduce the likelihood of unnecessary suffering in the event that deterrence fails.

If the academy concludes that a new study (or studies) is warranted, the U.S. government should fund it. Such a study should consider scenarios for U.S.-Russian and U.S.-Chinese nuclear exchanges, drawn from Defense Department (including USSTRATCOM) war games. An unclassified version should be made freely available to invite international discussion and debate. The United States should welcome similar studies by other nuclear-armed states and be prepared to engage in discussions with counterparts on them.

CHAPTER 7

CONCLUDING THOUGHTS: NUCLEAR POSTURE FOR 2021 AND BEYOND

The number of countries that pose threats requiring the United States to maintain nuclear weapons is few, as are the threat scenarios that would make it necessary and prudent for a U.S. president to order the use of these weapons. This good news is the result of many factors, not least of which is the essential caution that nuclear weapons inspire in those who possess them and those who may be targeted by them. Yet the present need for nuclear deterrence in general does not take policymakers and citizens very far in determining "how much is enough" to deter given adversaries, or in determining "how much is too much." Policymakers often err on the side of caution, but what is cautious depends on context and how risks are defined. During the Cold War, an overly cautious approach to "how much is enough" led the United States and the Soviet Union to accumulate nuclear arsenals with enough destructive power to wipe out much of humanity.

The number of countries that pose threats requiring the United States to maintain nuclear weapons is few, as are the threat scenarios that would make it necessary and prudent for a U.S. president to order the use of these weapons.

For those whose primary job is to deter major warfare, especially nuclear war, and to prevail if deterrence fails, caution means ensuring that one's own military has a sufficient variety and numbers of conventional and nuclear weapons systems and plans to use them to counter those held by one's strongest adversary. This perspective operates in the defense estab-

lishments of most nuclear-armed states, including the United States. While nuclear parity is not necessary to deter Russia, no U.S. political candidate or party wants to compete for elections by arguing it is sufficient for the United States to have fewer nuclear weapons than Russia or anyone else. This is why "second to none" is the politically safe policy to espouse. But if risk and national security requirements are assessed in a wider, more holistic context, the question "how much is enough?" must be balanced by also asking "how much is too much?" Are there conventional force postures, or specific types and numbers of nuclear weapons and targeting policies, that make the risk of starting or escalating nuclear war unnecessarily high, and make the prospect of global catastrophe too likely? Are the probability and consequence of deterrence failure with U.S. and Russian arsenals worse than the risk of failure with less destructive arsenals more like those of the seven other nuclear-armed states?

There are no certain answers to these questions—not in the United States, Russia, China, or anywhere else. The challenges and dilemmas inherent in answering these questions are too broad and portentous to leave them to defense establishments to resolve. Other policymakers, as well as informed citizens, need to be more engaged in these issues. The analyses and recommendations offered in these pages are debatable. Indeed, our objective is to encourage open, informed national and international debate on U.S. nuclear policy and that of its competitor countries in this domain.

APPENDIX A

FURTHER EXPLORATION OF THE MINUTEMAN III LIFE EXTENSION

While this report was in production, debate intensified over the feasibility of extending the life of Minuteman III. As a result, we concluded it would be useful to elaborate on our initial discussion of the ICBM force.

U.S. military officials, members of Congress, and other proponents argue that the service life of Minuteman III missiles cannot be extended. The USSTRATCOM commander, Admiral Charles Richard, recently said: "You cannot life-extend Minuteman III. . . . It is getting past the point of [where] it's not cost-effective to life-extend Minuteman III. You're quickly getting to the point [where] you can't do it at all."[212]

These assertions deserve examination. Three questions should drive the new administration's and Congress's analysis and decisionmaking on the ICBM issue:

- Is it technically possible to extend the life of Minuteman III?
- Are the costs and risks of extending Minuteman III less than those of proceeding now with GBSD?
- Are the net benefits of pausing GBSD greater than the benefits of proceeding with it now?

We offer brief answers to these questions here, while urging Joe Biden's administration to commission independent technical experts to study how Minuteman III life extension could be accomplished. (Such a study was proposed by members of Congress in the

FY 2020 National Defense Authorization Act.[213] However, Congress voted not to support it, reportedly under intense pressure from Northrop Grumman, which is slated to produce the GBSD replacement to Minuteman.)

TECHNICAL FEASIBILITY

In 2014, the U.S. Air Force conducted an "analysis of alternatives" to examine options to life extend or replace the Minuteman III.[214] The posited requirement was an ICBM inventory of at least 400 deployed missiles through 2075. (This assumption that the ICBM force would not be eliminated or reduced before 2075 is difficult to reconcile with U.S. disarmament obligations under Article VI of the Nuclear Non-Proliferation Treaty.)[215]

Basing analysis on a straight-line requirement projected all the way to 2075 practically predetermines the outcome. A more appropriate study would consider how long and at what cost Minuteman III could be extended under several scenarios. There is no inalterable security imperative behind the number 400 and the year 2075. Four hundred is the number the United States *chose* to deploy in a force structure designed to meet New START limits.[216] However, the Pentagon concluded in 2013 that U.S. deterrence objectives could be met with unilateral reductions of up to one-third of the deployed arsenal—that is, reducing the deployed warhead count of approximately 1,500 warheads to 1,000. U.S. leaders could conclude now or in the next decade that a lower number would suffice—because the United States does not need this many warheads to deter Russia, or new reductions are negotiated with Russia. Or, leaders could decide, for any number of reasons, to shift some number of warheads (or all) from ICBMs to submarine-based missiles. A Biden administration review of nuclear policy should determine the number of deployed warheads the United States needs to achieve its deterrence objectives, as was done in 2013.

The independent study should also evaluate the risks that the Air Force assumes in extending Minuteman III compared with risks it posits in GBSD production. The study would also need to determine which missile components can be overhauled, which can be taken from withdrawn missiles and reused in retained ones, and which would have to be built anew. (A RAND Corporation study concluded that incremental service life extension programs were feasible, and the least costly option for maintaining an ICBM force.[217]) And, as suggested above, the study should assess whether and how lowering the posited required number adds to the feasibility and reduces the cost of extending Minuteman III relative to building GBSD.

Relatedly, the second line of questioning should be whether the current rate of destructive testing of ICBMs is necessary. The Air Force's current practice of conducting (on average) 4.5 live-fire tests per year would reduce the Minuteman III stockpile below 400 deployed missiles by the year 2040.[218] If fewer missiles are consumed in flight tests, the existing

stockpile would last longer and more parts could be taken from some missiles to refurbish others. A reduced test rate combined with other refurbishments could enable the Air Force to maintain 400 deployed Minuteman IIIs through 2050.[219] We discuss a few potential steps below.

Solid rocket motors (SRMs) are destroyed in the Air Force's current process of testing their reliability. Yet, advances in modeling and simulation may reduce the need for destructive testing. Nondestructive testing methodologies, such as using ultrasound and computed tomography may suffice, according to SRM manufacturers and Air Force rocket propulsion experts.[220] We understand that the U.S. Navy uses nondestructive testing on Trident SLBM rocket motors—it has been doing so for at least the past two decades. More generally, it determines the health and remaining life of its missiles differently than the Air Force does.[221] It would be useful for the recommended commission to assess the relative merits of the two services' approaches.

Additionally, the Air Force's methodology for estimating Minuteman SRM operational lifetimes uses a much higher standard of reliability than is applied to aging ICBM motors used to launch payloads for the space program.[222] If the Air Force thinks the Minuteman rocket motors are becoming unreliable, it should explain how many of these same vintage (and often even older) rocket motors are used to launch payloads for the space program without problem.

A separate, but relatively simple life extension issue is the aging of Minuteman solid propellant. Propellant across the missile force may begin to age and become unreliable between 2029 and 2036. The Biden administration study should assess whether a new round of solid propellant replacements, coupled with other life extension efforts, would reliably extend the Minuteman force's life another twenty or more years.

The Congressional Budget Office and outside experts include a guidance system replacement in cost estimates for a Minuteman life extension program to maintain a reliable missile force into the 2040s. GBSD proponents assert that the new missile, with a new guidance system, will be more modular and easily upgraded than the current Minuteman guidance system, resulting in savings later in the new ICBM's life cycle.[223] The Air Force should explain what military requirements make the planned GBSD guidance system necessary. An independent commission should examine these issues, too.

As Steve Fetter and Kingston Reif argue, the Air Force has not actually determined that a Minuteman III life extension is technically infeasible. In fact, an Air Force official testified in March 2019 that "one more" Minuteman III life extension is possible before a new missile is needed.[224] These technical issues deserve thorough examination by an independent commission.

COSTS AND RISKS OF MINUTEMAN EXTENSION VERSUS BUILDING GBSD

The lifetime cost of the GBSD is estimated at $264 billion.[225] History suggests the actual costs would be much higher, and that it would impose difficult trade-offs. The former Air Force secretary, Heather Wilson, described the cost issues associated with nuclear modernization succinctly:

> "I think the next budget [FY 2022] is the first one with a steep slope for the cost of refurbishing the nuclear deterrent. Replacing the Minuteman, replacing the Air Launched Cruise Missile, and the B-61, while upgrading the B-52, will take a lot of money. Historically, nuclear modernization has been handled in several different ways. But the Air Force can't do this from inside a relatively static top line for the Air Force without crushing its ability to handle all of its other missions."[226]

The vulnerability of silo-based ICBMs and their other deficiencies compared with submarine-deployed weapons should make the ground leg of the historically sacrosanct triad expendable. It makes little sense to invest in a new generation of over 400 ICBMs without exhausting the possibility that arms reduction agreements could be reached over the next decade or two that would obviate the perceived need for ICBMs through 2075. These are the weapons that would be most strategically desirable to reduce from the U.S. force, either unilaterally or by negotiation.

The only obvious risk of pausing on GBSD and taking steps necessary to extend Minuteman would be if the latter somehow experienced a stockpile-wide technical failure without sufficient warning to allow GBSD to be built. However, if such a failure occurred while an arms control agreement limits new ICBMs, the United States could upload a significant number of warheads to SLBMs and bombers if leaders felt it was important to do so, as both the Obama and Trump administrations acknowledged. And if there are no arms control limits on U.S. and Russian forces, U.S. leaders could readily decide to build GBSD.

PAUSING GBSD VERSUS PROCEEDING WITH IT NOW

The study commission we recommend should assess the net cost differential between extending Minuteman and building GBSD not only between now and 2075, but also between now and 2040 (and perhaps another intermediate time). It is reasonable to think that pausing GBSD would save some money in the short term and defer a major long-term expenditure. Refurbishing Minuteman will not be cheap, but, again, the cost would depend on the number of weapons that are to be deployed over time.

Pausing GBSD could add to Russia's incentives to negotiate follow-on arms reductions if New START is extended. It would be reasonable for Russians and others to assume that after the United States expends new money to build a certain number of new ICBMs, it will be less likely to negotiate their reduction or elimination than it would be now to reduce or eliminate much older systems. (A similar logic should motivate U.S. leaders to pursue a new reduction agreement with Russia before it deploys the new heavy, MIRV-capable Sarmat ICBM.)

If GBSD were being built, but still not deployed, the United States could retain some negotiating leverage, but that would make the GBSD an expensive bargaining chip, which in turn creates domestic dynamics that work against negotiating or ratifying agreements to limit such weapons. Congressional and bureaucratic stakeholders would likely pressure the Defense Department to deploy the missile across existing ICBM bases to the benefit of military and civilian constituencies in those areas and oppose efforts to "trade" the new missile away in arms control negotiations.[227]

CONCLUSION

In sum, ICBMs are the most problematic delivery system in the U.S. nuclear deterrent, but they have constituencies that effectively resist eliminating them. GBSD is not needed now because Minuteman can and should be extended for at least some years, and in the intervening time the desirability and feasibility of further extension versus proceeding with GBSD should be independently assessed. Extension of Minuteman III eventually requires obtaining components from withdrawn weapons, meaning that the deployed force would need to be less than 400. Warheads removed from Minuteman in order to allow refurbishment could be substituted for with SLBM uploads, if necessary. Preferably, the United States could negotiate reductions in strategic warheads with Russia such that switching from Minutemen to uploaded SLBMs would not be necessary.

APPENDIX B

MISSILE DEFENSE TESTS: PURPOSES AND OUTCOMES

AEGIS/SM-3 TESTS

Date	Interceptor	Target	Range	Success/ Failure
1/25/02	SM-3	Unitary short-range (TTV)	Short	Success
6/13/02	SM-3	Unitary short-range (TTV)	Short	Success
11/21/02	SM-3	Unitary short-range (TTV)	Short	Success
6/18/03	SM-3	Unitary short-range (TTV)	Short	Failure
12/11/03	SM-3	Unitary short-range (TTV)	Short	Success
2/24/05	SM-3	Unitary short-range (TTV)	Short	Success
11/17/05	SM-3	Separating short-range (MRT)	Short	Success
5/24/06	SM-2 Block IV	Unitary short-range (Lance)	Short	Success
6/22/06	SM-3	Separating short-range (TTV)	Short	Success
12/7/06	SM-3	Unitary short-range (TTV)	Short	Failure
4/26/07	SM-3	Unitary short-range (ARAV-A)	Short	Success
6/22/07	SM-3	Separating short-range (MRT)	Short	Success
8/31/07	SM-3	Classified	N/A	Success
11/6/07	SM-3	Unitary short-range (ARAV-A)	Short	Success
11/6/07	SM-3	Unitary short-range (ARAV-A)	Short	Success
12/17/07	SM-3	Separating short-range (MRT)	Short	Success
6/5/08	SM-2 Block IV	Unitary short-range (FMA)	Short	Success
11/1/08	SM-3	Unitary short-range (ARAV-A)	Short	Success

11/1/08	SM-3	Unitary short-range (ARAV-A)	Short	Failure
11/19/08	SM-3	Separating short-range (MRT)	Short	Failure
3/26/09	SM-2 Block IV	Unitary short-range (Lance)	Short	Success
7/30/09	SM-3	Unitary short-range (ARAV-A)	Short	Success
10/27/09	SM-3	Separating short-range (MRT)	Short	Success
10/28/10	SM-3	Separating short-range (MRT)	Short	Success
4/14/11	SM-3	Separating intermediate range (LV-2)	Intermediate	Success
9/1/11	SM-3	Separating short-range (ARAV-B)	Short	Failure
5/9/12	SM-3	Unitary short-range (ARAV-A)	Short	Success
6/26/12	SM-3	Separating short-range (MRT)	Short	Success
10/25/12	SM-3	Separating short-range (ARAV-B)	Short	Failure
2/12/13	SM-3	Separating medium-range (MRBM-T3)	Medium	Success
5/15/13	SM-3	Separating short-range (ARAV-C)	Short	Success
9/10/13	SM-3	Separating medium-range (eMRBM-T1)	Medium	Success
9/18/13	SM-3	Separating short-range (ARAV-C++)	Short	Success
10/3/13	SM-3	Separating medium-range (ARAV-TTO-E)	Medium	Success
11/6/14	SM-3	Separating short-range (ARAV-B)	Short	Success
6/25/15	SM-3	Separating medium-range (IRBM-T1)	Medium	N/A
7/28/15	SM-6 Dual I	Unitary short-range (Lance)	Short	Success
7/29/15	SM-2 Block IV	Unitary short-range (Lance)	Short	Success
10/4/15	SM-3	Separating medium-range (eMRBM)	Medium	N/A
10/20/15	SM-3	Separating short-range (Terrier Orion)	Short	Success
11/1/15	SM-3	Separating medium-range (eMRBM)	Medium	Failure
12/10/15	SM-3	Separating medium-range (IRBM-T1)	Medium	Success
12/14/16	SM-6 Dual I	Unitary short-range (Lance)	Short	Success
2/13/17	SM-3	Separating medium-range (MRT)	Medium	Success
6/21/17	SM-3	Medium-range	Medium	Failure
8/29/17	SM-6 Dual I	Medium-range (MRBM)	Medium	Success
10/15/17	SM-3	Medium-range	Medium	Success
1/31/18	SM-3	Intermediate-range	Intermediate	Failure
9/11/18	SM-3	Simple separating	Assumed Short	Success
10/26/18	SM-3	Medium-range	Medium	Success
12/10/18	SM-3	Intermediate-range	Intermediate	Success
11/16/20	SM-3	ICBM	Intercontinental	Success

GMD TESTS

Date	Interceptor	Range[i]	Success/Failure
10/2/99	GBI	Intermediate	Success
1/19/00	GBI	Intermediate	Failure
7/8/00	GBI	Intermediate	Failure
7/14/01	GBI	Intermediate	Success
12/3/01	GBI	Intermediate	Success
3/15/02	GBI	Intermediate	Success
10/14/02	GBI	Intermediate	Success
12/11/02	GBI	Intermediate	Failure
12/15/04	GBI	Intermediate	Failure
2/14/05	GBI	Intermediate	Failure
9/1/06	GBI	Intermediate	Success
5/25/07	GBI	Intermediate	N/A
9/28/07	GBI	Intermediate	Success
12/5/08	GBI	Intermediate	Success
1/31/10	GBI	Intermediate	Failure
12/15/10	GBI	Intermediate	Failure
7/5/13	GBI	Intermediate	Failure
6/22/14	GBI	Intermediate	Success
5/30/17	GBI	Intercontinental	Success
3/25/19	GBI	Intercontinental	Success

Sources: "Ballistic Missile Defense Intercept Flight Test Record," Missile Defense Agency, U.S. Department of Defense, December 2018, https://www.defense.gov/Portals/1/Interactive/2018/11-2019-Missile-Defense-Review/ballistic-missile-defense-intercept-flight-test-record-UPDATED.pdf; Shervin Taheran, "U.S. Conducts 'Salvo Engagement' GMD Test," Arms Control Association, May 2019, https://www.armscontrol.org/act/2019-05/news/us-conducts-%E2%80%98salvo-engagement%E2%80%99-gmd-test; and "Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress," from Congressional Research Service, hosted by the Federation of American Scientists, December 23, 2020, https://fas.org/sgp/crs/weapons/RL33745.pdf.

i According to Missile Threat, all tests before 2017 were intermediate-range, which matches press descriptions of the 2017 test as the first time GMD was tested against an ICBM threat. "Ground-based Midcourse Defense – Media Resources," Missile Threat, accessed January 12, 2021, https://missilethreat.csis.org/ground-based-midcourse-defense-resources/.

NOTES

1 If other states violate their obligations under the Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty; NPT), they could then become objects of U.S. threats to use nuclear weapons to defend itself and its allies and partners, as noted in the 2010 and 2018 NPRs.

2 U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: U.S. Department of Defense, 2010), 17, https://dod.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf.

3 U.S. Department of Defense, *Department of Defense Law of War Manual* (Washington, DC: General Counsel of the Department of Defense, December 2016), 86, https://dod.defense.gov/Portals/1/Documents/pubs/DoD%20Law%20of%20War%20Manual%20-%20June%202015%20Updated%20Dec%202016.pdf?ver=2016-12-13-172036-190.

4 James A. Winnefeld Jr, "A Commonsense Policy for Avoiding a Disastrous Nuclear Decision," Carnegie Endowment for International Peace, September 10, 2019, https://carnegieendowment.org/2019/09/10/commonsense-policy-for-avoiding-disastrous-nuclear-decision-pub-79799.

5 U.S. Department of Defense, "Statement on the Fielding of the W76-2 Low-Yield Submarine Launched Ballistic Missile Warhead," February 4, 2020, https://www.defense.gov/Newsroom/Releases/Release/Article/2073532/statement-on-the-fielding-of-the-w76-2-low-yield-submarine-launched-ballistic-m/.

6 S. E. Rigby, T. J. Lodge, S. Alotaibi et al., "Preliminary Yield Estimation of the 2020 Beirut Explosion Using Video Footage From Social Media," *Shock Waves* 30 (September 22, 2020), DOI: 10.1007/s00193-020-00970-z.

7 These elements include industrial and scientific capacity associated with nuclear weapons safety, security, effectiveness, production, and dismantlement.

8 Some scholars argue that multiple factors since World War II have caused a general decline in the number and destructiveness of international conflicts, and they argue that this decline is likely to persist. The most widely known proponent is Steven Pinker, *The Better Angels of Our Nature: Why Violence Has Declined* (New York: Penguin Books, 2012). See also Michael Mousseau, "The End of War: How a Robust Marketplace and Liberal Hegemony Are Leading to World Peace," *International Security* 44, no. 1 (2019): 160–96. However, these theories are not uncontested; see Tanisha Fazal and Paul Poast, "War Is Not Over," *Foreign Affairs*, November/December 2019, https://www.foreignaffairs.com/articles/2019-10-15/war-not-over.

9 Some states may consider initiating conflict as a way, in their view, to prevent an adversary from committing an aggression or territorial aggrandizement in the near future. Others likely regard such preventive uses of force as offensive rather than defensive. The U.S. invasion of Iraq in 2003 is a recent much criticized example of preemptive use of force. China's recent behavior in and around its land and sea borders raise similar concerns of offensive behavior.

10 For example, consider Donald Trump's comments on burden-sharing in NATO (North Atlantic Treaty Organization) and his apparent consideration of U.S. withdrawal from the Washington Treaty. Steve Holland and Lesley Wroughton, "Trump Says NATO Countries' Burden-Sharing Improving, Wants More," Reuters, April 2, 2019, https://www.reuters.com/article/us-usa-nato-trump/trump-says-nato-countries-burden-sharing-improving-wants-more-idUSKCN1RE23P; and Julian E. Barnes and Helene Cooper, "Trump Discussed Pulling U.S. From NATO, Aides Say Amid New Concerns Over Russia," *New York Times*, January 14, 2019, https://www.nytimes.com/2019/01/14/us/politics/nato-president-trump.html; Michael R. Gordon and Gordon Lubold, "Trump Administration Weighs Troop Cut in South Korea," *Wall Street Journal*, last updated July 17, 2020, https://www.wsj.com/articles/trump-administration-weighs-troop-cut-in-south-korea-11595005050.

11 2018 NPR, 5

12 2018 NPR, 17.

13 The 2018 NPR states (p. 21) that "the United States will not use or threaten or threaten to use nuclear weapons against non-nuclear weapons states that are party to the NPT and in compliance with their nuclear non-proliferation obligations." The states that meet these conditions are all nuclear-weapon states, with the exception of Iran. Had the Trump administration not reneged on the Joint Comprehensive Plan of Action and Iran continued complying with its terms, there would be little reason to contemplate U.S. use of nuclear weapons against Iran.

14 Examples include the 1969 Sino-Soviet border war, the 1973 Yom Kippur War, the 1982 Falklands War, the 1983 bombings of the Multinational Force barracks and the U.S. Embassy in Beirut, the 1999 Indo-Pakistani Kargil War, the 2001 attacks on the World Trade Center and Pentagon, and the Indian and Pakistani air strikes during the 2019 Balakot incident.

15 Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China, Annual Report to Congress* (Washington, DC: Department of Defense, 2020), ix, https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF (hereinafter China Military Power Report).

16 Dmitri Adamsky, "Cross-Domain Coercion: The Current Russian Art of Strategy," Proliferation Papers no. 54 (Paris: Institut Francais des Relations Internationales, November 2015), 24, https://www.ifri.org/sites/default/files/atoms/files/pp54adamsky.pdf.

17 Steve Pifer, "Putin's Nuclear Saber-Rattling: What Is He Compensating For?," Brookings, June 17, 2015, https://www.brookings.edu/blog/order-from-chaos/2015/06/17/putins-nuclear-saber-rattling-what-is-he-compensating-for/. For more on Russian military exercises involving nuclear-capable forces, see Franz-Stefan Gady, "Russia Kicks Off Annual Nuclear Forces Readiness Exercise," *Diplomat*, October 15 2019, https://thediplomat.com/2019/10/russia-kicks-off-annual-nuclear-forces-readiness-exercise/ (Grom-2019); Dave Johnson, "VOSTOK 2018: Ten Years of Russian Strategic Exercises and Warfare Preparation," NATO Review, December 20, 2018, https://www.nato.int/docu/review/articles/2018/12/20/vostok-2018-ten-years-of-russian-strategic-exercises-and-warfare-preparation/index.html (Vostok-2018); and Keir Giles, "Russia Hit Multiple Targets With Zapad-2017," Carnegie Endowment for International Peace, January 25, 2018, https://carnegieendowment.org/2018/01/25/russia-hit-multiple-targets-with-zapad-2017-pub-75278 (Zapad-2017).

18 2018 NPR, 9; and Leo Michel and Matti Pesu, "Strategic Deterrence Redux: Nuclear Weapons and European Security," Finnish Institute of International Affairs, September 2019, https://www.fiia.fi/wp-content/uploads/2019/09/fiia_report60_strategic-deterrence-redux.pdf.

19 See Michael Kofman, "Fixing NATO Deterrence in the East Or: How I Learned to Stop Worrying and Love NATO's Crushing Defeat by Russia," War on the Rocks, May 12, 2016, https://warontherocks.com/2016/05/fixing-nato-deterrence-in-the-east-or-how-i-learned-to-stop-worrying-and-love-natos-crushing-defeat-by-russia/.

20 Paul K. Davis et al., *Exploring the Role Nuclear Weaposn Could Play in Deterring Russian Threats to the Baltic States* (Santa Monica: RAND Corporation, 2019), 81, https://www.rand.org/pubs/research_reports/RR2781.html.

21 Nikolai Sokov, "Russia Clarifies Its Nuclear Deterrence Policy," Vienna Center for Disarmament and Nonproliferation, June 3, 2020, https://vcdnp.org/russia-clarifies-its-nuclear-deterrence-policy/.

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23 Ibid.

24 As the authors of the April 2020 U.S. State Department paper on the W76-2 Low-Yield Option put it, "there is no such thing as a safe nuclear war or a low-risk nuclear strike, regardless of its magnitude." Bureau of Arms Control, Verification and Compliance, U.S. Department of State, "Strengthening Deterrence and Reducing Nuclear Risks: The Supplemental Low-Yield U.S. Submarine-Launched Warhead," Arms Control and International Security Papers 1, no. 4 (April 24, 2020), 6, https://www.state.gov/wp-content/uploads/2020/04/T-Paper-Series-4-W76.pdf. Regarding views of emerging U.S. strategists, see Elbridge Colby, "If You Want Peace, Prepare for Nuclear War," *Foreign Affairs*, November/December 2018, https://www.foreignaffairs.com/articles/china/2018-10-15/if-you-want-peace-prepare-nuclear-war, and Elbridge Colby, "Against the Great Powers: Reflections on Balancing Nuclear and Conventional Power," *Texas National Security Review* 2, no. 1 (November 2018): 145–52; Keir A. Lieber and Daryl G. Press, "The New Era of Counterforce: Technological Change and the Future of Deterrence," *International Security* 41, no. 4 (Spring 2017): 9–49, and Keir A. Lieber and Daryl G. Press, *The Myth of the Nuclear Revolution: Power Politics in the Atomic Ag*e (Ithaca: Cornell University Press, 2020).

25 Olya Oliker, "New Document Consolidates Russia's Nuclear Policy in One Place," Russia Matters, June 4, 2020, https://www.russiamatters.org/analysis/new-document-consolidates-russias-nuclear-policy-one-place; and 2018 NPR, 23.

26 See, for example, Dmitri Trenin's analysis of Russia's new "Foundations of State Policy of the Russian Federation in the Area of Nuclear Deterrence" document: "Finally, the Kremlin policy guidelines provide for the deployment of nuclear weapons in response to an attack against the critical national infrastructure that is responsible for controlling and employing nuclear weapons. This new provision may refer, for example, to cyberattacks that can disable Russian strategic command and control systems." Dmitri Trenin, "Decoding Russia's Official Nuclear Deterrence Paper," Carnegie Moscow Center, May 6, 2020, https://carnegie.ru/commentary/81983.

27 It is impossible to alleviate paranoid perceptions of threat.

28 See Paul K. Davis et al., *Exploring the Role Nuclear Weapons Could Play in Deterring Russian Threats to the Baltic States* (Santa Monica, CA: RAND Corporation, 2019), https://www.rand.org/pubs/research_reports/RR2781.html. "The insights derived from the research highlight the reality that, even if NATO makes significant efforts to modernize its nonstrategic nuclear weapons, it would have much stronger military incentives to end a future war than Russia would. That is, Russia would still enjoy escalation dominance," 2.

29 China Military Power Report, 70.

30 China Military Power Report, 72.

31 See James Griffiths, "China Ready to Fight 'Bloody Battle' Against Enemies, Xi Says in Speech," CNN, March 20, 2018, https://www.cnn.com/2018/03/19/asia/china-xi-jinping-speech-npc-intl/index.html; James Griffiths, "Xi Jinping Warns Taiwan Independence Is 'a Dead End,'" CNN, January 2, 2019, https://www.cnn.com/2019/01/02/asia/xi-jinping-taiwan-tsai-intl/index.html.

32 Eric Heginbotham, "An Interactive Look at the U.S.-China Military Scorecard," RAND Corporation, https://www.rand.org/paf/projects/us-china-scorecard.html.

33 ASEAN is composed of ten members (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam) and two observer states (East Timor and Papua New Guinea).

34 China's pledge consists of two commitments: "China will never use nuclear weapons first at any time nor under any circumstances, and China unconditionally undertakes not to use or threaten to use nuclear weapons against any nonnuclear-weapon state or in nuclear-weapon-free zones." The Department of Defense states that while "Some PLA officers have written publicly of the need to spell out conditions under which China might need to use nuclear weapons first; for example, if an enemy's conventional attack threatened the survival of China's nuclear force or of the regime itself." In fact, "There has been no indication that national leaders are willing to attach such nuances and caveats publicly to China's existing NFU policy as affirmed by recent statements by the PRC Foreign Ministry." See China Military Power Report, 86.

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37 China Military Power Report, 85.

38 See Hans M. Kristensen and Matt Korda, "Russian Nuclear Forces, 2019," *Bulletin of the Atomic Scientists* 75, no. 2 (2019): 73–84, DOI: 10.1080/00963402.2019.1580891; and Kristensen and Korda, "United States Nuclear Forces, 2020."

39 "Although China almost certainly keeps the majority of its nuclear force on a peacetime status—with separated launchers, missiles, and warheads—nuclear and conventional PLARF brigades conduct "combat readiness duty" and "high alert duty," which apparently includes assigning a missile battalion to be ready to launch, and rotating to standby positions as much as monthly for unspecified periods of time." China Military Power Report, 88.

40 China Military Power Report.

41 Wu Riqiang, "Living With Uncertainty: Modeling China's Nuclear Survivability," *International Security* 44, no. 4 (2020): 84–118.

42 "United States Northern Command and United States Strategic Command," United States Senate Committee on Armed Services, February 13, 2020, https://www.armed-services.senate.gov/hearings/20-02-13-united-states-northern-command-and-united-states-strategic-command.

43 Caitlin Talmadge, "Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War With the United States," *International Security* 41, no. 4 (2017): 50–92; and John Speed Meyers, "Mainland Strikes and U.S. Military Strategy Towards China: Historical Cases, Interviews, and a Scenario-Based Survey of American National Security Elites" (Santa Monica, CA: RAND Corporation, 2019), 16–17, https://www.rand.org/content/dam/rand/pubs/rgs_dissertations/RGSD400/RGSD430/RAND_RGSD430.pdf.

44 David E. Sanger and William J. Broad, "A New Superpower Competition Between Beijing and Washington: China's Nuclear Buildup," *New York Times*, June 30, 2020, updated July 14, 2020. https://www.nytimes.com/2020/06/30/us/politics/trump-russia-china-nuclear.html.

45 See Roberts and Perkovich, "U.S. Nuclear Weapons in the Twenty-First Century": "Asymmetry of stake couldn't have been more perfectly summarized than by General Yao Yunzhu (ph) . . . a member of the PLA, a participant in our unofficial dialogues on nuclear issues. She said, let's review this point on Taiwan. What interest will be at stake for you Americans in a conflict on Taiwan? Well, your commitment to democracy in Taiwan, your historic commitment to the Republic of China, your standing with your allies in East Asia, your global standing with your allies and your credibility. You'd have a lot at risk, a lot at stake. Where would we, China, have a stake? Sovereignty and culmination of the recovery after the century of humiliation. Who's got more at stake, she said? Well, obviously we will. So our Chinese steps to escalate will look more credible to you Americans than your threats to escalate. You will have to contemplate the need to back down." Brad Roberts and George Perkovich, "U.S. Nuclear Weapons in the Twenty-First Century," Carnegie Endowment for International Peace, June 28, 2016, transcript, pp. 4–5, https://carnegieendowment.org/files/Transcript17.pdf.

46 Adam Mount, *Conventional Deterrence of North Korea* (Washington, DC: Federation of American Scientists, 2019), 20–21, https://fas.org/wp-content/uploads/2019/12/FAS-CDNK.pdf.

47 "If the United States has a credible damage limitation option, the Kim regime is more likely to calculate that crossing the nuclear threshold would be a strategy for suicide, not survival, because North Korea would lack a reliable second-strike capability to deter regime change." Vince Manzo and John K. Warden, "Want to Avoid Nuclear War? Reject Mutual Vulnerability With North Korea," War on the Rocks, August 29, 2017, https://warontherocks.com/2017/08/want-to-avoid-nuclear-war-reject-mutual-vulnerability-with-north-korea/.

48 "The current and prospective security environment is marked both by increasing uncertainty and increasingly severe threats to the United States and its allies. These developments have become blatantly evident since the 1994, 2001, and 2010 NPRs. . . . These developments mandate a fundamental reorientation of US nuclear policy priorities from that established explicitly in the 2010 NPR. The United States must now reestablish deterrence, assurance, and defense as the priority goals for US nuclear policy." Keith Payne and John S. Foster, *New Nuclear Review for a New Age*, National Institute for Public Policy (Fairfax, VA: National Institute Press, 2017), 50–61, https://www.nipp.org/wp-content/uploads/2017/06/A-New-Nuclear-Review-final.pdf.

49 Barry R. Posen, *Inadvertent Escalation: Conventional War and Nuclear Risks* (Ithaca, NY: Cornell University Press, 1991). See discussion in chapter 1.

50 James M. Acton, "Escalation Through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risk of Inadvertent Nuclear War," *International Security* 43 no. 1 (2018): 56–99.

51 James M. Acton et al., "Entanglement: Chinese and Russia Perspectives on Non-Nuclear Weapons and Nuclear Risks," Carnegie Endowment for International Peace, November 8, 2017, https://carnegieendowment.org/2017/11/08/entanglement-chinese-and-russian-perspectives-on-non-nuclear-weapons-and-nuclear-risks-pub-73162.

52 Thomas C. Schelling, *Arms and Influence* (New Haven, CT: Yale University Press, 1966), 94.

53 For example, John Warden suggests the United States and its allies "think through the details of potential settlements, including the tradeoffs and concessions required," and incorporate them into deterrence planning. Andrew Coe and Victor Utgoff similarly posit a need for the U.S. government to consider how allies, adversaries, and the domestic population will view the conclusion and aftermath of a nuclear conflict and assess important assumptions regarding how the United States will act in such a future war. See John Warden, "Limited Nuclear War: The 21st Century Challenge for the U.S.," Livermore Papers on Global Security No. 4, July 2018, pp. 42–47, https://cgsr.llnl.gov/content/assets/docs/CGSR_LP4-FINAL.pdf; and Andrew Coe and Victor Utgoff, "Restraining Nuclear War" (Alexandria, VA: Institute for Defense Analyses, June 2011), 8, https://apps.dtic.mil/sti/pdfs/ADA575230.pdf.

54 In *Exploring the Role Nuclear Weapons Could Play in Deterring Russian Threats to the Baltic States*, wargame participants considered the merits of a Russia pressing a conventional campaign even in the face of NATO first use: "The Russians, surrounding or occupying the Baltic capitals and not having responded with nuclear weapons to NATO's first use, could shift the blame to NATO by labeling the Alliance as having engaged in a reckless provocation to which Russia wisely did not respond. The participants considered this response by Russia to be a definite possibility but did not rule out that Russia would find it necessary to respond with a nuclear attack." Davis et al., *Exploring the Role Nuclear Weapons Could Play in Deterring Russian Threats to the Baltic States*, 95.

55 For a thoughtful and partially clarifying analysis of this challenge, see Bureau of Arms Control, Verification and Compliance, "Strengthening Deterrence and Reducing Nuclear Risks."

56 Timothy McDonnell, "Bolts From the Blue, Monsters Under the Bed, and the Pursuit of Absolute Security," War on the Rocks, October 17, 2017, https://warontherocks.com/2017/10/bolts-from-the-blue-monsters-under-the-bed-and-the-pursuit-of-absolute-security/.

57 Fred Kaplan, *The Bomb: Presidents, Generals, and the Secret History of Nuclear War* (New York: Simon & Schuster, 2020), 120.

58 USSTRATCOM commander General John Hyten vividly recounted in July 2018 the proclivity of large arsenals and attendant operational doctrines to produce escalation. General Hyten described to an audience a "big exercise" that his command conducted that February. "I just want you to ask in your own head, how do you think it ends? It ends the same way every time. It does. It ends bad . . . meaning it ends with global nuclear war." Hyten continued by describing how the Chairman of the Joint Chiefs of Staff, General Joseph Dunford, and the entire Joint Staff observed the exercise from the National Airborne Operations Center, the airborne command and control base. "As soon as the NAOC landed after the exercise was over," Hyten recalled, Dunford "called me, like within seconds. And I'll just say General Dunford wasn't happy with the way the exercise went. He said we should provide the President more options, not fewer options. And the way the process was driving down, we were providing very few options. [So] the goal is to provide more options to the President to give him options to de-escalate a conflict, not just escalate a conflict. To get us off that escalation ladder. . . . I don't know how many times I've said I don't want on the escalation ladder; I want off the escalation ladder. That's the point. And for whatever reason, the whole structure of the command was about the escalation ladder." See General John Hyten, "The Mitchell Institute

Triad Conference," U.S. Strategic Command, July 17, 2018, http://www.stratcom.mil/Media/Speeches/Article/1577239/the-mitchell-institute-triad-conference/.

59 *Department of Defense Law of War Manual*, 86.

60 See "Report on Nuclear Employment Strategy of the United States, Specified in Section 491 of 10 U.S.C., U.S. Department of Defense," Department of Defense, June 12, 2013, p. 4, https://fas.org/wp-content/uploads/2013/06/NukeEmploymentGuidance_DODbrief061213.pdf; and 2018 NPR, 21.

61 2018 NPR, 21. "The United States would only consider the employment of nuclear weapons in extreme circumstances to defend the vital interests of the United States, its allies, and partners. Extreme circumstances could include significant non-nuclear strategic attacks. Significant non-nuclear strategic attacks include, but are not limited to, attacks on the U.S., allied, or partner civilian population or infrastructure, and attacks on U.S. or allied nuclear forces, their command and control, or warning and attack assessment capabilities." For "clarification" of this statement, see Bureau of Arms Control, Verification and Compliance, "Strengthening Deterrence and Reducing Nuclear Risks," 1. See also George Perkovich, "Critiquing the State Department's Nuclear Posture Clarification," Carnegie Endowment for International Peace, May 6, 2020, https://carnegieendowment.org/2020/05/06/critiquing-state-department-s-nuclear-posture-clarification-pub-81722.

62 2018 NPR, 22.

63 Some analysts privately suggest that preemptive nuclear use may be permitted under a U.S. NFU policy in certain limited circumstances. For example, if the United States received intelligence information warning that an adversary was preparing a nuclear attack against the United States, then the United States would be justified in using nuclear weapons to prevent that attack—if doing so was the only means available at the time.

64 Steve Fetter and John Wolfsthal, "No First Use and Credible Deterrence," *Journal for Peace and Nuclear Disarmament* 1, no. 1 (2018): 102–14.

65 "Report on Nuclear Employment Strategy of the United States."

66 2018 NPR, 23. The United States has been more transparent about its legal considerations than any other nuclear-armed state, and military lawyers are part of the targeting staff at the U.S. Strategic Command headquarters in Omaha, even as legal doctrine on these issues remains unsettled. See *Air Force Operations and the Law*, 2014, p. 300, https://www.afjag.af.mil/Portals/77/documents/AFD-100510-059.pdf.

67 For example, U.S. government lawyers often have relied on the contested doctrine of "belligerent reprisal"—which successive instruments of international law have weakened over the years. Lieutenant Colonel Ted Richard and Sean Watts, "The International Legal Environment for Nuclear Deterrence," Just Security, March 27, 2017, https://www.justsecurity.org/39281/international-legal-environment-nuclear-deterrence/. A comprehensive review of the history of U.S. nuclear targeting and the law of belligerent reprisal is found in Theodore T. Richard, "Nuclear Weapons Targeting: The Evolution of Law and U.S. Policy," *Military Law Review* 224, no. 4 (2016): 862–978. Belligerent reprisal is assessed in Anthony J. Colangelo, "The Duty to Disobey Illegal Nuclear Strike Orders," *Harvard National Security Journal* 9, no. 2 (2018): 84–120; and Scott D. Sagan, "The Commitment Trap: Why the United States Should Not Use Nuclear Threats to Deter Biological and Chemical Weapons Attacks," *International Security* 24, no. 4 (2000): 85–115, https://www.jstor.org/stable/2539316. For broader explorations of legal issues, see Valentin Jeutner, *Irreversible Norm Conflicts in International Law* (Oxford: Oxford University Press, 2017); Timothy J. Heverin, "Legality of the Threat or Use of Nuclear Weapons: Environmental and Humanitarian Limits on Self-Defense," *Notre Dame*

Law Review 72, no. 14 (2014), 1290; Richard Falk, "Nuclear Weapons, International Law and the World Court: A Historic Encounter," *American Journal of International Law* 91, no. 1 (1997): 64–75, Colangelo, "The Duty to Disobey Illegal Nuclear Strike Orders"; Stuart Casey-Maslen, "The Use of Nuclear Weapons as a Reprisal Under International Humanitarian Law," in *Nuclear Weapons Under International Law*, ed. Gro Hystuen, Stuart Casey-Maslen, and Annie Golden Bersagel (Cambridge, UK: Cambridge University Press, 2014), 182; and John Burroughs, "Looking Back: The 1996 Advisory Opinion of the International Court of Justice," Arms Control Today, July/August 2016, https://www.armscontrol.org/ACT/2016_07/Features/Looking-Back-The-1996-Advisory-Opinion-of-the-International-Court-of-Justice.

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71 David E. Sanger and William J. Broad, "Pentagon Suggests Countering Devastating Cyberattacks with Nuclear Arms," *New York Times*, January 16, 2018, https://www.nytimes.com/2018/01/16/us/politics/pentagon-nuclear-review-cyberattack-trump.html.

72 See for example, the *Department of Defense Law of War Manual.*

73 Judy Aita, "Security Council Gives Assurances in Case of Nuclear Attack," U.S. Information Agency, April 11, 1995, https://fas.org/nuke/control/npt/news/950411-386876.htm.

74 Practical problems abound in the provision of effective security guarantees and legal accountability and redress. Each of the five primary security guarantors in the UN Security Council can veto calls for action by the council. They also have nuclear weapons and comparatively strong conventional military forces. If one or more of these nuclear powers were involved in the given crisis or conflict, they likely would veto proposals to use force or impose sanctions to compel them to deescalate and avert nuclear use. Other states could take preemptive military or political-economic measures such as sanctions, but it is difficult to imagine how these measures would influence events except in coalition with at least some of the permanent members.

75 2018 NPR, 23.

76 Charles L. Glaser and Steve Fetter, "Should the United States Reject MAD? Damage Limitation and U.S. Nuclear Strategy Toward China," *International Security* 41, no. 1 (2016): 49–98, https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/b/1590/files/2018/08/Should-the-United-States-Reject-MAD-Damage-Limitation-and-U.S.-Nuclear-Strategy-toward-China-27i9iqk.pdf.

77 Fred Kaplan has recently recounted how presidents Kennedy, Johnson, Nixon, Ford, Carter, Reagan, Bush, Clinton, Bush, and Obama, often guided by senior civilian advisers, all concluded that plans for massive nuclear strikes on the Soviet Union/Russia were untenable. See Kaplan, *The Bomb*. The Defense Department's 2013 report to Congress on the U.S. nuclear employment strategy reflects the Obama administration's grappling with how to decrease the role of nuclear weapons in counterforce strategy. See "Report on Nuclear Employment Strategy of the United States."

78 On nuclear winter, see Alan Robock, Luke Oman, and Georgy Stenchikov, "Nuclear Winter Revisited With a Modern Climate Model and Current Nuclear Arsenals: Still Catastrophic Consequences," *Journal of Geophysical Research* 112 (2007), DOI: 10.1029/2006JD008235; and Joshua M. Pierce and David C. Denkenberger, "A National Pragmatic Safety Limit for Nuclear

Weapon Quantities," *Safety* 4 no. 25 (2018), 5, DOI:10.3390/safety4020025. See also Keir A. Lieber and Daryl G. Press, "The New Era of Counterforce," *International Security* 41, no. 4 (2017): 9–49, https://www.belfercenter.org/sites/default/files/files/publication/isec_a_00273_LieberPress.pdf, especially the "Cumulative Consequences for Counterforce" section (pages 22–32).

79 Joshua Coupe, Charles G. Bardeen, Alan Robock, and Owen B. Toon, "Nuclear Winter Responses to Nuclear War Between the United States and Russia in the Whole Atmosphere Community Climate Model Version 4 and the Goddard Institute for Space Studies Model," *JGR Atmospheres* 124, no. 15 (2019), DOI: 10.1029/2019JD030509.

80 See "Report on Nuclear Employment Strategy of the United States."

81 For example, it is unclear the last time a president participated in a nuclear wargame to fully understand the political, societal, and physical effects of nuclear war. High-ranking civilian advisers continue to explore these issues; however, given the president's sole authority to authorize nuclear employment, his or her unfamiliarity with nuclear operations is problematic, in our view. See Fred Kaplan, *The Bomb*, 284–90.

82 Jeffrey Lewis, "Is Launch Under Attack Feasible?," NTI, August 24, 2017, https://www.nti.org/analysis/articles/launch-under-attack-feasible/.

83 Jeffrey Lewis, "Our Nuclear Procedures Are Crazier Than Trump," *Foreign Policy*, August 5, 2016, https://foreignpolicy.com/2016/08/05/our-nuclear-procedures-are-crazier-than-trump/.

84 "Dual phenomenology" refers to a requirement to source warning of an incoming attack from two separate types of indicators. To this end, the United States deploys space-based infrared sensors that can detect a missile's launch and land-based early warning radars that can track a missile in its flight. See Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, "Nuclear Matters Handbook 2016," U.S. Department of Defense, 2016, p. 76.

85 Winnefeld, "A Commonsense Policy for Avoiding a Disastrous Nuclear Decision."

86 William Perry, "All Souls: Humans Will Err Again," October 26, 2016, https://webmaster-perry.squarespace.com/notes-from-the-brink/william-perry-speaks-at-all-souls#:~:text=%E2%80%9CHumans%20will%20err%20again%3B%20machines,false%20alarms%20will%20happen%20again.

87 Geoffrey Forden, Pavel Podvig, and Theodore A. Postol, "False Alarm, Nuclear Dangers," *IEEE Spectrum* 37, no. 3 (2000): 31–39.

88 One area of growing concern is the role that accelerated disinformation could play in a political leader's decisionmaking process for nuclear use. Nuclear-armed states should ensure their bureaucratic processes take the attendant risks into account in devising launch policies and procedures. See the recent report by Heather Williams at King's College of London on this topic: https://www.kcl.ac.uk/csss/assets/10957%E2%80%A2twitterconflictreport-15july.pdf.

89 "While we continue to posture our forces to deter large-scale attacks, the 2018 NPR also highlighted the importance of deterring limited nuclear attacks on allies and deployed U.S. forces—something both the Obama and Trump administrations considered more likely than a 'bolt-out-of-the-blue' attack." Bureau of Arms Control, Verification and Compliance, "Strengthening Deterrence and Reducing Nuclear Risks," 1.

90 Sandra Erwin, "STRATCOM to Design Blueprint for Nuclear Command, Control, and Communications," *SpaceNews*, March 29, 2019, https://spacenews.com/stratcom-to-design-blueprint-for-nuclear-command-control-and-communications/.

91 Winnefeld, "A Commonsense Policy for Avoiding a Disastrous Nuclear Decision."

92 These rivalries originated in the late 1940s when the Navy and Air Force competed vigorously for a larger share of the defense budget. See Anand Toprani, "'Our Efforts Have Degenerated Into a Competition for Dollars': The 'Revolt of the Admirals', NSC-68, and the Political Economy of the Cold War," *Diplomacy and Statecraft* 30, no. 4 (2019): 681–706; and Darius Watson, "Rethinking the U.S. Nuclear Triad," *Strategic Studies Quarterly* 11, no. 4 (2017): 138–40.

93 In the late 1950s, the Navy then looked to wrest the atomic monopoly away from the Air Force and Strategic Air Command with the Polaris SSBN. In response, the Air Force designed "counterforce": an attempt to utilize the greater accuracy of bombers compared to submarine-launched missiles (which at the time, were accurate enough to be aimed at cities but not at nuclear forces). The Air Force's bureaucratic strategy was to suggest a more politically palatable counterforce "limited" nuclear strike that would spare an adversary's cities; see discussion in Kaplan, *The Bomb*, 25–36.

94 Patrick Tucker and Marcus Weisgerber, "A New Nuclear Warhead? STRATCOM Chief Can't Answer Yes or No," Defense One, February 27, 2020, https://www.defenseone.com/politics/2020/02/new-nuclear-warhead-stratcom-chief-cant-answer-yes-or-no/163395/.

95 Valerie Insinna, "US Air Force Nears Battle Over Next B-52 Engine," Defense News, September 15, 2019, https://www.defensenews.com/smr/global-strike/2019/09/16/us-air-force-nears-battle-over-next-b-52-engine/.

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101 Andy Weber and Christine Parthemore, "Cruise Control: The Logical Next Step in Nuclear Arms Control?," *Journal for Peace and Disarmament* 2, no. 2 (2019): 453–67, DOI: 10.1080/25751654.2019.1681886.

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104 Oliver Meier, "German Politicians Renew Nuclear Basing Debate," Arms Control Association, June 2020, https://www.armscontrol.org/act/2020-06/news/german-politicians-renew-nuclear-basing-debate.

105 Sebastian Sprenger, "NATO Chief Backs Germany's Vow to Keep War-Ready US Nukes," Defense News, May 11, 2020, https://www.defensenews.com/global/europe/2020/05/11/nato-chief-backs-german-vow-to-keep-war-ready-us-nukes/.

106 Hans M. Kristensen, "US SSBN Patrols Steady, but Mysterious Reduction in Pacific in 2017," Federation of American Scientists, May 24, 2019, https://fas.org/blogs/security/2018/05/ssbnpatrols1960-2017/.

107 "Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress," R41129 (Washington, DC: Congressional Research Service, October 7, 2020), https://fas.org/sgp/crs/weapons/R41129.pdf.

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109 The head of U.S. Strategic Command, Admiral Charles A. Richard, warns that "there is no margin to extend the OHIO-class further; therefore, the COLUMBIA-class SSBN must field on time to avoid a capability gap in the triad." Other senior military officials have similarly stated there is little margin for error in producing the Columbia SSBN on its current schedule: "the bottom line is there's no additional margin for construction and delivery of Columbia." See "Statement of Charles A. Richard, Commander United States Strategic Command, Before the Senate Committee on Armed Services 13 February 2020," Senate Committee on Armed Services, February 13, 2020, https://www.stratcom.mil/Portals/8/Documents/2020_USSTRATCOM_Posture_Statement_SASC_Final.pdf; and Sydney J. Freedberg Jr., "Inside America's Aging Nuclear Missile Submarines," Breaking Defense, July 16, 2018, https://breakingdefense.com/2018/07/inside-americas-aging-nuclear-missile-submarines/.

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111 The Trident II SLBM's capabilities have been compared favorably to the Peacekeeper MX. See "Triad Hearing Follow-Up," GAO/PEMD-93-28R, Government Accountability Office, August 6, 1993, p. 6, https://www.gao.gov/assets/90/83310.pdf. "We found the D-5 Mark 5 SLBM to be equivalent to the Peacekeeper ICBM on the measure of capability to destroy hard targets. In contrast, MM III is considerably less accurate than either the Peacekeeper or D-S/ Mark 5, and hence would be much less lethal against hard targets. On other measures, such as communications speed and system reliability, MM III is essentially the equal of the two other systems, while sharing the same deficiency as Peacekeeper with regard to easy locatability, given its basing mode in fixed silos. In sum, the D-5 with Mark 5 (W88) warheads would be considerably more capable with regard to hard targets than the MM III."

112 Lisbeth Gronlund and David C. Wright, "Depressed Trajectory SLBMs: A Technical Evaluation and Arms Control Possibilities," *Science and Global Security* 3 (1992): 101–59, http://www.scienceandglobalsecurity.org/archive/sgs03gronlund.pdf. See also Lieber and Press, "The New Era of Counterforce," 24n44 (and more broadly Lieber and Press' discussion of the SLBM's counterforce capabilities).

113 A life extension for the W76 (now called the W76-1) was recently completed, and the W88 is undergoing a life extension now. The Department of Energy and U.S. Navy recently announced the new W93 warhead for the Trident II, which likely will be deployed by 2040. Aaron Mehta, "Inside America's Newly Revealed Nuclear Ballistic Missile Warhead of the Future," Defense News, February 24, 2020, https://www.defensenews.com/smr/nuclear-arsenal/2020/02/24/inside-americas-newly-revealed-nuclear-ballistic-missile-warhead-of-the-future/.

114 John M. Donnelly, "Trump Team's Case for New Nuke Cites Risks in Current Arsenal," *Roll Call*, July 29, 2020, https://www.rollcall.com/2020/07/29/trump-teams-case-for-new-nuke-cites-risks-in-current-arsenal/.

115 Robert S. Norris and Hans M. Kristensen, "U.S. Nuclear Warheads, 1945–2009," *Bulletin of the Atomic Scientists* 65, no. 4 (2009): 72–81, DOI: 10.2968/065004008.

116 The Trident D5 can carry eight W88 or twelve W88 warheads, but the United States limits the number of warheads on each missile to meet the limits of New START (approximately four warheads per deployed Trident D5). See Congressional Budget Office, "The Potential Costs of Expanding U.S. Strategic Nuclear Forces if the New START Treaty Expires," August 2020, https://www.cbo.gov/system/files/2020-08/56475-START.pdf, 10.

117 Amy F. Woolf, "Defense Primer: Strategic Nuclear Forces," IF10519, Congressional Research Service (updated January 10, 2020), https://fas.org/sgp/crs/natsec/IF10519.pdf.

118 Statement of Vice Admiral Johnny Wolfe, "FY 2021 Budget Request for Nuclear Forces and Atomic Energy Defense Activities," March 3, 2020, 5, https://www.congress.gov/116/meeting/house/110593/witnesses/HHRG-116-AS29-Wstate-WolfeJ-20200303.pdf.

119 Hans M. Kristensen and Matt Korda, "United States Nuclear Forces, 2019," *Bulletin of the Atomic Scientists* 75, no. 3 (2019): 123.

120 John Rood, "Statement on the Fielding of the W76-2 Low-Yield Submarine Launched Ballistic Missile Warhead. Department of Defense," U.S. Department of Defense, February 4, 2020, https://www.defense.gov/Newsroom/Releases/Release/Article/2073532/statement-on-the-fielding-of-the-w76-2-low-yield-submarine-launched-ballistic-m/.

121 2018 NPR, 53. However, in 2011, then principal deputy undersecretary of defense for policy James Miller told the House Subcommittee on Strategic Forces that Russia had 2,000 to 4,000 such weapons. See "The Current Status and Future Direction for U.S. Nuclear Weapons Policy and Posture, Hearing Before the Subcommittee on Strategic Forces of the Committee

on Armed Services, House of Representatives," November 2, 2011, https://www.govinfo.gov/content/pkg/CHRG-112hhrg71527/html/CHRG-112hhrg71527.htm. There has been no public U.S. government statement about this discrepancy, which suggests that Russia has actually reduced its nonstrategic nuclear warheads in the past decade.

122 Olya Oliker, "Moscow's Nuclear Enigma," *Foreign Affairs*, November/December 2018, https://www.foreignaffairs.com/articles/russian-federation/2018-10-15/moscows-nuclear-enigma.

123 The term "mod" designates a different version of the bomb; here, mod-12 designates the latest B61 following a life extension program.

124 Stephen Carlson, "Lockheed Martin Contracted for F-35 Flight Testing and Nuclear Capability," Space Daily, November 16, 2018, https://www.spacedaily.com/reports/Lockheed_Martin_contracted_for_F-35_flight_testing_and_nuclear_capability_999.html.

125 Kristensen and Korda, "United States Nuclear Forces, 2020," 124.

126 According to some Soviet war plans, NATO airfields would be targeted with tactical nuclear weapons once a NATO–Warsaw Pact conflict began: "The Warsaw Pact would have used many more smaller 'tactical' nukes against NATO command posts, army bases, airfields, equipment depots and missile and communications sites." See "This Is How the World Could Have Ended," War Is Boring (Medium), January 14, 2014, https://medium.com/war-is-boring/this-is-how-the-world-could-have-ended-1ecd1db17ff2.

127 See the statement by Jens Stoltenberg at NATO Defence Ministerial: "Defence Ministers confirmed that NATO had no intention to deploy new land-based nuclear missiles in Europe, and did not want a new arms race." See "NATO and the INF Treaty," NATO, August 2, 2019, https://www.nato.int/cps/en/natohq/topics_166100.htm.

128 As mentioned earlier, the United States would need to use advanced conventional strike options where possible to better adhere to the law of armed conflict. The LYD5 is likely designed for targets where conventional weapons have little utility; this paper does not contest the assignment of nuclear or conventional weapons to unknown targets.

129 See Bureau of Arms Control, Verification and Compliance, "Strengthening Deterrence and Reducing Nuclear Risks."

130 Kris Osborn, "Air Force Upgrades B-2 Stealth Bomber as Modern Air Defenses Advance," Military.com, April 24, 2015, https://www.military.com/daily-news/2015/04/24/air-force-upgrades-b2-stealth-bomber-as-air-defenses-advance.html.

131 For an extensive discussion of AirLand Battle and potential uses of tactical nuclear weapons, see Douglas W. Skinner, "Airland Battle Doctrine," Center for Naval Analyses, September 1988, https://apps.dtic.mil/dtic/tr/fulltext/u2/a202888.pdf. Though NATO countries worried about the possibility of nuclear use on friendly territory, the doctrine clarified the issue: "It is important to note, however, that tactical use of nuclear weapons is generally associated with the deep battle far away from friendly territory" (p. 17).

132 Bureau of Arms Control, Verification and Compliance, "Strengthening Deterrence and Reducing Nuclear Risks," 3.

133 Bureau of Arms Control, Verification and Compliance, "Strengthening Deterrence and Reducing Nuclear Risks," 5.

134 Bureau of Arms Control, Verification and Compliance, "Strengthening Deterrence and Reducing Nuclear Risks," 6.

135 For instance, have U.S. policymakers closely examined Russian military doctrine which considers any WMD use on Russian territory as warranting a nuclear response? Dara Massicot, "Anticipating a New Russian Military Doctrine in 2020: What It Might Contain and Why

It Matters," War on the Rocks, September 9, 2019, https://warontherocks.com/2019/09/anticipating-a-new-russian-military-doctrine-in-2020-what-it-might-contain-and-why-it-matters/.

136 See Konstantin Bogdanov, "Not-so-Nuclear War," Russian International Affairs Council, March 10, 2020, https://russiancouncil.ru/en/analytics-and-comments/analytics/not-so-nuclear-war/.

137 Then USSTRATCOM commander General John Hyten stated of the LYD5 in February 2018, "I don't see it as escalatory at all I see it as that is a logical extension of our capabilities that we should have as warfighters to present to the President of the United States." General John Hyten, "Nuclear Posture Review Discussion at National Defense University," USSTRATCOM, February 16, 2018, https://www.stratcom.mil/Media/Speeches/Article/1446542/nuclear-posture-review-discussion-at-national-defense-university/.

138 Austin Long, "Discrimination Details Matter: Clarifying an Argument About Low-Yield Nuclear Warheads," War on the Rocks, February 16, 2018, https://warontherocks.com/2018/02/discrimination-details-matter-clarifying-argument-low-yield-nuclear-warheads/.

139 As some experts have assessed, the detection of launch, tracking of underwater targets, and utilization of prompt antisubmarine (possibly nuclear-armed) weapons are complex technical problems that must be overcome to destroy an SSBN that has launched an LYD5, and undoubtedly stealthily moved several miles away from the launch point. See Austin Long, "Location, Location, Location: Evaluating Risks to Submarines From Low-Yield Warhead and Submarine Missile Launch Detection," Lawfare, March 11, 2018, https://www.lawfareblog.com/location-location-location-evaluating-risks-submarines-low-yield-warhead-and-submarine-missile.

140 Hyten, "Nuclear Posture Review Discussion at National Defense University."

141 It is notable that U.S. allies in Europe or Asia did not raise concerns regarding the LYD5 deployment.

142 Aaron Mehta, "The US Navy's New Nuclear Cruise Missile Starts Getting Real Next Year," Defense News, February 21, 2020, https://www.defensenews.com/smr/nuclear-arsenal/2020/02/21/the-navys-new-nuclear-cruise-missile-starts-getting-real-next-year/.

143 Mehta, "The U.S. Navy's New Nuclear Cruise Missile."

144 See Michael Pugh, "Nuclear Warship Visiting: Storms in Ports," *The World Today* 45 no. 10 (1989): 180–83, https://www.jstor.org/stable/pdf/40396059.pdf?refreqid=excelsior%3Ab1b206673c55403c3ade701d3b703a4e.

145 Aaron Mehta, "Will the US trade Its New Sub-Launched Cruise Missile for Russian Arms Treaty Compliance?," Defense News, February 6, 2018, https://www.defensenews.com/space/2018/02/06/will-the-us-trade-its-new-sub-launched-cruise-missile-for-russian-arms-treaty-compliance/.

146 Under the New START force structure, 400 ICBMs is the maximum deployed by the United States. And additional 50 silos are empty but kept in "warm" status, which would allow 450 ICBMs to be deployed if desired. See "Fact Sheet on U.S. Nuclear Force Structure Under the New START Treaty," n.d., https://archive.defense.gov/documents/Fact-Sheet-on-US-Nuclear-Force-Structure-under-the-New-START-Treaty.pdf.

147 Anthony Capaccio, "U.S. ICBM to Replace 1970s Minuteman May Cost $111 Billion," Bloomberg, October 1, 2020, https://www.bloomberg.com/news/articles/2020-10-01/pentagon-s-next-generation-icbm-program-may-cost-111-billion.

148 Kingston Reif, "New ICBM Replacement Cost Revealed," *Arms Control Today*, March 2017, https://www.armscontrol.org/act/2017-03/news/new-icbm-replacement-cost-revealed.

149 The history of U.S. administrations' efforts to win approval for mobile ICBMs should disabuse anyone of the political feasibility of this approach. See John T. Correll, "Peacekeeper by Fits and Starts," *Air Force Magazine*, February 26, 2019, https://www.airforcemag.com/article/peacekeeper-by-fits-and-starts/.

150 Matthew Kroenig, "The Case for the US ICBM Force," *Strategic Studies Quarterly* 12, no. 3 (2018), 61–62, https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-12_Issue-3/Kroenig.pdf.

151 Kroenig, "The Case for the US ICBM Force," 60–61.

152 Of course, the possessors of silo and mobile ICBMs also use hardening, camouflage, dummy targets, and other operational practices to increase the chance that incoming warheads may malfunction or miss the target.

153 Acton, "Escalation Through Entanglement."

154 "Report on Nuclear Employment Strategy of the United States"; and Hans M. Kristensen, "New Nuclear Weapons Employment Guidance Puts Obama's Fingerprint on Nuclear Weapons Policy and Strategy," Federation of American Scientists, June 20, 2013, https://fas.org/blogs/security/2013/06/nukeguidance/.

155 See Kristensen and Korda, "United States Nuclear Forces, 2020": "Each Trident SLBM can carry up to eight nuclear warheads, but normally carry an average of four or five warheads, for an average load-out of approximately 90 warheads per submarine."

156 Dennis Evans and Jonathan Schwalbe, "Intercontinental Ballistic Missiles and Their Role in Future Nuclear Forces," Johns Hopkins Applied Physics Laboratory, 2017, p. 11, https://www.jhuapl.edu/Content/documents/ICBMsNuclearForces.pdf.

157 2018 NPR, p. 21.

158 Some experts suggest pursuing a conventional ICBM—something the United States considered in the 2000s as part of the Conventional Prompt Global Strike program—to reduce the destabilizing disarming first-strike dangers posed by vulnerable nuclear U.S. silo ICBMs. There may be some merit to this approach: the United States may benefit from a long-range conventional strike option that does not rely on expensive, potentially vulnerable, and limited-in-number air and sea platforms; a conventionally armed ICBM is also more compliant with the law of armed conflict. However, the efficacy of such systems at attacking an enemy's nuclear forces, even with conventional warheads, means the change from nuclear to conventional ICBMs is unlikely to reduce first strike stability concerns that the land-based leg of the triad creates in Moscow, Beijing, or Pyongyang. Scholars outside of government have suggested several novel ideas to retain the Minuteman for years beyond the end of its projected lifespan, including adjustments to flight test frequency and maintenance practices. See Steve Fetter and Kingston Reif, "A Cheaper Nuclear Sponge," War on the Rocks, October 18, 2019, https://warontherocks.com/2019/10/a-cheaper-nuclear-sponge/.

159 Nick Adde, "Minuteman III Replacement Program Moves Toward Next Phase," *National Defense*, November 2, 2018, https://www.nationaldefensemagazine.org/articles/2018/11/2/minuteman-iii-replacement-program-moves-toward-next-phase; and Fetter and Reif, "A Cheaper Nuclear Sponge."

160 Elbridge Colby, Mackenzie Eaglen, and Roger Zakheim, "How to Trim the Defense Budget Without Harming U.S. Security," *Foreign Policy*, September 30, 2020, https://foreignpolicy.com/2020/09/30/defense-budget-cut-pandemic-austerity-security/; and Rachel S. Cohen.

"Smith: Coronavirus Should Spur Fiscal Responsibility, Defense Industry Action," *Air Force Magazine*, April 7, 2020, https://www.airforcemag.com/smith-coronavirus-should-spur-fiscal-responsibility-defense-industry-action/.

161 John R. Harvey, "U.S. Nuclear Command and Control for the 21st Century," NAPSNet Special Reports, May 24, 2019, https://nautilus.org/napsnet/napsnet-special-reports/u-s-nuclear-command-and-control-for-the-21st-century/.

162 This is a $19 billion increase of the ten-year estimate from 2017. Congressional Budget Office, "Projected Costs of U.S. Nuclear Forces, 2019 to 2028," January 2019, https://www.cbo.gov/system/files/2019-01/54914-NuclearForces.pdf.

163 See, for background, Peter Hayes, "Nuclear Command, Control and Communications (NC3): Is There a Ghost in the Machine?" (PowerPoint presentation, April 9, 2018), https://www.nonproliferation.org/wp-content/uploads/2018/04/180409-nc3-is-there-a-ghost-in-the-machine.pdf.

164 See Defense Intelligence Agency, "Challenges to Security in Space," Defense Intelligence Agency, January 2019, https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf; and Jon Lindsay, "Cyber Operations and Nuclear Weapons," NAPSNet Special Reports, June 20, 2019, https://nautilus.org/napsnet/napsnet-special-reports/cyber-operations-and-nuclear-weapons/.

165 Creating wholly separate conventional and nuclear command, control, and communications hardware is financially and operationally infeasible, and current NC3 modernization plans will continue the practice of integrated NC3 for the foreseeable future. As a result, the United States must look to make the current NC3 system, with modern hardware and updated practices, address growing entanglement risks.

166 James N. Miller Jr. and Richard Fontaine, "A New Era in U.S.-Russian Strategic Stability: How Changing Geopolitics and Emerging Technologies Are Reshaping Pathways to Crisis and Conflict," Center for a New American Security, 2017, p. 5, https://s3.amazonaws.com/files.cnas.org/documents/CNASReport-ProjectPathways-Finalb.pdf.

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178 This statement is significant in that it was a much more explicit acknowledgment that the United States and China are mutually vulnerable to the others' strategic arsenals than the United States had expressed up to that point.

179 2019 MDR, xii.

180 See 2018 NPR; 2019 MDR; Bureau of Arms Control, Verification and Compliance, U.S. Department of State, "Strengthening Deterrence and Reducing Nuclear Risks"; and Trenin, "Decoding Russia's Official Nuclear Deterrence Paper."

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187 Alexey Arbatov and Vladimir Dvorkin, "The Great Strategic Triangle," Carnegie Moscow Center, April 1, 2013, https://carnegie.ru/2013/04/01/great-strategic-triangle-pub-51362.

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193 "Under such conditions, there was no alternative to ground-based missiles. And it was the development of nuclear weapons delivery vehicles, such as Sergei Korolev's R-7 ballistic missile or Lavochkin design Bureau's Burya cruise missile, that made it possible to ensure parity and shape the basis of the nuclear relations that later became known as strategic stability. After all, the key pillar of the strategic stability in the traditional military sense of this term involves, first and foremost, the ability to reach the enemy. This is its central and determining factor." See "Article by Deputy Director of the Department for Nonproliferation and Arms Control of the Ministry of Foreign Affairs of Russia Vladimir L. Leontiev 'Message Received. Attempt at Distance Communication With the U.S. State Department' Published in the Magazine 'Independent Military Review,' April 12, 2019," Ministry of Foreign Affairs of the Russian Federation, April 12, 2019, https://www.mid.ru/en/foreign_policy/international_safety/regprla/-/asset_publisher/YCxLFJnKuD1W/content/id/3613093.

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