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**A NUCLEAR STRATEGY
AND POSTURE FOR
2030**

By Elbridge Colby



Center for a
New American
Security

About the Author

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A Nuclear Strategy and Posture for 2030

BY ELBRIDGE COLBY

Introduction

U.S. nuclear strategy and posture have exhibited a great degree of continuity over time. This is exemplified by the substantial commonality on core issues among the three Nuclear Posture Reviews (NPRs) of the post–Cold War era and, before that, in U.S. nuclear policy during the latter stages of the Cold War.¹ This continuity is largely a virtue given how consequential these weapons are in guaranteeing the security of the United States and its allies, telegraphing the strength and stability of U.S. resolve, and, more broadly, discouraging major war.

Yet while continuity has been a hallmark of U.S. nuclear policy and posture, so too have been adaptation and evolution. This is only natural, as effective deterrence is not the result of a static formula divorced from context but rather the product of relating credible threats to the scale, scope, and intensity of the challenges to the nation’s security. If, then, the U.S. nuclear posture is to be effective in deterring potential adversaries and reassuring allies and partners, it must adapt to the strategic and military-technological circumstances the nation and the beneficiaries of its extended deterrent face.

This is especially pertinent because we are entering a period of significant and possibly dramatic change in both the geopolitical and military-technological spheres. Geopolitically, the global strategic landscape is shifting markedly, away from a situation of unchallenged U.S. supremacy – a situation that some characterized as “unipolarity” – to a more contested one in which the United States can maintain its leading position but in which it will face more serious competition.² The global

landscape appears likely to be defined by the rise of an increasingly capable and more assertive China, a resurgent and revanchist Russia, and a host of more powerful regional players such as India, Saudi Arabia, Brazil, and Indonesia whose strategic trajectories are uncertain.³ This will result in a geopolitical environment characterized more by flux, as some nations leverage and explore the limits of their newfound power (such as China and India), others adapt to relative decline (particularly in Europe), and still others (such as in Southeast Asia) decide which countries it is safe to resist and which it is more prudent to accommodate.

WHILE CONTINUITY HAS BEEN A HALLMARK OF U.S. NUCLEAR POLICY AND POSTURE, SO TOO HAVE BEEN ADAPTATION AND EVOLUTION.

These dynamics will have significant ramifications in the nuclear policy realm because these tectonic shifts in power, and the new ambitions they will enable, look set to put increasing pressure on the legacy U.S.-led security architecture in Europe, East Asia, and the Middle East. In brief, the United States is likely to confront more significant challenges from more capable powers than appeared to be the case even a few years ago. For instance, in Asia the United States and its regional allies and partners will face an increasingly powerful China that appears determined to establish itself as the region's leading power, if not its hegemon. In Eastern Europe, meanwhile, the United States and its NATO allies will encounter a Russia that, while still only a fraction of the Soviet Union's peak strength, has invested heavily in new military capabilities and has

adopted a far more revanchist and domineering approach toward its near abroad. And in the Middle East, the United States will continue to be compelled to deal with a chaotic region defined by instability, endemic conflict, and skepticism about the reliability and relevance of U.S. security assurances.

Relatedly, the military-technological environment is also undergoing rapid and in some cases profound change in ways that will implicate U.S. nuclear policy. Most importantly, the United States no longer enjoys a monopoly on the advantages afforded by the so-called Revolution in Military Affairs.⁴ Rather, a growing number of countries are exploiting the opportunities provided by advanced technologies to improve the potency, reach, and flexibility of their military forces.⁵ This is true above all of China and Russia, which are – not coincidentally – also the United States' prime competitors in the nuclear sphere. In practice, this means that U.S. conventional military advantages over its plausible opponents will very likely shrink, particularly with respect to China and, to a lesser degree, Russia. This will represent a marked shift from the era following the Cold War, when U.S. nonnuclear forces enjoyed a commanding mastery over potential adversaries, an ascendancy that in practice allowed the United States to rely on these forces for dealing with nearly all plausible contingencies about which it cared. Looking to the future, however, the United States will have to strive – vigorously in certain domains and regions – for nonnuclear military advantage rather than simply assume it. Indeed, it is entirely possible that the United States could lose such advantage with respect to key contingencies about which it has traditionally cared a great deal. This eventuality is most plausible in the Western Pacific but also relevant in the former Soviet space.

The combination of these geopolitical and military-technological developments will have substantial implications for U.S. nuclear policy. The geopolitical developments mean that the United States is likely to face renewed strategic competition with countries that wish to revise the regional orders they inhabit, or even the global order, by exploiting their newfound strength with respect to the United States and its traditional allies.⁶ This will heighten the possibility of serious conflict with major nuclear-armed powers, necessitating that the United States grapple more earnestly with the possibility of conflict under the nuclear shadow, and even with the possibility of nuclear conflict itself.⁷ At the same time, because of the growing competitiveness of the military forces of its potential adversaries, the United States will not be able to rely so significantly and so confidently on its nonnuclear forces to deter and, if necessary, to prevail against its and its allies' opponents. This means that the United States may need to consider shifting more weight on to its nuclear forces in order to compensate for the diminished coercive power of its conventional military.⁸

Thus the United States will need to think anew about the roles and missions of its nuclear forces, their composition, how they and their potential employment are best explained, and how they should be postured and, if need be, used. The entry into office of a new presidential administration in January 2017 will offer an excellent opportunity for such new thinking. In particular, Congress has in the past legislatively mandated that the DoD conduct an NPR, and there is good reason to think such a legislative mandate will recur in the future.⁹ This review will be able to build on efforts to begin grappling with the implications of these trends for U.S. nuclear policy and posture, particularly efforts begun in recent years to

revitalize and adapt U.S. nuclear forces.¹⁰ It will also be able to carry forward much of the thinking and policy laid out in previous NPRs, including the most recent 2010 version, which recommitted the United States to maintaining a safe, secure, and effective nuclear deterrent.¹¹

THE UNITED STATES IS LIKELY TO FACE RENEWED STRATEGIC COMPETITION WITH COUNTRIES THAT WISH TO REVISE THE REGIONAL ORDERS THEY INHABIT, OR EVEN THE GLOBAL ORDER, BY EXPLOITING THEIR NEWFOUND STRENGTH WITH RESPECT TO THE UNITED STATES AND ITS TRADITIONAL ALLIES.

But in important respects it must also depart from the thinking of the 2010 review, which focused on continuing reductions in the numbers and shrinking the salience of U.S. nuclear forces, prioritized addressing nuclear terrorism rather than the deterrence of major war and aggression as the prime focus of U.S. nuclear policy, and effectively established a policy by which the United States would extend a basically static and progressively shrinking nuclear force into the indefinite future.¹² This review reflected an underlying confidence that geopolitical and military-technological conditions would not materially worsen for the United States and its allies. Yet such confidence appears unfounded, and thus a new look is in order.

This paper offers the outlines of a revised nuclear policy and posture, one that is in basic and primary continuity with the long-established U.S. approach toward the nation's reliance on "the absolute weapon" but that also, as the United States has repeatedly

done in the past, adapts that long-standing approach to a new era.¹³ It emphasizes a greater degree of discrimination and flexibility in the U.S. posture, attributes that have always been to some degree present in the U.S. nuclear posture and always aspired to, but that have been relatively neglected in the post-Cold War era.

U.S. Nuclear Strategy

THE ROLE AND VALUE OF NUCLEAR WEAPONS

The principal role for U.S. nuclear weapons should continue to be to deter major aggression and coercion of all kinds against the United States and its allies. The United States should seek to rely where possible – and at reasonable cost and risk – on its and its allies' conventional forces for deterrence, but U.S. nuclear forces should be a backstop for these conventional forces should they fail to achieve U.S. objectives or if the costs of such an effort become too great.¹⁴

GIVEN ONGOING TRENDS IN THE GLOBAL SECURITY ENVIRONMENT, HOWEVER, THE RELATIVE VALUE OF U.S. NUCLEAR WEAPONS WILL LIKELY RISE.

U.S. nuclear weapons should also continue to have important subsidiary uses, particularly in discouraging nuclear proliferation (including among allied and friendly states), mitigating the tendencies toward arms racing and the militarization of international politics, and exercising a general, if diffuse, constraint on tendencies toward major war, even beyond U.S. security perimeters.¹⁵

Given ongoing trends in the global security environment, however, the relative value of U.S. nuclear weapons will likely rise. This judgment stems from the assessment that at least some potential U.S. adversaries are likely to become relatively stronger and/or more assertive while, at the same time, U.S. conventional military superiority, in particular but not exclusively in Asia, is likely to come under increasing pressure as these potential adversaries exploit the potential of the so-called Revolution in Military Affairs to improve their military capabilities.¹⁶ Furthermore, nuclear weapons have become or are likely to become more salient in the strategies and military postures of Russia, China, and North Korea.¹⁷ These factors mean that, if the United States continues to want to extend deterrence effectively, it will likely need to rely more than it has in the recent past on its own nuclear forces in order to compensate for its diminished conventional advantages to deter and, if necessary, prevail against the nuclear strategies and capabilities of its potential adversaries.

THE OBJECTS OF U.S. NUCLEAR DETERRENCE

The United States should rely on its nuclear weapons to deter major aggression or the attempt to exploit the credible threat of such aggression for strategic advantage by any adversary against the United States or its allies. While the United States should view its nuclear forces as deterring a wide range of potential forms of aggression, it should regard them as forces useful solely for “extreme circumstances.” That is, while the United States should rely on them more than solely for deterrence of nuclear attack, they should be reserved for the most severe types of non-nuclear aggression, for instance, conventional attack that could not otherwise be defeated.

Nuclear weapons will therefore, in principle, have a general deterrent function. In practice, however, the main deterrent targets of U.S. nuclear weapons should be countries with the ability to mount major aggression against and with significant political and strategic tensions or disputes with the United States or its allies. This will likely continue to mean that Russia, China, and, to a considerably lesser degree, North Korea will receive the bulk of U.S. attention regarding its nuclear planning and posture. Other countries with nuclear forces or significant nonnuclear capabilities capable of imperiling the United States or its allies should, however, be targets of a latent or recessed deterrence in the sense that they should be made aware (either explicitly or implicitly) that developing a more adversarial relationship with the United States or its allies would likely bring them into the orbit of U.S. nuclear planning.

Given its formidable nuclear capabilities and its recovered conventional forces, Russia should continue to serve as the “pacing” threat for U.S. nuclear forces, planning, and posture. Russia’s substantial nuclear modernization program will necessitate that the United States maintain a highly survivable and capable set of delivery platforms; weapons; and command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems able to effectively deter and, if necessary, strike back after attack by Russia’s modernized force. In addition, U.S. nuclear forces and planning will need to be sufficiently discriminate and controllable to enable an effective deterrent and, if necessary, a response to any Russian attempt to put into action Moscow’s amended nuclear doctrine, one that envisions limited nuclear use for strategic effect.¹⁸

China’s role in U.S. nuclear planning and posturing will very likely grow. This is substantially because of the growing sophistication of China’s nuclear forces, allowing the People’s Republic of China (PRC) more credible options for selective use in a contingency. U.S. nuclear forces will need to be able to deter such use or, if necessary, respond to it effectively. In addition, China’s major conventional military buildup, one that threatens to undermine U.S. military primacy in the Western Pacific, will also necessitate that the United States pay greater attention to how U.S. nuclear forces can help compensate for material advantages the PRC might attain in the conventional military balance in maritime Asia.¹⁹

Given existing trends, it is likely that the Democratic People’s Republic of Korea (DPRK) will pose an increasing concern for U.S. nuclear planning. The DPRK’s progress toward a more developed nuclear arsenal and the growing size and sophistication of its missile force (in addition to its potential alternative modes of delivery, such as via submarines or special operations units) mean that it will pose a considerably intensifying threat to U.S. allies in the region and to the United States itself.²⁰ The United States will need to find ways to adapt its deterrent posture – including its nuclear forces – to continue to persuade Pyongyang that substantial aggression or the attempt to use its nuclear forces for advantage (either wholly or selectively, for instance, through iterated employment) would be a gravely losing proposition. This would become more difficult as North Korea’s ability to iteratively and survivably employ its nuclear forces increases, raising significant “decoupling” concerns for the United States with respect to its Northeast Asian allies.

While these three nations are likely to absorb the bulk of U.S. attention regarding its nuclear forces, other nations should also be the object of a more indirect or latent type of deterrence. For instance, Iran should be an object of U.S. nuclear deterrence in the sense that U.S. nuclear forces should communicate to Tehran the inutility and danger of Iran obtaining its own nuclear arsenal and seeking to exploit it for strategic gain, as well as the futility of seeking to conduct major aggression against U.S. allies in the region.

THE MISSIONS OF U.S. NUCLEAR WEAPONS

Retaliation should continue to be the basic strategic orientation of U.S. planning for large-scale nuclear use. That is, the United States should continue to procure and posture its nuclear forces to demonstrate to any opponent (most relevantly Russia) that U.S. retaliation to any attack would be certain and that the response to a large-scale assault would be utterly devastating and would clearly cost the initiator far more than it could plausibly gain, including by holding its most valued assets at risk.²¹ U.S. retaliatory forces will therefore need to be able to reach and destroy or severely damage not only an adversary's capital and political centers, industrial areas, and military bases and forces but also its most guarded facilities, such as underground leadership redoubts, to ensure it did not think there were sanctuaries from U.S. reprisal.²²

A special focus of U.S. effort should be to continue to work to extend the decision time available to U.S. national leadership in the event of attack, including under the most stressing conditions, in order to provide maximal time, information, and clarity to accountable leaders regarding the nature of an attack, thus providing the best basis for determining the appropriate response.²³ In particular, the United States should seek to build greater assurance, survivability, and flexibility into its forces and their associated

C4ISR capabilities to alleviate doubts about the U.S. ability to retaliate effectively and to minimize pressures toward precipitate action stemming from purely operational or technical factors.

U.S. NUCLEAR WEAPONS, HOWEVER, NEED TO DO MORE THAN THREATEN UNHINDERED DEVASTATION.

U.S. nuclear weapons, however, need to do more than threaten unhindered devastation. Under continuing conditions of U.S. conventional superiority in areas of vital interest, nuclear weapons should play an important reserve role in U.S. planning regarding war termination and escalation control, primarily as a deterrent to a losing adversary's effort to "cheat" the rules of a war that the United States is winning and wishes to keep conventional. In this role, U.S. nuclear forces will provide a powerful disincentive to an adversary contemplating seeking to use its nuclear forces to dramatically escalate a conflict and either break U.S. or allied will or short-circuit U.S. conventional dominance.²⁴ U.S. nuclear forces will need to be appropriately structured and tailored to respond to such a limited nuclear attack (although it is also worth noting that U.S. political objectives would also need to be scaled appropriately to avoid or de-escalate such a scenario).²⁵

In a situation in which the United States has lost the conventional advantage, however, U.S. nuclear weapons should play a vital role in bringing a war the United States and its allies are losing to a tolerable close. While such a loss of conventional advantage appears unlikely for the nearer term, this eventuality could develop in particular in maritime Asia,

where the United States could lose its conventional dominance should it not take sufficiently effective and resolute actions to maintain its margin over the PRC.²⁶ In such an event, U.S. nuclear forces will need to provide the United States with credible options for controlled escalation against China, options designed to telegraph firm U.S. resolve to continue escalating, positively influence the conventional military conflict that would be the presumed precursor for such use, and demonstrate a willingness to end the conflict on mutually satisfactory terms.²⁷

NUCLEAR WEAPONS IN EXTENDED DETERRENCE

U.S. nuclear forces should continue to play a very significant role in U.S. extended deterrence and assurance strategy. Thus U.S. extended deterrence and assurance strategy should continue to be a key driver of U.S. force posture, structure, and policy. In particular, U.S. nuclear forces should continue to serve as the cornerstone of U.S. extended deterrent arrangements with the nations of NATO and with allies in Asia and the Pacific. Depending on circumstances, such arrangements might be extended to allied and partner countries in the Middle East, albeit likely in modified form.

How salient U.S. nuclear forces should be in extended deterrence and assurance will depend critically on both the United States' and its allies' perception of how effective U.S. conventional forces are relative to potential adversaries and on how resolute and credible U.S. political leadership is perceived to be. U.S. nuclear policy will need to be adapted to these military and perceptual realities.

Depending on circumstances, the U.S. extended nuclear deterrent might also take a different shape in the future. For instance, in the event of a greatly magnified threat from

the PRC, or especially aggressive behavior by a more capable DPRK, U.S. arrangements along the lines of its approach in NATO Europe might be replicated in Asia. This would be motivated by some combination of the desire to demonstrate greater collective resolve against potential adversaries, enable more direct participation by allies in the deterrent posture, and demonstrate greater presence and thus credibility of commitment to threatened allies, thereby mitigating pressures toward proliferation. It will therefore be important for the United States to maintain the ability to forward deploy theater nuclear forces, such as dual-capable aircraft, to various regions of the world.

A particularly important aspect of U.S. nuclear forces' role in extended deterrence will be to continue to play a prominent part in preventing further nuclear proliferation, including among allied and friendly states. Accordingly, U.S. nuclear policy should continue to be tailored to pursue this aim. Assurance efforts in this regard will be particularly important in Northeast Asia for Seoul and Tokyo in light of North Korea's continuing belligerence and China's military buildup, for Central and Eastern Europe in light of the challenge to NATO security posed by Russia, and for Persian Gulf and Middle East allies and partners due to Iran's regional assertiveness and nuclear ambitions. If the threat from plausible adversaries grows in these regions and U.S. allies and partners appear to be seriously considering either alternative strategic trajectories or independent nuclear arsenals, the United States should be willing to explore alternative arrangements for strengthening nuclear deterrence and assurance, including through mechanisms enabling greater allied participation in the U.S. nuclear deterrent posture.²⁸

This all said, while preventing proliferation should remain an important goal for U.S. nuclear policy, it should not be the primary aim. Ultimately, nonproliferation objectives need to be reconciled with broader and more fundamental geostrategic objectives and, in the final analysis, with the security of the United States itself. U.S. nuclear policy should thus ultimately be determined based on these strategic considerations rather than primarily on nonproliferation factors, though direct tradeoffs should be avoided where and when possible.²⁹

NONPROLIFERATION OBJECTIVES NEED TO BE RECONCILED WITH BROADER AND MORE FUNDAMENTAL GEOSTRATEGIC OBJECTIVES AND, IN THE FINAL ANALYSIS, WITH THE SECURITY OF THE UNITED STATES ITSELF.

DECLARATORY POLICY

U.S. declaratory policy should emphasize U.S. resolve and ability to employ nuclear weapons to defeat or retaliate against major aggression while at the same time stressing U.S. commitment to the responsible stewardship of and restraint regarding these awesome weapons. The United States should therefore state that it stands ready to use nuclear weapons in the event of major aggression against itself or its allies, but that it will only contemplate employment of its arsenal in extreme circumstances and for strategically defensive purposes. The precise contours of these criteria should be left deliberately ambiguous, but the doctrine should be explained as one designed to chill adversaries' consideration of resorting to the use of nuclear weapons, strategically

significant weapons of mass destruction (WMD), massive conventional force, or comparable forms of violence against the United States or its allies.

The United States should emphasize that it would not use nuclear weapons for strategically offensive purposes. Nuclear weapons should be reserved for the strategic defense – the preservation and restoration of the status quo rather than conquest or revision. This would both serve U.S. interests, which are essentially status quo in nature, and accord U.S. nuclear policy with the established political-security order, which would contribute to the legitimacy of reliance on such threats.³⁰ Needless to say, such a declaration would be inherently ambiguous. But in this case ambiguity would not be a demerit. The United States would simply want to telegraph that it would use its nuclear forces to defend, restore, or vindicate its existing interests, not to expand them.

At the same time, while the United States should only resort to nuclear employment in extreme or particularly perilous circumstances, it should make clear that it will not necessarily view nuclear arms as weapons of “last resort.” Rather, the United States should make clear that it would consider resorting to its nuclear forces if a situation were sufficiently dire even though other forces had not been fully exhausted. This declaratory policy would prevent a situation from developing in which adversaries could calculate that they could avoid running the risk of a U.S. nuclear response by conducting major aggression limited enough to avoid exhausting U.S. nonnuclear capabilities but sufficiently effective to damage U.S. interests seriously. This should be particularly helpful in deterring nations like Russia and China from thinking that they could conduct targeted aggression against U.S. allies and partners in their respective regions.

Finally, the United States should emphasize that it will seek to “minimize” (rather than “reduce” as in the current parlance) its reliance on nuclear forces in its security strategy. This emphasis should be designed to suggest the interest of the United States in keeping the salience of its nuclear forces as modest as feasible without pledging a continuing reduction, a reduction that cannot be justified divorced from strategic context. Rather, nuclear forces’ relevance in U.S. security strategy needs to be modulated to the strategic and military- technological environment. As elaborated above, their salience will need to increase should the threats to the United States and its allies increase and/or if U.S. advantages in nonnuclear capabilities decline.

THE UNITED STATES SHOULD EMPHASIZE THAT IT WILL SEEK TO “MINIMIZE” (RATHER THAN “REDUCE” AS IN THE CURRENT PARLANCE) ITS RELIANCE ON NUCLEAR FORCES IN ITS SECURITY STRATEGY.

EMPLOYMENT POLICY

In addition to ensuring the basic retaliatory deterrent function outlined previously, U.S. employment policy should emphasize U.S. capability for and willingness to wield nuclear weapons discriminately. That is, while the ultimate source of U.S. deterrence should remain the threat of the overwhelming devastation that would be wrought by release of the full power of the U.S. nuclear force, the United States should also prepare for and make clear that it would, as

appropriate, use its nuclear force in more limited fashion for more focused effect. In particular, the United States should develop capabilities, options, and doctrine to enable limited and tailored nuclear strikes – including with varying yields, trajectories, and target types – designed to demonstrate resolve and the preparedness to escalate further to an opponent, degrade the enemy’s capability to persist in the actions the United States was objecting to (e.g., by attacking an adversary’s conventional or theater nuclear forces engaged in a regional conflict that had been the catalyst for escalation to the nuclear level), and clearly convey a measure of restraint and thus willingness to terminate the war.³¹

The logic of this policy would be to render more credible and effective the U.S. nuclear deterrent for less than total contingencies, such as regional conflicts, and in particular for extended deterrence scenarios. In these situations, total release of U.S. nuclear forces would not be particularly credible, let alone appropriate. These capabilities would be especially useful for deterrence of Russia and China and escalation management in the event of conflict with them. Each of these two states possesses substantial survivable strategic nuclear forces of their own that would compel the United States to seek to limit any war. But such tailored capabilities could also be applicable in the event of conflict with North Korea, which is moving in the direction of obtaining survivable and iteratively usable nuclear forces. Accordingly, the United States should make a special effort to develop the platforms and weapons, doctrine, planning capacity, and other capabilities needed to fight a limited nuclear war more effectively than plausible adversaries. Such superiority in the ability to fight a limited nuclear war would give the United States coercive leverage over these potential opponents – leverage that could become significant and even crucial in the event of war.

U.S. Nuclear Posture

THE COMPOSITION OF THE U.S. NUCLEAR FORCE

The ideal U.S. nuclear force, therefore, is one that is not only highly survivable and able to issue a devastating blow against any adversary under any scenario but that is also capable of conducting effective limited nuclear operations in a controlled fashion while maintaining the ability to escalate to full-scale war if necessary. It is a force that can achieve reasonably precise effects for U.S. national decisionmakers across a wide spectrum of possible scenarios, enabling a more effective limited nuclear war capability and thus providing greater leverage and advantage for the United States.

THE IDEAL U.S. NUCLEAR FORCE IS CAPABLE OF CONDUCTING EFFECTIVE LIMITED NUCLEAR OPERATIONS IN A CONTROLLED FASHION WHILE MAINTAINING THE ABILITY TO ESCALATE TO FULL-SCALE WAR IF NECESSARY.

The U.S. force of today is not optimally designed for this demanding set of criteria. In order to move in this direction, therefore, the United States should invest heavily in a survivable and resilient nuclear command and control system that can provide sure and reliable communications, enable a wide variety of taskings, and disseminate detailed information to forces – and do all of these things in an iterated fashion.³² Achieving this in an increasingly perilous and competitive C4ISR environment entails that the United States explore novel ways of communicating and of protecting communications, more resilient space assets,

developing more terrestrial and air-breathing platforms for C4ISR, and a more modular and disaggregated architecture. In particular, given the rising threats to the U.S. Nuclear Command and Control System (NCCS), especially in space, the United States should develop a redundant non-space-based command and control system for its nuclear forces to minimize this vulnerability.³³ This should allow the United States to conduct effective nuclear operations even if an adversary is able to deny or substantially degrade U.S. use of its space assets.

In terms of weapons and platforms, the United States should move in the direction of providing all its nuclear forces with variable yield warheads/weapons that can provide a variety of types of effects (e.g., electromagnetic pulse (EMP), different height of burst) so that the United States can more effectively tailor strikes from the full range of its available platforms. To the extent feasible, the United States should invest in enabling a greater degree of variability of yield in its warheads and gravity bombs and in enabling these weapons to be employed in a variety of different modes, for instance, at sea and at varying elevations. The United States should in particular focus on making the ballistic missile force more capable of discriminate strikes.

While the United States should also invest substantially in developing and procuring a long-range bomber and associated family of systems capable of penetrating the most advanced air defense systems, it would also behoove the country to possess a suite of long-range standoff nuclear attack munitions that can alleviate the need for penetration. This is important particularly due to the growing capabilities of integrated air defense systems and rising questions concerning the

Current U.S. Nuclear Weapons and Delivery Systems

Warheads – Strategic Ballistic Missile Platforms

| TYPE | DESCRIPTION | CARRIER | MISSION | MILITARY |
|---------|--------------------------|---|---------------------|----------------|
| W78 | Re-entry vehicle warhead | Minuteman III intercontinental ballistic missile | Surface to surface | U.S. Air Force |
| W87 | Re-entry vehicle warhead | Minuteman III intercontinental ballistic missile | Surface to surface | U.S. Air Force |
| W76-0/1 | Re-entry body warhead | D5 submarine-launched ballistic missile Trident submarine | Undersea to surface | U.S. Navy |
| W88 | Re-entry body warhead | D5 submarine-launched ballistic missile Trident submarine | Undersea to surface | U.S. Navy |

Bombs – Aircraft Platforms

| TYPE | DESCRIPTION | CARRIER | MISSION | MILITARY |
|------------|--------------------|-------------------------------------|----------------|----------------|
| B61-3/4/10 | Non-strategic bomb | F-15, F-16, certified NATO aircraft | Air to surface | U.S. Air Force |
| B61-7 | Strategic bomb | B-52 and B-2 bombers | Air to surface | U.S. Air Force |
| B61-11 | Strategic bomb | B-2 bomber | Air to surface | U.S. Air Force |
| B83-1 | Strategic bomb | B-52 and B-2 bombers | Air to surface | U.S. Air Force |

Warheads – Cruise Missile Platforms

| TYPE | DESCRIPTION | CARRIER | MISSION | MILITARY |
|-------|--|-------------|----------------|----------------|
| W80-1 | Air-launched cruise missile strategic weapon | B-52 bomber | Air to surface | U.S. Air Force |

Adapted from the National Nuclear Security Administration, “Current U.S. Nuclear Weapons and Associated Delivery Systems,” <http://nnsa.energy.gov/ourmission/managingthestockpile/weapons>.

long-term viability of stealth and other methods of ensuring penetration.³⁴ The new long-range standoff missile (LRSO) is intended to be the system that addresses this problem, and so the LRSO and/or other future standoff nuclear missiles should also offer a range of effects in terms of yield, height of burst, and the like.³⁵

Earth penetration should be a special focus of long-term research and development and, ultimately, procurement. As a number of expert bodies have pointed out, there appear to be significant limits to the effectiveness of straight-forward earth penetration systems.

Given the proliferation of hardened and deeply buried targets (HDBTs), however, and the importance of denying potential adversaries sanctuary, it is very important for the United States to have concepts of operations and appropriate capabilities able to credibly hold at risk these facilities, and potentially significant numbers of such facilities. Addressing this worsening problem should therefore be a significant focus of U.S. investment.³⁶

In accordance with this strategy, the United States should modify its existing nuclear force structure. In addition to the existing weapons in its arsenal, the United States should seek to develop and procure:

- A greater variety of variable yield weapons able to be launched from various types of platforms – particularly on ballistic missiles and standoff cruise missiles.
 - » This could include loading some Trident II D5s with primary-only warheads (perhaps one to two per strategic ballistic missile submarine [SSBN]) and emplacing a variable yield warhead on the LRSO.
- Better earth penetration capability for defeat of proliferating HDBTs. The gravity bomb and replacement nuclear cruise missile could both be explored to serve this function.
- The greatest feasible variety of weapons effects, most notably varying yield options, low collateral damage weapons, and EMP-optimized weapons.

In terms of the size and composition of the stockpile, the United States should:

- Avoid reductions for their own sake with respect either to the deployed force or to the geopolitical hedge. Reductions in general below New START levels should be disfavored barring a compelling rationale.
 - » Reductions from the technical hedge should be undertaken once a truly responsive infrastructure has been developed, the stockpile has been sufficiently modernized, and as greater confidence is developed regarding the reliability of relevant warhead classes.³⁷
- Arms control efforts should be pursued avidly but oriented toward the promotion of stability rather than on reducing numbers.

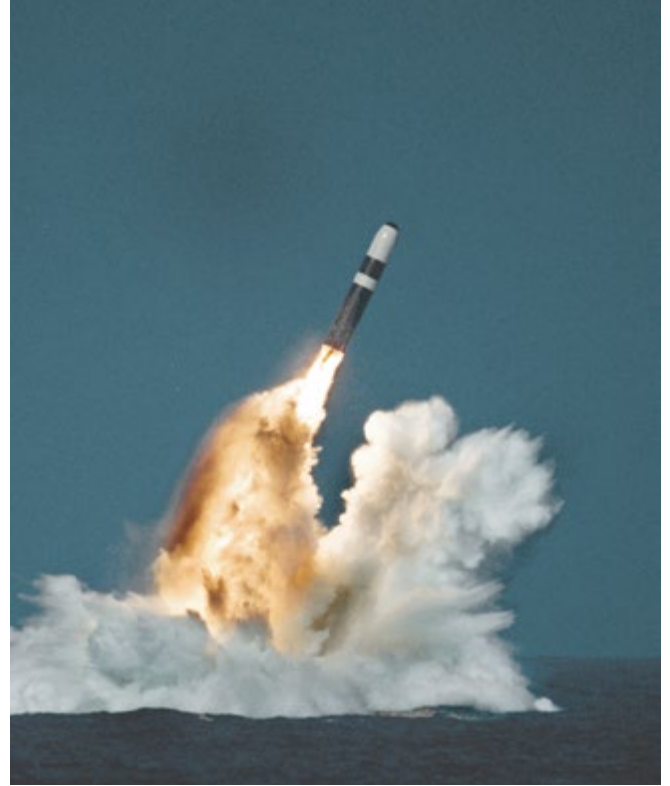
- » Instead of focusing on highly ambitious, comprehensive agreements, arms control efforts could more productively focus on specific stability-promoting measures. For instance, the United States could seek to devise mechanisms to assure the Russians and Chinese that U.S. defensive and conventional strike systems are not designed for or capable of disarming their strategic retaliatory force, thus reducing the chances of miscalculation while also reducing the political baggage these forces must carry.³⁸

With respect to its delivery systems, the United States should:

- Maintain a triad of SSBNs, ICBMs, and nuclear-armed bombers.³⁹
 - » *Submarines.* The United States should fully fund the *Ohio* ballistic-missile submarine replacement program, with a particular emphasis on maintaining the submarine's ability to operate securely and clandestinely over its full lifetime. The United States should plan to purchase at least 12 such SSBNs but, if geopolitical or military-technological circumstances warrant it, should be prepared to purchase additional submarines.
 - The Trident II D5 SLBM should remain the missile for both submarine classes for the life of the missile.
 - » *ICBMs.* Decisions about how to modernize the ICBM will pivot substantially on the strategic and military-technological environment and on cost considerations. Assuming that a major new form of threat to the ICBM force does not arise, the United States should life extend and incrementally modernize the Minuteman III for as long as practicable, potentially considerably beyond 2030. Once life extension is no longer practicable or if the



Minuteman III intercontinental ballistic missile launch. (Wikimedia Commons)



A Trident II missile breaches the surface during an underwater launch. (Wikimedia Commons)



The graphic concept for the U.S. navy nuclear submarine that will replace the Ohio-class ballistic missile submarine. (Wikimedia Commons)

United States determines it needs greater capability from its ICBM force, the United States should replace the Minuteman with a modernized ICBM, likely also emplaced in existing silos.

- The United States should continue exploring various options for the ICBM as well as alternative basing modes but, given cost constraints and the limited additional utility provided by an alternative basing

option as compared to a silo-based missile, should incline toward life extension of the Minuteman with an eye toward its eventual replacement by a similar, modernized missile.⁴⁰

- The United States should seek to use common components between the ICBM and SLBM inventories to reduce costs, consistent with maintaining force resiliency in the event of component failure.
- » *Bombers.* The United States should maintain and modernize its fleet of nuclear-armed bombers to ensure they and/or their weaponry are able to penetrate to strike highly defended targets. This modernization effort is particularly important in light of the unique attack capabilities found in the bomber force and the growing challenges to stealth and other traditional U.S. approaches to penetration of adversary air defenses.



A B-52 and B-2 fly in formation. (U.S. Air Force)

- *Penetrating long-range strike bomber (LRSB)/family of systems.* This critical aircraft/family of systems should be procured as a low-observable/stealth penetrating platform, made nuclear capable, and equipped to deliver both nuclear gravity bombs and nuclear-armed cruise missiles, including the LRSO. While the nuclear ranks of the LRSB should be sufficient to ensure it is not merely a boutique capability, not all of the 80–100 LRSB aircraft need to be nuclear capable.
- *Standoff bomber.* B-52Hs should be maintained in a standoff role as long as practical and affordable. The B-2A fleet, meanwhile, should be equipped for effective stand-off attack, especially as their penetration capability diminishes in light of challenges to stealth technology.
- The United States should also explore the possibility of an “arsenal aircraft” designed to deliver nuclear (and conventional) weapons from stand-off range, in particular to replace the aging B-52H.
- » *Dual-capable shorter-range attack aircraft.* The United States should procure sufficient numbers of F-35 aircraft in a dual-capable mode to provide for theater deterrence and assurance purposes in Europe, East Asia, and the Middle East. These aircraft are the only purely “tactical” or theater nuclear weapons platforms in the U.S. inventory and thus are particularly useful for tailored assurance and deterrence strategies. The United States will need to acquire enough such dual-capable aircraft to enable forward deployment in multiple regions simultaneously.



Lawrence Livermore National Laboratory, a key facility for U.S. nuclear weapons research. (Lawrence Livermore National Laboratory)

- The United States should also explore rendering the naval variant F-35C nuclear capable. Whether to pursue this option will depend on the competing pressures of strategic and political circumstance on the one hand and cost and organizational disruption risks on the other. The United States will be unlikely to need new types of platforms for delivery of nuclear weapons before 2030. Given the rapidly changing nature of the military-technological and geopolitical environments, however, such platforms might be useful or even necessary in the years following 2030 as weapons, platforms, C4ISR systems, and other relevant military capabilities evolve.⁴¹ The United States should therefore continue and, as appropriate, intensify research and development, concept exploration, technological feasibility studies, and other appropriate avenues to explore the utility, need, and advantages and disadvantages of different means of delivering nuclear weapons.

It is also important to emphasize the essential value of a responsive infrastructure. This is vital to the long-term health and ultimately the deterrent credibility of the U.S. nuclear posture. The goal of the United States should be to develop a nuclear weapons infrastructure responsive to evolving national strategic requirements. The United States should regard the nuclear weapons complex to be sufficiently responsive when it has attained the capability, capacity, and agility to turn over the entire stockpile in a timely fashion (on the order of 10 years) and to respond to emerging threats over the medium term.

The Relationship of Nuclear Forces to Other Strategic Capabilities

The relationship of nuclear forces to other key strategic capabilities is by necessity intimate. Nuclear forces need to be able to operate and perform their missions reliably under any plausible conditions, including the most stressing forms of attack, and need to do so in sufficiently controlled and deliberate fashions. This puts a special premium on a highly capable and resilient NCCS and on additional space, cyber, and other capabilities needed or useful for conducting battle damage assessment, enabling penetration, and related functions. At the same time, the nuclear force needs to be effective even in the face of attacks from advanced technologies across domains such as cyber, electronic warfare, space/counterspace, and novel forms of conventional strike. Moreover, the United States needs to be able to conduct limited and controlled nuclear warfare under these conditions rather than being constrained to employing such weapons only in large-scale and devastating fashion.

While nuclear forces need to be planned for and postured in a way integrated with other key strategic technologies, nuclear weapons should remain a clearly distinct suite of capabilities and should continue to be “firebreathed” from these other capabilities.

A leading issue in this respect will be to ensure that U.S. nuclear forces are able to achieve their goals even against the most severe threats to the NCCS and associated space, cyber, and other capabilities. The United States should therefore continue and, where necessary, augment investments in modern NCCS and related capabilities as well as in training and research and development necessary to effectively use and continue innovating with respect to this vital set of assets.

In terms of declaratory policy, potential adversaries – particularly Russia and China – should be put on notice that attacks on NCCS-related assets would be construed as the gravest form of assault and would be treated as akin to a strategic attack. By the same token, however, the United States should seek to promote the principle that NCCS systems should be exempted from attack among the three major nuclear weapons powers. Accordingly, the United States should also make clear that it would seek to exercise restraint with respect to Russian and Chinese NCCS in the event of crisis or conflict. The United States should also therefore push in its own procurement and posture to delineate NCCS from nonnuclear capabilities – and press Russia and China to do the same. At the same time, in order to avoid moral hazard and ensure the U.S. ability to strike important and relevant targets in the event of war below the strategic nuclear level, the United States should make clear that dual-use systems employed in a conventional conflict would not be exempted from attack.⁴²

Measuring the Sufficiency of U.S. Nuclear Forces: Key Capabilities and Attributes

A recurring central issue in U.S. nuclear weapons policy and procurement has been determining “how much is enough.” Of course this question cannot be answered without reference to specific strategic and military-technological circumstances. Yet it is useful for decisionmakers to frame such a broad question against a more specific set of criteria. Such criteria should measure the key characteristics that the United States should seek from its nuclear forces. Needless to say, no single platform or system is likely to satisfy fully all such metrics, but the force as a whole should.⁴³

- *Operational effectiveness.* Ability of a given capability or deployment option to achieve specific goals assigned by national or military leadership.
 - » *Lethality.* Ability of a given system or deployment option to contribute effectively to holding at risk key targets, especially what an adversary values.
 - » *Survivability.* Ability of a given system or deployment option to survive enemy attack, especially surprise attack.
 - » *Penetration.* Ability of a given system or deployment option to perform reliably under specified conditions. This includes the ability to penetrate to a target effectively.
 - » *Promptness.* Ability of a given system or deployment option to operate within specified time constraints.
- *Capability for limited conflict.* Ability to employ a given capability or deployment option for limited nuclear options by achieving relevant effects while controlling escalation.
 - » *Discrimination.* Ability of a given system or deployment option to achieve precise and flexible effects against relevant targets while minimizing collateral damage.
 - » *Severability.* Ability of a given system or deployment option to be used without necessitating use of or rendering vulnerable other systems or deployment options in such a way as to heighten the probability of a wider war or reduce overall force effectiveness.
 - » *Controllability.* Ability of national or military leadership effectively and persistently to control a given system or execution of a given deployment option.
- » *Distinguishability.* Ability of opponent to perceive correctly that a given system or deployment option is being used in a deliberately limited fashion.
- *Effect on adversary decisionmaking.* The impact of a given capability or deployment option on the decisionmaking of an adversary.
 - » *Coercive value.* Degree to which a given capability or deployment option would cause an adversary to be more cautious toward or accommodating of U.S. objectives/interests due to fear of consequences of the use of the capability or exploitation of the deployment option.
 - » *First-strike stability.* Degree to which a given capability or deployment option would avoid causing an adversary to fear a U.S. attempted disarming first strike or otherwise cause an adversary to be more ready to adopt or put into action a destabilizing posture.
 - » *Arms race response.* Degree to which a given capability or deployment option would avoid causing an adversary to build up or posture its nuclear or conventional forces in ways detrimental to U.S. interests.
- *Assurance.* Ability of a given capability or deployment option to assure allies of commitment and capability of United States to protect them.
 - » *Elite assurance.* Value of a given system or deployment option in conveying U.S. commitment and resolve to ally elite decisionmakers.
 - » *Political durability.* Political acceptability and sustainability of a given system or deployment option to allied publics.

- *Signaling. Value of a system or deployment option for telegraphing resolve, desire to de-escalate, and other messages to an opponent and/or ally.*
 - » *Visibility. Degree to which a given system or deployment option is readily apparent to adversaries and/or allies prior to employment.*
 - » *Perceptible modularity in posture. Ability to modulate a given capability or deployment to convey signals to adversaries and/or allies.*
- *Long-term viability. The degree to which a given system or deployment option is practically sustainable and useful over the longer term.*
 - » *Cost-efficiency. Cost-efficiency of a given system or deployment option.*
 - » *Adaptability. Ability of a given system or deployment option to enable, integrate, and/or provide new capabilities.*
 - » *Resilience. Ability of a given system or deployment option to continue to be effective over long periods despite technological advances and other developments.*
 - » *Interoperability. Ability of a given system or deployment option to contribute, either directly or indirectly (as through technological advances), to nonnuclear military missions.*
 - » *International implications. Degree to which a given system or deployment option supports U.S. nuclear policy and broader international objectives, including maintenance of effective deterrence strategic stability with major powers as well as the upholding of the international nonproliferation order.*

In seeking to create a future force exhibiting the range of these characteristics, the United States should continue catering to historically emphasized criteria such as operational effectiveness and long-term viability but should devote increased attention to capability for limited conflict and to assurance and signaling functions.

What Should Change this Strategy?

The primary geopolitical driver that would necessitate a fundamental shift in U.S. nuclear posture would be the reemergence of a major peer competitor seeking to develop a nuclear and broader military arsenal that could plausibly hold at risk the U.S. nuclear force, including its basic retaliatory capability, as the Soviet Union threatened to do during the Cold War. Such a power would be developing a strategic (both nuclear and nonnuclear) force of the scale and sophistication that it could plausibly threaten to destroy, degrade, or hobble the U.S. nuclear force to such a degree that retaliation would be excessively foolish, suicidal, or simply impossible. (This could stem not only from the vulnerability of U.S. weapons systems and platforms themselves but also from vulnerabilities in the U.S. NCCS as well as adversary's defensive capabilities to "mop up" residual U.S. retaliation.)

In the event such a geopolitical threat were to arise, the United States would have to dedicate far greater effort and resources than it has since the end of the Cold War to ensuring the survivability and effective performance of its forces, that these forces could penetrate enemy defenses, and that they could create the effects required to destroy key adversary assets. In this scenario the United States would likely have to revisit the notion of fixed, silo-based ICBMs in favor of a more survivable

land-based configuration and would have to relook at both the consolidation of the U.S. heavy bomber force at a few bases and their maintenance at a vulnerable low-alert status. Though no power appears likely in the near to medium term to seek, let alone to be able, to hold the U.S. nuclear force at risk in this fashion, it is possible that such a scenario could develop over the longer term.

The primary technological development that would necessitate a major shift in U.S. nuclear posture would be the appearance of a dramatically enhanced antisubmarine warfare (ASW) capability, in particular one that is operationalized. (That is, an ASW breakthrough on its own that is too complicated or expensive to operationalize would not necessarily compel a dramatic shift in U.S. nuclear posture, since the United States might control for such boutique ASW capabilities through changes in SSBN deployment patterns, operating tactics, fleet size, and other techniques or force posture changes.) In the event that a substantial, broadly applicable ASW capability is developed or obtained by U.S. adversaries – for instance, through “transparent oceans” technology or ultra-effective sound-tracking techniques – and an effective kill mechanism deployed, the United States would in the near term likely need to compensate for the diminished survivability of its SSBNs by adopting more conservative operating patterns for these submarines (e.g., by operating in waters closer to the United States and by providing the vessels with greater defenses, such as with surface ships or with accompanying aircraft). In such a scenario, the United States would also want to augment the survivability of the other legs of the triad, for instance by increasing the alert status of its nuclear heavy bombers. Over the longer term, the United States would want to explore alternative platforms for

its sea-based deterrent, for instance, by disaggregating the highly concentrated SSBNs into smaller survivable or expendable (likely also subsurface) vessels and exploiting novel platforms for deployment of nuclear strike capabilities in the subsurface realm. In so doing, the United States could explore greatly expanding the number of launch points available at sea, thereby substituting a large number of targets for the survivability of individual platforms – as is the case with the Minuteman ICBM force today. The United States would also likely want to seriously consider pursuing mobile land-based ICBMs in this case to increase the survivability of the land-based nuclear force.

As noted, neither of these eventualities appears likely in the near to medium term, but given the stakes involved, the U.S. intelligence community and outside experts should maintain a watchful eye for them.

Conclusion

The world is changing in ways that dictate that U.S. nuclear policy and posture should also change. The renewal of competition among the major states, the shifts of power in the international system away from traditional U.S. allies and toward some potential U.S. adversaries, and the narrowing of U.S. nonnuclear military advantages all mean that the United States needs to reexamine and revise its nuclear policy and posture. The NPR likely to be mandated by Congress for the next administration offers an excellent opportunity to do just this, and to do so while many of the trends demanding this reexamination are evident but still inchoate and susceptible to more effective counteraction by the United States. The United States should therefore grasp this opportunity to adapt its nuclear policy and posture, maintaining U.S. strategic advantages and mitigating vulnerabilities and weaknesses where possible.

It is worth explaining why this is not only important but also justified, for nuclear weapons are terrible weapons capable of killing large numbers of people in short order. Any substantial modernization of such arms requires a rationale beyond the desire of a nation to maintain primacy, bureaucratic inertia, or pride. The modernization program laid out in this document does have such a rationale. And that is that U.S. nuclear weapons continue to offer the prospect of deterring major aggression against not only the United States but also a wide range of like-minded states, and doing so with unique efficacy. The modernization program here is offered in the hopes of making this most formidable of deterrents as effective in the future as it has been since its inception, a 75-year period correlated with an unprecedented abeyance of major power war and the protection, maturation, and expansion of free systems of sociopolitical organization. If the United States continues to use its nuclear forces as the cornerstone of its own security and the security of its like-minded allies and partners, and thinks about how to use those forces sternly but responsibly, then a modernization program that will make that deterrent more effective in a new era is not just defensible. It is actually incumbent upon the country to support it.

Endnotes

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2. See, for instance, Charles Krauthammer, “The Unipolar Moment,” *Foreign Affairs* 70 no. 1 (Winter 1990/91): 23–33. For some of the challenges to American primacy and ways to sustain that position in the face of these difficulties, see Elbridge Colby and Paul Lettow, “Have We Hit Peak America? The Sources of U.S. Power and the Path to National Renaissance,” *Foreign Policy* (July/August 2014): 54–63.
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4. On the Revolution in Military Affairs, see Andrew Krepinevich, *The Military-Technical Revolution: A Preliminary Assessment* (Center for Strategic and Budgetary Assessments, 2002); and, more recently, Barry D. Watts, “The Maturing Revolution in Military Affairs” (Center for Strategic and Budgetary Assessments, 2011).
5. Chuck Hagel, “‘Defense Innovation Days’ Opening Keynote” (Newport, RI, September 3, 2014), www.defense.gov/Speeches/Speech.aspx?SpeechID=1877.
6. For an exploration of the importance of this dynamic, see, inter alia, Evan B. Montgomery, “Contested Primacy in the Western Pacific: China’s Rise and the Future of U.S. Power Projection,” *International Security* 38 no. 4 (Spring 2014): 115–49; and Jakub Grygiel and A. Wess Mitchell, “The Vulnerability of Peripheries,” *American Interest*, March 2011.
7. For good explorations of the growing salience of nuclear weapons in the contemporary military-strategic environment, see, for instance, David Ochmanek and Lowell H. Schwartz, *The Challenge of Nuclear-Armed Regional Adversaries* (Santa Monica, CA: RAND, 2008); Forrest E. Morgan et al., *Dangerous Thresholds: Managing Escalation in the 21st Century* (Santa Monica, CA: RAND, 2008); Forrest Morgan, “Dancing with the Bear: Managing Escalation in a Conflict with Russia,” *IFRI Proliferation Papers* 40 (Winter 2012); Keir Leiber and Daryl Press, “Coercive Nuclear Campaigns in the 21st Century” (Monterey, CA: Naval Postgraduate School, March 2013); Larsen and Kartchner, *On Limited Nuclear War in the 21st Century*.
8. This of course assumes that the United States will seek to preserve the existing strategic architecture of its alliances and partnerships, at least to some substantial degree. Needless to say, there is a debate about this topic, though of limited influence on actual U.S. policy. For the author’s argument for why the United States should seek to preserve this architecture, albeit with greater selectivity and focus than it has exhibited in the last 20 years, see Elbridge Colby, “Why the U.S. Needs Its Liberal Empire,” *The Diplomat*, August 10, 2011, <http://thediplomat.com/2011/08/why-us-needs-its-liberal-empire/>. For a more elaborated argument for this approach, placing the need for such a policy in its historical, developmental, and strategic context, see William E. Odom and Robert Dujarric, *America’s Inadvertent Empire* (New Haven, CT: Yale University Press, 2004).
9. For the 2010 legislative mandate, see 110th Congress, Public Law 110-181, Sec. 1070.
10. For an outline of this ongoing effort, see Frank Kendall, “Air Force Association 2014 Conference and Exposition” (National Harbor, MD, September 17, 2014), <http://www.defense.gov/Speeches/Speech.aspx?SpeechID=1884>.
11. U.S. Department of Defense, *Nuclear Posture Review Report* (2010).
12. *Ibid.*, 15–17.
13. For a similar view, see the excellent short article by retired STRATCOM commander Admiral Richard Mies, “Strategic Deterrence in the 21st Century,” *Undersea Warfare* (Spring 2012):12–18.
14. This represents substantial continuity with long-standing U.S. nuclear policy. See, for instance, North Atlantic Treaty Organization, North Atlantic Military Committee, “Final Decision on MC 14/3: A Report by the Military Committee to the Defense Planning Committee on Overall Strategic Concept for the Defense of the North Atlantic Treaty Organization,” January 16, 1968, <http://www.nato.int/docu/stratdoc/eng/a680116a.pdf>. The United States has always retained the prerogative to use nuclear weapons in response to nonnuclear, including conventional attacks. Even the most recent NPR explicitly did not rule this out with respect to countries armed with nuclear weapons or not in compliance with their nuclear nonproliferation commitments – a categorization that, practically speaking, includes all plausible prospective U.S. adversaries. See U.S. Department of Defense, *Nuclear Posture Review Report*, 15–16.
15. For the utility of nuclear weapons in generally discouraging war, see William Walker, “Nuclear Enlightenment and Counter-Enlightenment,” *International Affairs*, 83 no. 3 (2007): 431–55.
16. Hagel, “‘Defense Innovation Days’ Opening Keynote.” See also Chuck Hagel, “Reagan National Defense Forum Keynote” (Simi Valley, CA, November 15, 2014), <http://www.defense.gov/Speeches/Speech.aspx?SpeechID=1903>.

See also, for instance, Andrew Krepeivich, "The Pentagon's Wasting Assets," *Foreign Affairs* (July/ August 2009).

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18. For a concise analysis of Russia's thinking and strategy on this, see Nikolai N. Sokov, "Why Russia Calls a Limited Nuclear Strike 'De-Escalation,'" *Bulletin of the Atomic Scientists*, March 13, 2014, <http://thebulletin.org/why-russia-calls-limited-nuclear-strike-de-escalation>.

19. For the author's deeper exploration of the issue of the growing salience of nuclear weapons in the Asian security environment, see Elbridge Colby, "Asia Goes Nuclear," *National Interest*, January/February 2015, <http://nationalinterest.org/feature/welcome-china-americasnuclear-nightmare-11891>.

20. See, for instance, Patrick M. Cronin, "If Deterrence Fails: Rethinking Conflict in the Korean Peninsula" (Center for a New American Security, March 2014); Leiber and Press, "Coercive Nuclear Campaigns in the 21st Century"; and Vincent Manzo, "After the First Shots: Managing Escalation in Northeast Asia," *Joint Forces Quarterly*, no. 77 (2015): 91–100, <http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-77/jfq-77.pdf>.

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23. See, for instance, Andrew Brown and Jeffrey Lewis, "Reframing the Nuclear De-Alerting Debate: Towards Maximizing Presidential Decision Time," Nuclear Threat Initiative, December 11, 2013, <http://www.nti.org/analysis/articles/reframing-nuclear-de-alerting-debate-towards-maximizing-presidential-decision-time/>. See also U.S. Department of Defense, *Nuclear Posture Review Report*, 25–27.

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25. For discussions of the problems of limited nuclear war, see, inter alia, Robert E. Osgood, *Limited War: The Challenge to American Strategy* (Chicago: University of Chicago Press, 1957); and Klaus Knorr, *Limited Strategic War* (New York: Praeger, 1962).

26. See, for instance, the statement of Under Secretary of Defense for Acquisition, Technology, and Logistics Frank Kendall, "The Challenge to U.S. Technological Superiority" (undated manuscript).

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30. See, for instance, Odom and Dujarric, *America's Inadvertent Empire*.

31. For the author's further elaboration of this point, see Elbridge Colby, "Defining Strategic Stability"; and Elbridge Colby, "The Need for Limited Nuclear Options," in *Challenges in U.S. National Security Policy: A Festschrift Honoring Edward L. (Ted) Warner*, ed. David Ochmanek and Michael Sulmeyer (Santa Monica, CA: RAND, 2014), 141–68, http://www.rand.org/content/dam/rand/pubs/corporate_pubs/CP700/CP765/RAND_CP765.pdf.

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34. See, for instance, Paul Davis and Peter Wilson, *Looming Discontinuities in U.S. Military Strategy and Defense Planning: Colliding RMA's Necessitate a New Strategy* (Santa Monica, CA: RAND, 2011); and Watts, *Maturing Revolution in Military Affairs*.

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Why They Are Actually Stabilizing” (Foreign Policy Research Institute E-Note), May 2011, http://www.fpri.org/docs/media/201105.colby_nuclear.pdf; and Elbridge Colby and Jeffrey Lewis, “How to Worry Kim Jong-Il,” *The Diplomat*, September 23, 2011, <http://thediplomat.com/2011/09/how-to-worry-kim-jong-il/>. It is important to emphasize that, contrary to most discussion of “bunker busters” as first-strike weapons, the earth penetration function is particularly critical for *second* strike rather than preemptive missions. It is vital that adversaries know that they cannot achieve sanctuary in HDBTs, sanctuary that might encourage them to lash out against the United States and/or its allies, hope they could ride out reprisal, and force Washington to terminate a conflict on unsatisfactory terms. In the ideal, U.S. adversaries should understand that they are vulnerable wherever they go, and that the United States can exploit that vulnerability relatively quickly and confidently. This means having an effective earth penetration capability.

37. For a discussion of the idea of a “responsive infrastructure,” see Dallas Boyd, “Hedging Nuclear Deterrence: Reserve Warheads or a Responsive Infrastructure,” *Strategic Studies Quarterly* (Summer 2014), 96–114.

38. For the author and others’ further elaborations of these kinds of idea, see Elbridge Colby and Abraham Denmark, cochairs, *Nuclear Weapons and U.S.-China Relations: A Way Forward* (Center for Strategic and International Studies, March 2013), http://csis.org/files/publication/130307_Colby_USChinaNuclear_Web.pdf.

39. For the author’s arguments for retaining the triad, see presentation at “The End of Overkill? Reassessing U.S. Nuclear Policy” (Cato Institute, Washington, DC, October 15, 2013), <http://www.cato.org/events/end-overkill-reassessing-us-nuclear-weapons-policy>; and presentation at the Center for Strategic and International Studies, January 29, 2014, <https://www.youtube.com/watch?v=mwNkdIz5Ff4>.

40. For a thorough analysis of this issue, see Lauren Caston et al., *The Future of the U.S. Intercontinental Ballistic Missile Force* (Santa Monica, CA: RAND, 2014), http://www.rand.org/content/dam/rand/pubs/monographs/MG1200/MG1210/RAND_MG1210.pdf.

41. For an exploration of some of these trends and dynamics, see Robert O. Work and Shawn Brimley, *20YY: Preparing for War in the Robotic Age* (Center for a New American Security, January 2014), http://www.cnas.org/sites/default/files/publications-pdf/CNAS_20YY_WorkBrimley.pdf.

42. This is particularly relevant in the case of China, which is reported to have collocated conventional and nuclear forces. See, for instance, Wu Riqiang, “Issues in Sino-US Nuclear Relations: Survivability, Coercion and Escalation” (UK Foreign and Commonwealth Office, June 21, 2013), <https://www.gov.uk/government/publications/issues-in-sino-us-nuclear-relations-survivability-coercion-and-escalation/issues-in-sino-us-nuclear-relations-survivability-coercion-and-escalation>.

43. These criteria are drawn from Elbridge Colby et al., *Strengthening U.S. Extended Nuclear Deterrence in the Western Pacific Beyond 2025* (Center for Naval Analyses, 2012), 148–50.

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