

Project Atom

*A Competitive Strategies Approach to
Defining U.S. Nuclear Strategy and
Posture for 2025–2050*

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Executive Summary

Clark Murdock

Center for Strategic and International Studies

Project Atom took a competitive strategies approach to its zero-based, “blue-sky” review of U.S. nuclear strategy and force posture. Three independent think tank teams—the Stimson Center, the Center for a New American Security (CNAS), and the National Institute for Public Policy (NIPP)—addressed the fundamental issues:

- What should U.S. nuclear strategy be for the new era, defined as 2025–2050?
- What U.S. nuclear posture is needed to support that strategy?

Their analysis (which can be found in the appendices of this report) was unconstrained by current strategy (e.g., reducing the role of nuclear weapons in U.S. strategy) and current policy (e.g., the prohibition against new nuclear weapons or new nuclear capabilities), but was conducted within a common framework of assumptions about the future security environment, likely technological trends, and resource constraints. After leading the development of the common analytic framework and participating in the debate among the think tank teams, I drafted a recommended nuclear strategy and posture for 2025–2050, defended it at a half-day Project Atom working group meeting, consulted with additional experts, and drafted the study report. The competitive strategies approach, including the use of external (to the think tank teams) experts, was extremely helpful as I developed and refined my recommended nuclear strategy and posture. Although many authors contributed to the Project Atom study effort (their work is included in the appendices), I am solely responsible for the views expressed in the main text of this final report.

2025–2050: Recommended U.S. Nuclear Strategy

The recommendations made here are based on two related propositions about what would occur *in the absence* of an effective U.S. nuclear strategy to counteract these trends:

- The dynamics of the 2025–2050 security environment will cause further nuclear proliferation—perhaps not to the 18 nuclear powers envisioned in an alternative future, but higher than the 9 to 11 nuclear powers of the 2030 and beyond (2030+) “Likely Future” assumed by the think tank teams.

- The credibility of U.S. extended deterrence, as well as the assurance that U.S. allies and friends derive from it, will decline significantly in 2025–2050, in part because of the failure to prevent further nuclear proliferation.

A major stimulus for a faster rate of nuclear proliferation is U.S. conventional military superiority. This causes nonnuclear nation-states (such as North Korea, Iran, Iraq, Syria, and Libya) to pursue nuclear weapons as a counter or offset to U.S. military prowess. It also leads nuclear-armed states with interests in opposition to the United States (Russia, for sure, but perhaps China) to increase their reliance on nuclear weapons, much in the way that the United States did during the Cold War. Although the margin of U.S. conventional superiority has never been as great as often proclaimed and is declining relative to other major powers, the prospect of a conventional-only war with the United States is a losing proposition for any state. The value of nuclear weapons as a “trump card” for negating U.S. conventional power was enhanced by the U.S. invasion of Iraq in 2003 to prevent Saddam Hussein from acquiring a nuclear weapon. If the United States apparently believes that it can be deterred by an adversary’s nuclear weapons, why wouldn’t a nonnuclear “regional rogue” want one?

More nuclear-armed regional adversaries (to the United States and its allies) and increased reliance on nuclear weapons by major powers in competition with the United States will lead U.S. nonnuclear allies to rely more on U.S. extended nuclear deterrence. However, the credibility of U.S. extended deterrence will have been weakened by the failure of U.S.-led efforts to prevent the nuclear proliferation that led to the increased demand from its allies for help in deterring nuclear-armed adversaries. This vicious cycle is likely to continue *unless* the United States moves forcefully to counter it, which, in my judgment, requires a U.S. nuclear strategy designed for twenty-first century realities. Adoption of the recommended strategy could limit projected nuclear proliferation to the greater Middle East and prevent it from spreading to Northeast Asia, Europe, and elsewhere.

DISCRIMINATE NUCLEAR OPTIONS

The scenarios for nuclear employment have changed greatly since the “balance of terror” between the two global superpowers. In “the second nuclear age,” potential U.S. adversaries are thinking through how they might actually employ a nuclear weapon, both early in a conflict and in a discriminate manner, to get the United States to “back off” in a conflict. U.S. nuclear forces were designed for a global conflict involving the exchange of thousands of high-yield weapons, not limited exchanges of low-yield weapons. Since most U.S. nuclear response options are large, “dirty,” and inflict significant collateral damage, the United States might be “self-deterred” and not respond “in kind” to discriminate nuclear attacks. U.S. conventional superiority establishes escalation control for the United States at the conventional level and causes its adversaries to think about breaking the nuclear threshold. The United States needs discriminate nuclear options at all rungs of the nuclear escalation ladder to make that option unattractive as well.

FORWARD-DEPLOYED U.S. NUCLEAR WEAPONS

“Coupling” U.S. security to the security of its allies was always a huge challenge during the Cold War. Although U.S. nuclear strategy and employment policy changed from massive retaliation to flexible response, it was the presence of 7,000 U.S. nuclear weapons in Europe that ensured that any major conflict in the European region would escalate rapidly to nuclear war. And the United States deployed hundreds of nuclear weapons in South Korea (and about 3,000 nonstrategic nuclear weapons in the Pacific region) to underscore its extended deterrence commitments there. This encirclement by forward-based U.S. nuclear weapons worked during the Cold War and was largely dismantled after the Cold War ended.

When security anxieties are acute, “reassurance” or “assurance” is most reliably provided by credible extended deterrence—if the adversaries of American allies are deterred, the allies will be assured. Deterring regional adversaries from “going nuclear” requires credible nuclear responses to their nuclear attack options. Forward deploying a robust set of discriminate nuclear response options conveys the message that the United States will “respond in kind” and proportionately to nuclear attacks on its allies. The credibility of that message is reinforced because the U.S. homeland would not be engaged in the U.S. response to a nuclear attack on a regional ally, which leaves the burden on the regional aggressor to escalate to the level of “homeland exchanges.” The price, however, for this more credible U.S. “nuclear umbrella,” is likely to be the ally’s willingness to host U.S. nuclear weapons. This is what will constitute “nuclear burden sharing” in 2025–2050.

The nuclear strategy being recommended here is called “Measured Response.” This is not a new strategy; it is grounded in the U.S. strategy of escalation control that evolved as the United States turned away from the “massive retaliation” strategy of the 1950s and adopted “flexible response.” It’s about ensuring that there are no gaps in U.S. nuclear response options that would prevent it from retaliating proportionately to any employment of a nuclear weapon against the United States and its allies. U.S. conventional superiority lowers the nuclear threshold because it tempts conventionally weaker adversaries to early (rather than as a last resort) employment of a nuclear weapon in order to avoid adverse results at the conventional level. By having a robust set of proportionate nuclear responses, the United States raises the nuclear threshold because it reduces the attractiveness of nuclear escalation. This may seem paradoxical, to be sure, but paradoxes seem to be endemic to any nuclear age.

2025–2050: Recommended Nuclear Posture

As it shapes its nuclear forces for coping with 2025–2050 realities, the United States needs to address its inferiority (with Russia) in nonstrategic nuclear forces (NSNF, but also known as “tactical nuclear weapons” or TNWs) by developing a robust set of discriminate nuclear options and forward-deployable nuclear weapons. While I do not believe that the United

States needs to match Russia quantitatively, I do believe that Russia's qualitative superiority in NSNF does undercut the proposed Measured Response strategy.

The two primary missions for U.S. nuclear weapons are deterrence and extended deterrence, and the future force should be structured accordingly. In order to execute its Measured Response strategy, the nuclear forces for both deterrence and extended deterrence should have low-yield, accurate, special-effects options that can respond proportionately at the lower end of the nuclear continuum.

- *Strategic deterrent force (SDF)*, consisting of *Ohio*-replacement class submarines, Minuteman III ICBMs (or a follow-on ground-based strategic deterrent [GBSD]) and B-52s and B-2s (and a new nuclear-capable bomber at some point), is the highly survivable, assured destruction force that is the foundation on which U.S. nuclear deterrence resides. This is the “strategic triad” that deterred the Soviet Union during the Cold War and it provides the United States its “nuclear shadow.”
 - Discriminate employment options, delivered both by gravity bombs and a new cruise missile, would be provided by the same suite of air-delivered discriminate warheads used for extended deterrence.
- *Extended deterrent force (EDF)*, consisting of forward-based and rapidly deployable dual-capable aircraft would enable both permanent and temporary “coupling” of the U.S. nuclear deterrent to host-nation security.
 - Dual-capable F-35As (based on land) and F-35Cs (based on carriers) would provide visible manifestations of U.S. extended deterrence and allied burden sharing.
 - Discriminate employment options would be provided by a suite of low-yield, special-effects warheads (low collateral, enhanced radiation, earth penetration, electromagnetic pulse, and others as technology advances), including possibly a smaller, shorter-range cruise missile that could be delivered by F-35s.

In this recommended 2025–2050 nuclear posture, bombers serve as an all-purpose hedge force that can enable, complement, and hedge for the other three “legs” (submarine-launched ballistic missiles [SLBMs], intercontinental ballistic missiles [ICBMs], and dual-capable F-35s). They provide extended-deterrence presence and discriminate nuclear options in regions where there are no forward-based or deployed F-35s. They can also provide weapons and mobility to deploying F-35As. As the traditional complement to SLBMs and ICBMs in the SDF, bombers are the most flexible leg of the strategic triad and can be used for signaling.

The time frame 2025–2050 is too far into the future to project specific numbers. However, the following are offered as guidelines for sizing the future U.S. nuclear force:

- Maintain rough parity with Russia.
- Maintain nuclear superiority over China.

- Maintain sufficient capability to cope simultaneously with nuclear-armed “regional rogues.”
- Maintain a smaller stockpile, which is enabled by a responsive infrastructure.

The capabilities envisioned for this recommended nuclear posture include weapons intended to deter discriminate nuclear attacks at the lower end of the nuclear continuum; forward-based and forward-deployable delivery systems intended for extended deterrence, and assured destruction weapons that have intercontinental range, larger payloads, and are deployed in numbers sufficient to ensure stability and survivability. These are the right capabilities for nuclear deterrence in the twenty-first century because they counter the “nuclear offset” that U.S. adversaries might adopt for coping with U.S. conventional superiority.

Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025–2050

Clark Murdock
Center for Strategic and International Studies

Study Objective

The end of the Cold War and the 9/11 terrorist attacks on the U.S. homeland have profoundly changed the global security environment and reordered U.S. security priorities. During the Cold War, sometimes characterized as “the first nuclear age,” the United States and the Soviet Union engaged in a nuclear arms race as each side pursued massive nuclear arsenals sized and shaped to fight nuclear wars with each other.¹ Nuclear issues were deemed so important that the U.S. nuclear deterrent was often characterized as its *strategic* deterrent, because it was the primary strategy for coping with the existential threat posed by Soviet nuclear weapons. Today, the threat posed to the United States by nuclear-armed nation-states is not even the top-ranked nuclear danger, as the 2010 Nuclear Posture Review (NPR) report elevated nuclear terrorism and nuclear proliferation as more important challenges.² Today, the American policy community pays little attention to U.S. nuclear strategy and posture, as the nuclear mission itself has become a neglected backwater in the defense establishment and draws attention only when mistakes and scandals occur.

This loss of saliency for U.S. nuclear strategy and capabilities was clearly demonstrated at the end of George W. Bush’s administration when Congress refused to fund the Reliable Replacement Warhead (RRW) despite a last-minute campaign by the secretaries of Defense and Energy. While the role of nuclear weapons in U.S. security policy has clearly declined since the Cold War, reducing it further did not become official policy until President Obama, in his April 2009 Prague speech, committed the United States to the long-term pursuit of a world without nuclear weapons.³ Although President Obama has stated

1. Paul Bracken, *The Second Nuclear Age: Strategy, Danger and the New Power Politics* (New York: Times Books, 2012).

2. U.S. Department of Defense (DoD), *Nuclear Posture Review Report* (Washington, DC: DoD, 2010).

3. The White House, “Remarks by President Barack Obama, Prague, Czech Republic,” April 5, 2009, https://www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered.

repeatedly (both in his Prague speech and since) that the United States must maintain a “safe, secure, and effective” nuclear force for “as long as nuclear weapons exist,” he also stated in June 2013 that the United States will never be “truly secure” as long as nuclear weapons exist.⁴ Given the presidential-level commitment to reduce the role of nuclear weapons, it is not surprising that there has been little serious attention, much less national debate, about U.S. nuclear strategy and posture in what Paul Bracken has characterized as “the second nuclear age”—that is, a world in which regional rivalries, sectarian conflicts, and competitions for resources (to name only a few) occur “in a nuclear context” because they increasingly involve states armed with nuclear weapons.⁵ Today, the United States pursues a strategy that is anchored in Cold War concepts and seeks to sustain a smaller version of the nuclear posture that supported its Cold War strategy. Almost by definition, this is not the right posture for the second nuclear age. Looking ahead to the 2017–2018 NPR process, Project Atom launched a zero-based, “blue sky” review of U.S. nuclear strategy and force posture that addressed the fundamental issues:

- What should U.S. nuclear strategy be for the new era, defined as 2025–2050?
- What U.S. nuclear posture is needed to support that strategy?

This “clean slate” review was predicated on the assumption that the vision of a world without nuclear weapons is *not* feasible for the foreseeable future. It was unconstrained by current strategy (e.g., reducing the role of nuclear weapons in U.S. strategy) and current policy (e.g., the self-imposed prohibition against new nuclear weapons or new nuclear capabilities). However, it was constrained by likely technological trends and the affordability of nuclear modernization (approximately \$35 billion per year in constant 2013 dollars, comprising 4–5 percent of the defense budget). In the effort to generate new thinking about first-order questions, Project Atom followed a competitive strategies approach, which the CSIS study team modified during its execution.

Methodological Approach

The “competitive strategies” approach adopted by Project Atom had two intellectual foundations:

- At the beginning of his first administration, President Dwight Eisenhower established Project Solarium, which created three independent teams that were chartered to develop alternative versions of his predecessor’s containment strategy and then present them to the new president’s national security team.⁶ After participating in (and listening to) the debate, Eisenhower chose a less-aggressive

4. The White House, “Remarks by President Obama at the Brandenburg Gate—Berlin, Germany,” June 19, 2013, <https://www.whitehouse.gov/the-press-office/2013/06/19/remarks-president-obama-brandenburg-gate-berlin-germany>.

5. Bracken, *Second Nuclear Age*, 245.

6. Michèle A. Flournoy and Shawn W. Brimley, *Strategic Planning for U.S. National Security: A Project Solarium for the 21st Century*, Princeton Project Papers (Princeton, NJ: Woodrow Wilson School of Public and International Affairs, September 2006), <http://www.princeton.edu/~ppns/papers/interagencyQNSR.pdf>.

containment (vs. rollback) strategy of communism that emphasized American economic strength and “more bang for the buck” reliance on the nuclear (vs. conventional) force.

- In early 2013, the Center for Strategic and Budgetary Analysis (CSBA), under the leadership of Todd Harrison, conducted a military portfolio “rebalancing exercise” in which small analytic teams from three Washington-based think tank teams (the author led the CSIS team) “rebalanced” the U.S. military as it was reduced to fit under the budgetary ceilings established by the Budget Control Act of 2011.

Project Atom fused these into a hybrid approach that envisioned a series of largely sequential steps:

1. Identify and recruit three “think tank teams” that cover the broad middle of the spectrum of opinion, each led by a well-known expert in nuclear strategy and posture (see Appendix A for the list of Project Atom participants and Appendix B for Project Atom timelines).
2. Identify and recruit five to six external (to the think tank teams) subject-matter experts (SMEs) who would participate in the working group meetings and provide additional feedback on Project Atom products (see Appendix A).
3. Establish a common framework to ensure that each think tank team would address the same issues and would be using similar assumptions.
 - a. “Template and Framing Assumptions for Think Tank Team Papers” (Appendix H)
 - b. “Technological Possibilities for Nuclear Weapons in 2025–2050” (Appendix I)
 - c. “Adversary Nuclear Strategies: 2030+” (Appendix J)
 - d. “2030+ Security Environment: The ‘Likely Future’ and Several Alternative Worlds” (Appendix K)
4. Operating independently from one another, each think tank team produced a detailed statement (17 to 23 pages) of its views and then presented it in a daylong working group session on 11 August 2014.
 - a. After the working group discussion, each think tank team had the opportunity to revise its paper, which are included in final form at Appendix C (Stimson Center), D (CNAS), and E (NIPP).
5. Dr. Clark Murdock drafted his statement, circulated it to the working group, and defended it at a 22 October 2014 half-day working group meeting.
 - a. As stated at the outset, the 17 October 2014 paper was “decidedly NOT an effort to synthesize or integrate the positions” expressed in the think tank team papers but “represent[ed] the best judgment, reached after the Project Atom competitive strategy exercise and an informal vetting process, of Clark Murdock as to what U.S. nuclear strategy and force posture should be in 2025–2050.”

- b. This 17 October 2014 paper also “use[d] stark, deliberately simplified language, with little nuance, hedging language and obfuscation that often characterizes discussion of nuclear strategy and policy.”
 - i. In retrospect, this was a mistake, because the language in which an idea was expressed was sometimes so incendiary that it was counterproductive and undermined the persuasiveness of the argument. This failed experiment in ignoring any “PC standards” in “thinking about the unthinkable” led to my *not* including the draft paper as an appendix.
6. After taking two months to reflect, consult with a few noted experts, and engage in additional research, I drafted the Project Atom report, which was then circulated to Project Atom working participants (and several additional experts) for comment and revised several times in February and early March 2015.
 - a. Discussions with Vic Utgoff were particularly useful, in part because he has been considering many of the same questions addressed here.⁷
 - b. In late 2014, Jeffrey A. Larson and Kerry M. Kartchner published a collection of readings entitled *On Limited Nuclear War in the 21st Century* that in some instances mirrored and supplemented the analysis in this paper.⁸
 - c. Former senior Department of Defense (DoD) official and independent consultant John Harvey provided thoughtful and detailed commentary that was much appreciated.
 - d. Appendix F compares the positions taken in this report with the three think team papers on the 5 July 2014 template issues (see Appendix H).⁹
 - e. Thomas Karako joined CSIS as a visiting fellow in the summer of 2014 midway through the Project Atom study effort. He later became a full time senior fellow. In addition to helpful comment on Project Atom products, Dr. Karako took an independent look at how U.S. strategic (not just nuclear) forces could be postured in 2025–2050. His paper is attached at Appendix G.

ADJUSTMENTS TO THE METHODOLOGY

From a process perspective, Project Atom executed the methodology in the manner intended: provide a common framework for the competition of ideas among three independent think tank teams and then develop a CSIS position that would be vetted extensively. One methodological adjustment was referred to in Step 5, namely that the 17 October 2014 CSIS paper was “decidedly NOT an effort to synthesize or integrate the positions” of the NIPP, CNAS, and Stimson Center teams. As demonstrated in the comparison essay at

7. See Andrew J. Coe and Victor A. Utgoff, *Restraining Nuclear War* (Alexandria, VA: Institute for Defense Analysis, June 2011), and Victor A. Utgoff and Michael O. Wheeler, *On Deterring and Defeating Attempts to Exploit a Nuclear Theory of Victory* (Alexandria, VA: Institute for Defense Analysis, April 2013).

8. Jeffrey A. Larsen and Kerry M. Kartchner, eds., *On Limited Nuclear War in the 21st Century* (Stanford, CA: Stanford Security Studies, 2014).

9. Each of the think tank teams had the opportunity to review CSIS’s characterization of their positions in this comparative assessment.

Appendix F, the disagreement on fundamental issues, particularly with respect to the role and value of U.S. nuclear weapons, between the NIPP and CNAS teams, on the one hand, and the Stimson Center team were too great. As the author of the final report, my views were shaped and influenced by the debate among the independent think tank teams, but did not attempt to bridge the differences on fundamentals between the competing approaches.

The second major methodological adjustment concerned how far into the future Project Atom should project—that is, should it postulate a strategy for 2025–2050, as originally intended, or just to 2030 and beyond (aka “2030+”)? In working group discussions on 13 May 2014, several think tank team members argued that there was too much uncertainty about what the security environment might look like in 2040 and beyond, thus making it pointless to speculate about what U.S. nuclear strategy and posture should be. So the time frame for the Likely Future was pulled back to 2030+, which was thought to be far enough into the future that a new nuclear capability could be developed and fielded, but not so far in the future that it was difficult to forecast a Likely Future. However, in reviewing the first drafts of the think tank papers, the CSIS study team concluded that, despite clear differences on the role and value of U.S. nuclear weapons, the recommended 2030+ postures were quite similar across the teams and differed very little from the current U.S. nuclear posture.

One think tank team member commented that the United States has already paid for the current posture, so there is little reason not to keep it. Besides, he continued, from the perspective of U.S. nuclear modernization, “2030+ is not that far away.” The CSIS study team made two adjustments: (1) it reintroduced 2025–2050 as the framework for its analysis in the 17 October 2014 paper; and (2) asked the think tank teams some additional questions (e.g., “What factors would lead you to change your recommended nuclear strategy and posture?”) intended to elicit some “blue-sky” or “blank-check” thinking. As can be seen in Appendices G–J, the additional questions did provoke a bit more “out-of-the-box” thinking. As will be discussed in the next section, reintroducing the 2025–2050 time frame forced Project Atom to abandon the “Likely Future” construct and adopt instead an “assumed future” as the basis for the recommended 2025–2050 U.S. nuclear strategy and posture.

As a final note in this methodological section, I want to endorse the competitive strategies approach as extremely useful for a fundamental, “back-to-basics” review for important public policy issues. The think tank teams produced first-rate papers, and the working group discussions were lively, provocative, and most informative. Adding a few external (to the think tank teams) experts also broadened the discussion and ensured that additional perspectives were brought to bear. Iterating draft Project Atom products, ranging from supporting analysis to the final report, was often a painful process, but the result was a set of ideas that have been well tested in the intellectual marketplace. I want to thank all of the Project Atom participants for engaging in this study effort, as well as the Smith-Richardson Foundation for funding it. And while taking sole responsibility for the views

expressed in this final report, I want to thank everybody for helping me develop and refine them. It was a great learning experience, and I hope the final product meets the high standard set by their level of engagement in this study effort.

Defining the 2025–2050 Security Environment

As defined in the template and framing assumptions paper (see Appendix H), the 2030+ Likely Future is a “projection of current trends and likely developments that takes the current security environment as its departure point and projects how it evolves *in the absence* of ‘wild cards,’ discontinuities, ‘black swans,’ and other game-changing events that would significantly change the nature of the 2030+ security environment.” To ensure that think tank team positions were comparable within a common framework, the CSIS study team relied on an issue template that identified the questions each team had to address and “framing assumptions” (FAs), which were the trends and likely developments that established the boundary conditions for think tank team analysis. These “framing assumptions” were iterated several times with the working group (Appendix H was version #5). With respect to the 2030+ security environment, the working groups accepted the following out of those proposed in Appendix H:

- FA #2: As the world’s strongest (although its margins are decreasing) military power, still with many economic strengths, the United States will continue its post-World War II role as a provider of global stability and principal architect of the international order.
- FA #3: Nuclear weapons in the twenty-first century are one of several weapons that can have strategic effects on a crisis or conflict.
 - Ballistic missile defenses (BMD) will increase the ability to defend against regional small-scale missile attacks but have little utility against nuclear arsenals the size of Russia’s and China’s.
 - Irregular means of delivering a nuclear weapon cannot be entirely eliminated.
 - By 2050, the capacity for destruction and disruption of chemical and biological weapons and offensive cyber weapons will have increased significantly, making it necessary to deter and defend against them (although not necessarily with nuclear weapons).
 - Vulnerability of space-based assets will grow, but nuclear weapons will not have been deployed in space and space-based lasers will remain impractical.
 - Improving conventional prompt global strike (CPGS) capabilities will increase concern among some, if not all, nuclear-armed powers about the risk of nonnuclear attacks on their nuclear weapons, which (when combined with more effective BMD) could negate their assured second-strike capability against the United States.

- FA #7: The 2030+ Likely Future will have 9 to 11 nuclear powers.
 - While the possible addition of Iran, followed closely by Saudi Arabia, to the nuclear club would complicate and raise the stakes in the already complex, uncertain, and violent Middle East, it would not have the global impact that more widespread nuclear proliferation would have. A “proliferated world,” defined in this study as a world of 18 nuclear powers (see Appendix H), would fully realize Paul Bracken’s “second nuclear age” since many more regional conflicts would have a nuclear dimension.

A straight-line projection of today’s security environment, particularly if it is only to 2030+, does not force significant changes to today’s U.S. nuclear posture. If the nuclear triad (plus forward-deployed nuclear bombs in North Atlantic Treaty Organization [NATO] Europe) “works” today, it should work 10–15 years from now. Given the “sunk costs” of prior investment in U.S. nuclear capabilities and the era of austerity triggered by the Budget Control Act of 2011, the overriding bureaucratic and fiscal imperative to extend the life of current systems as long as possible (e.g., a recent RAND study envisions incremental life-extension actions for Minuteman III for decades beyond initial projections).¹⁰ Nuclear warheads wear out (see the B61 bomb), as do delivery systems (see the air-launched cruise missile [ALCM] and *Ohio*-class submarine), and will need to be replaced, but the fiscal environment will suppress the pace of U.S. nuclear modernization. The United States could afford to spend more on its nuclear capabilities—even the largest estimate of a trillion dollars over 30 years still comprises less than 5 percent of the overall defense budget—but is unlikely to unless the security environment changes markedly and significantly increases the perceived role and value of U.S. nuclear weapons in its security strategy.^{11, 12}

There is no neatly empirical way to think about nuclear weapons or about the future. Blast radius, heat, fragmentation, and radiation levels can be calculated. Allied and adversary perception cannot—not tomorrow, and certainly not 30 years in the future. To think about the future need for nuclear weapons requires no small degree of imagination. To make policy choices—*which must be made*—requires judgment based on that imagination.

When it comes to nuclear weapons, there is little that historical precedent or experience can provide. There has never been a nuclear exchange between nations. The only use of atomic weapons, by the United States against Japan on 6 and 9 August 1945, yields little insight about what would happen if nuclear weapons were employed during a war. Even

10. Lauren Castol 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.

11. Jeffrey Lewis et al., *The Trillion Dollar Nuclear Triad: US Strategic Nuclear Modernization over the Next Thirty Years* (Monterey, CA: James Martin Center for Nonproliferation Studies, January 2014), http://cns.miis.edu/opapers/pdfs/140107_trillion_dollar_nuclear_triad.pdf.

12. All but China (if their reported figures are accepted) spend a higher percentage of their defense budget on nuclear weapons: Pakistan (27 percent), Russia (13 percent), United Kingdom (7 percent), France (7 percent), and China (4 percent). Sources: Bruce G. Blair and Matthew A. Brown, “World Spending on Nuclear Weapons Surpasses \$1 Trillion per Decade,” *Global Zero*, June 2011, http://www.globalzero.org/files/gz_nuclear_weapons_cost_study.pdf; Stockholm International Peace Research Institute (SIPRI), “SIPRI Military Expenditure Database,” http://www.sipri.org/research/armaments/milex/milex_database.

the conclusion that nuclear weapons ended World War II by breaking the Japanese will to fight is still being debated.¹³ This is also the case with the nonuse of nuclear weapons (the so-called nuclear taboo) and the theory and practice of deterrence during the Cold War. Did it work or were the Cold War opponents lucky?

My views on the nature of the 2025–2050 security environment are considerably more pessimistic than those expressed in the 2030+ Likely Future.¹⁴ The recommendations made here are based on two related propositions about what would occur *in the absence* of an effective U.S. nuclear strategy to counteract these trends. Of course, these propositions are judgments, not absolute truths, and are debatable. They also risk being self-fulfilling prophecies, because strategies and weapons designed to cope with a more threatening security environment often make it more likely that the darker future will, indeed, occur. However, that risk is outweighed by the risk of planning for a more benign future and being unprepared for the grimmer one that the United States might actually face. While acknowledging up front that two propositions below are debatable, they are made explicitly in order to facilitate a debate on the fundamentals, which is consistent with the competitive strategies approach of Project Atom.

Proposition #1: The dynamics of the 2025–2050 security environment will cause further nuclear proliferation—perhaps not to the 18 nuclear powers envisioned in an alternative future, but higher than the 9-to-11 nuclear powers of the 2030+ Likely Future.

Proliferation optimists note that warnings over the coming cascade of proliferation have been made for decades, most notably by President John F. Kennedy, but have not materialized. However, the current trend line is quite negative:

- The United States invaded Iraq in 2003 in large part because the Bush administration wanted to prevent Saddam Hussein from getting nuclear weapons; Hussein was rapidly removed from power and subsequently hanged in a Baghdad basement.
- Perhaps startled by the ease with which the United States removed Hussein from power, Muammar el-Qaddafi gave up his nuclear weapons program and ended up dying even more ignominiously than his Iraqi counterpart.
- Despite receiving several “red-line” warnings and becoming more isolated, both diplomatically and economically, North Korea joined the nuclear club even as the Kim dynasty endured a generational change of power; in this instance, acquiring a nuclear weapon has helped ensure regime survival.

13. Ward Wilson, “Military Wisdom and Nuclear Matters,” *Joint Force Quarterly* 68, no. 1 (2013): 18–24.

14. Paul Bernstein divides the expert community into “proliferation optimists,” who note that previous predictions of a “highly proliferated world” have not come true and there’s no reason why they should now, and “proliferation pessimists,” who take “little comfort” in the historical record and believe that the global nonproliferation regime is “weakening.” (See Paul I. Bernstein, “The Emerging Nuclear Landscape,” in *On Limited Nuclear War in the 21st Century*, ed. Jeffrey A. Larsen and Kerry M. Kartchner [Stanford, CA: Stanford Security Studies, 2014], 102–3.) I am squarely in the latter camp.

- The jury is out on whether Iran will give up its nuclear weapons program, but many believe that Saudi Arabia would rapidly “go nuclear” if Iran joined the Democratic People’s Republic of Korea (DPRK) as the newest members of the nuclear club;
 - With three Middle Eastern powers in the nuclear fold, the incentives would grow for Egypt and Turkey to follow suit.
- If such a regional proliferation cascade occurred, the perceived power of the United States would be diminished, which would have repercussions elsewhere as regional allies increasingly doubt the will and ability of the United States to counter a more belligerent Russia and an increasingly assertive China.

A major stimulus for a faster rate of nuclear proliferation is U.S. conventional military superiority. This causes nonnuclear nation-states (such as North Korea, Iran, Iraq, Syria, and Libya) to pursue nuclear weapons as a counter or offset to U.S. military prowess. It also leads nuclear-armed states with interests in opposition to the United States (Russia, for sure, and perhaps China) to increase their reliance on nuclear weapons, much in the way that the United States did during the Cold War.¹⁵ Although the margin of U.S. conventional superiority has never been as great as often proclaimed (e.g., see the lower end of the spectrum of conflict) and is declining relative to other major powers, the prospect of a conventional-only war with the United States is a losing proposition for any state. The value of nuclear weapons as a “trump card” for negating U.S. conventional power was enhanced by the U.S. invasion of Iraq in 2003 to prevent Saddam Hussein from acquiring a nuclear weapon. If the United States apparently believes that it can be deterred by an adversary’s nuclear weapons, why would a nonnuclear “regional rogue” not want one? This leads directly to my second (more pessimistic) proposition about the 2025–2050 security environment:

Proposition #2: The credibility of U.S. extended nuclear deterrence, as well as the assurance that U.S. allies and friends derive from it, will decline significantly in 2025–2050, in part because of the failure to prevent further nuclear proliferation.

More nuclear-armed regional adversaries (to the United States and its allies) and increased reliance on nuclear weapons by major powers in competition with the United States will lead U.S. nonnuclear allies to rely more on U.S. security commitments, especially with regard to extended nuclear deterrence. However, the credibility of those commitments will have been weakened by the failure of U.S.-led efforts to prevent the nuclear proliferation that led to the increased demand from its allies for help in deterring nuclear-armed adversaries. While some (including myself) argue that it is not realistic to believe that a nation both capable of acquiring a nuclear weapon and determined to do so can be stopped, the inability of the United States to prevent what it has repeatedly declared is

15. And at a much cheaper price: Paul Bracken noted that “Nuclear weapons allowed the United States to get away with defense on the cheap,” because the United States (and its peak-sized army of 20 divisions) offset the Soviet Union (and its 200-plus divisions) with defense budget levels of order smaller (in terms of percentage of gross domestic product [GDP]) than the Soviet Union, which typically spent 25 percent of its GDP on the military. Bracken, *Second Nuclear Age*, 45.

“unacceptable” will erode its credibility to cope with the “unacceptable” when it nevertheless happens.

U.S. threats to employ the full range of its military capabilities (including nuclear weapons) to respond to nuclear attacks against their allies are at the core of both extended deterrence and assurance. How credible those “statements of intent” are to potential adversaries (in the case of extended deterrence) and to its allies (in the case of assurance) depend on adversarial and allied perceptions of U.S. nuclear capabilities and will:

- As reflected in the now-infamous Healey theorem, which states that credible assurance requires a 95 percent probability that a nuclear threat will be carried out versus a 5 percent probability for credible deterrence, the standards for credibility will depend on context and the specific actors.¹⁶
- How credible will U.S. security commitments be in 2025–2050, both to its adversaries and its allies? After North Korea’s nuclear test in February 2013 and statements by the United States that it would not consider redeploying tactical nuclear weapons (TNWs) on the peninsula, 66 percent (10 percentage points higher than in 2010) of the South Korean public supported a domestic nuclear weapons program.¹⁷
- Assurance in 2025–2050 will depend less on what the United States says to its allies about its commitment to them and more on the allies’ perception of how well the United States actually acts when its security commitments are challenged. Today, the United States and its allies are “talking the talk,” but that is less likely to be enough in the future.
- As demonstrated recently with respect to U.S. enforcement of red lines against the use of chemical weapons in Syria, credibility can be lost, and once lost, may be hard to reestablish. Nuclear-armed regional powers, many with irredentist agendas, will engage in more provocative behavior (see North Korea in 2010) and erode the faith of U.S. allies in U.S.-extended deterrence commitments.
 - In a 2006 study (in which I participated) on realigning the U.S. global military posture, a senior South Korean defense official, when asked about the U.S. willingness to risk San Francisco for Seoul, said, “I think I believe it, but I’m not sure the Chinese do.”

A faster rate of nuclear proliferation both adds to the demand for the U.S. nuclear umbrella and erodes its credibility. This vicious circle is likely to continue *unless* the United States moves forcefully to counter it, which, in my judgment, requires a U.S. nuclear strategy designed for twenty-first century realities. Adoption of the recommended strategy could limited nuclear proliferation to the greater Middle East and prevent it from spreading to Northeast Asia, Europe, and elsewhere.

16. Denis Healey, *The Time of My Life* (New York: W.W. Norton, 1990), 6.

17. Jiyoon Kim, Karl Friedhof, and Chungku Kang, “The Fallout: South Korean Public Opinion Following North Korea’s Third Nuclear Test,” *Issue Brief: The Asian Institute for Policy Studies* 46 (2013), 7–9.

2025–2050: The Role or Function of U.S. Nuclear Weapons

The principal role of U.S. nuclear weapons is to deter other states from employing nuclear weapons against the United States and its allies.^{18, 19} U.S. nuclear weapons ensure that any major conflict with the United States has a nuclear dimension and occurs under a “nuclear shadow.”²⁰ Deterring nuclear attacks is not the *sole* purpose of U.S. nuclear weapons, in part because it is U.S. policy to maintain “strategic ambiguity” about the circumstances under which the United States might actually employ nuclear weapons. In perhaps the last semi-explicit nuclear threat made by the United States, Secretary of State Jim Baker told Tariq Aziz, Iraq’s foreign minister, that “If you use chemical or biological weapons against U.S. forces, the American people will demand vengeance. And we have the means to exact it . . . This is not a threat, it is a promise.”²¹ Although the effect of this implied threat of nuclear retaliation on Iraq’s behavior is still the subject of much debate, the possession of nuclear weapons by the United States (and any other nuclear-armed state, for that matter) has an inherent or intrinsic deterrent effect, because it, unlike nonnuclear states, can escalate to the nuclear level.²²

- Debates over declaratory policies such as no-first-use have always been a little unreal. The circumstances under which a state—that is, the men and women acting on behalf of that nation—would actually employ a nuclear weapon are characterized by extreme urgency, great peril, and fundamental uncertainty. Statements made during peacetime about what a nation’s leadership would actually do under those

18. Nonstate actors who gain possession of a nuclear weapon are nondeterrable—criminal elements will sell the weapon to the highest bidder and terrorist groups (in this era of suicide bombers) will employ it. One kills, contains, disrupts, and destroys nuclear-armed nonstate groups. Nuclear deterrence is not relevant to this security challenge, although one might consider employing a nuclear weapon against a nonstate actor in order to send a message to a state providing sanctuary for that nonstate actor. Nuclear weapons are used to influence the behavior of nation-states through the threat of retaliation and are employed against targets valued by the men and women who decide and act on behalf of that state.

19. The statement that “we *use* nuclear weapons every day” is frequently made and is fundamentally true. The possession of a nuclear weapon by State A affects other states’ perceptions about the capabilities and will of State A and, thus, provides State A with a basis (but by no means the only one) for influence relationships (including deterrence) with other states. In contrast, the *employment* of a nuclear weapon is a physical act that involves “blast, heat, and fragmentation” and has a radioactive signature.

20. While tautological and subject to varying interpretations, “minor” conflicts (like “minor aggression” or “smaller-scale contingencies”) do not involve a nuclear dimension, because, by definition, they are not seen as important enough to warrant consideration of nuclear employment. Similarly, U.S. interests are considered “vital” if they are deemed important enough to warrant employing military force (including nuclear weapons) in defending them.

21. James A. Baker III, “Opening Statement,” Senate Foreign Relations Committee, May 19, 2010, <http://www.foreign.senate.gov/imo/media/doc/BakerTestimony100519p.pdf>.

22. As I observed in my 2008 report on DoD and the nuclear mission, the subsequent memoirs of the principal U.S. decisionmakers at the time disavowed any serious consideration of the nuclear option, which “makes it hard to make credible threats when you tell the world (including future adversaries) that you were bluffing the last time you made one.” See Clark A. Murdock, *The Department of Defense and the Nuclear Mission in the 21st Century: A Beyond Goldwater-Nichols Phase 4 Report* (Washington, DC: CSIS, March 2008), 18, <http://csis.org/files/media/csis/pubs/080305-murdock-nuclearmission.pdf>.

circumstances have always been speculative, if only, as Yogi Berra is alleged to have said, “making predictions is awfully hard, particularly about the future.”

Nuclear weapons are a critical element of the global distribution of power that provides the underlying structure for relationships (including deterrence) among all states, not just those states seeking to oppose the United States. The world is divided into nuclear-armed and nonnuclear states, the latter of which includes “threshold nuclear powers” or “latent nuclear powers” (i.e., states that could “go nuclear” fairly quickly) and “nuclear wannabes” (a group that used to include North Korea). How U.S. nuclear capabilities stack up against those of other nuclear-armed states matters. Since World War II, the U.S. superpower status has included maintaining nuclear capabilities that are “second-to-none,” which, as will be discussed, the United States should sustain in 2025–2050.

2025–2050: Recommended U.S. Nuclear Strategy

DISCRIMINATE NUCLEAR OPTIONS

The scenarios for nuclear employment have changed greatly since the “balance of terror” between the two global superpowers. During “the first nuclear age,” it was the mutual fear of nuclear escalation that kept the Cold War cold as the United States and the Soviet Union engaged in Thomas Schelling’s “competition in risk taking.”²³ In “the second nuclear age, our adversaries have to cope with a United States that both possesses conventional superiority and acts as if nuclear war were unthinkable. Of course, they are thinking through how they might actually employ a nuclear weapon to get the United States to “back off” in a crisis or conflict. Russian military officers have said they are developing “very low-yield” weapons (most likely in the subkiloton range) that will be very accurate and “clean” (i.e., producing little radiation), thus minimizing collateral damage.²⁴ If such a weapon were employed against U.S. or allied forces, the United States might not “respond in kind,” because its nuclear response options were larger, “dirtier,” and caused significant collateral damage. To counter this risk of “self-deterrence,” the United States needs more discriminate nuclear options across the range of nuclear attacks.

The United States is not well postured for this type of nuclear employment scenario. Its Cold War-era nuclear weapons were designed for a global conflict involving thousands of high-yield weapons in a massive exchange. The United States needs to develop and deploy more employable nuclear weapons, ones that enable the United States to respond directly and proportionately to an adversary’s employment of a nuclear weapon. This is not about “nuclear war-fighting,” but demonstrating the resolve to match an adversary’s escalation of a conflict to the nuclear level. By doing so, the United States sends a powerful political message—“You can’t win this conflict by going nuclear”—and, in effect, makes nuclear escalation a less attractive option.

23. Thomas C. Schelling, *Arms and Influence* (New Haven, CT: Yale University Press, 1966), 91.

24. Mark B. Schneider, “Russian Nuclear Modernization,” National Institute for Public Policy, June 20, 2012, <http://www.nipp.org/wp-content/uploads/2014/11/Schneider-Russian-nuclear-modernization-.pdf>.

Credibility, it is often noted, is always in the eyes of the beholder. To a potential adversary considering employing a nuclear weapon to offset the conventional superiority of the United States, the awareness that the United States has anticipated this eventuality and developed more discriminate, more employable nuclear options of its own will be doubly impactful, because it demonstrates the same kind of hard-nosed, realistic thinking that led him to consider employing a nuclear weapon in the first place.

The Stimson Center paper notes that their recommended nuclear posture is “dependent on U.S. conventional military superiority” and “so does not need to rely on weak state tactics.”²⁵ This misses the basic point—the United States needs to focus on its nuclear deterrent because its potential adversaries will rely more on nuclear capabilities to compensate for their conventional weakness. U.S. conventional superiority gives it escalation control at the conventional level and causes its adversaries to think about breaking the nuclear threshold. The United States needs employable nuclear options at all rungs of the nuclear escalation ladder to make that option unattractive as well.

FORWARD-DEPLOYED U.S. NUCLEAR WEAPONS

With the exception of about 200 B61 nuclear bombs deployed in five NATO Europe countries, the United States no longer forward deploys nonstrategic nuclear forces (NSNF). U.S. naval surface ships no longer carry nuclear weapons and the nuclear variant of the U.S. Navy’s cruise missile (TLAM-N), which was once characterized as the Navy’s “theater nuclear weapon” to be used in defense of its Northeast Asian allies, has been withdrawn from service. The United States still forward deploys American military personnel (albeit in much lower numbers) but has largely dismantled the “inner ring” of nuclear weapons that once encircled its principal adversaries.

U.S.-extended deterrence commitments will be significantly less credible (both to potential adversaries and our allies) in 2025–2050 than they are today *unless* that commitment is provided by U.S. nuclear weapons based on the territory of the ally whose security is threatened by a nuclear-armed regional adversary. Extended deterrent threats are inherently less believable than direct deterrence threats, since they involve putting the U.S. homeland at risk by attacking the adversary’s homeland in response to a nuclear attack on the homeland of the U.S. ally. This dilemma is often expressed in the question “Will the United States trade Los Angeles (or New York City) for Tokyo (or Berlin)?”²⁶

“Coupling” U.S. security to the security of its allies was always a huge challenge during the Cold War. Although U.S. nuclear strategy and employment policy changed from “massive retaliation” to flexible response, it was the presence of 7,000 U.S. nuclear weapons in

25. See Appendix C.

26. In commenting on an earlier draft of this report, a former senior government official wrote: “If we are not willing to risk our homeland in defense of allies, then we better get out of this business. Your expressing this view is not helpful to long term assurance goals.” The issue is not whether we believe it; it’s whether our adversaries believe it. And just as it did during the Cold War, the act of putting U.S. nuclear weapons on the territory of its allies will have more credibility than any words American leaders utter about how the United States will respond if its allies are attacked by a nuclear weapon.

How Russia is thinking about its nuclear weapons: at the level of doctrine

In his masterful survey of the emerging nuclear landscape, Paul I. Bernstein concludes:

“[It] is clear that Russia’s nuclear strategy today encompasses a concept for deterring and terminating conventional war based on the threat of limited nuclear strikes for the purposes of “demonstration” and “de-escalation.” In this context, these terms refer to a “limited counter-force nuclear strike in the theater of military operations”—an action compensating for conventional force weakness intended to compel the adversary’s withdrawal by signaling Russia’s high stake in the conflict and its willingness to escalate the level of violence in order to prevail. This approach, premised as it is on the strategy of nuclear first use against a conventionally superior adversary to alter the political dynamics of conflict, is strikingly similar to the concept of flexible response that defined NATO’s strategy for many years.”

—Paul I. Bernstein, “The Emerging Nuclear Landscape,” in *On Limited Nuclear War in the 21st Century*, ed. Jeffrey A. Larsen and Kerry M. Kartchner (Stanford, CA: Stanford Security Studies, 2014), 109.

Europe that ensured that any major conflict in the Europe region would escalate rapidly to nuclear war. And the United States deployed hundreds of nuclear weapons in South Korea (and about 3,000 nonstrategic nuclear weapons in the Pacific Region) to underscore its extended deterrence there.²⁷ This encirclement by forward-based U.S. nuclear weapons worked during the Cold War and was largely dismantled after the Cold War ended.

In 2025–2050, the goals of U.S. nuclear strategy will remain the same, but the manner in which they are pursued will likely change. The 2014 Quadrennial Defense Report (QDR) states that

Our nuclear deterrent is the ultimate protection against a nuclear attack on the United States, and through extended nuclear deterrence, it also serves to reassure our distant allies of their security against regional aggression. It also supports our ability to project power by communicating to potential nuclear-armed adversaries that they cannot escalate their way out of failed conventional aggression.²⁸

When security anxieties are acute, “reassurance” or “assurance” is most reliably provided by credible extended deterrence—if American allies’ adversaries are deterred, they will be assured. Deterring regional adversaries from “going nuclear” requires credible nuclear responses to their nuclear attack options. Forward deploying a robust set of

27. Arms Control and Non-Proliferation Initiative, “50 Facts About U.S. Nuclear Weapons Today,” Brookings, April 28, 2014, <http://www.brookings.edu/research/articles/2014/04/28-50-nuclear-facts>.

28. DoD, *2014 Quadrennial Defense Review Report* (Washington, DC: DoD, 2014), v.

How Russia is thinking about its nuclear weapons: in messaging NATO

In a recent policy brief on “close military encounters”—defined as violations of national airspace, emergency scrambles, narrowly avoided mid-air collisions, close encounters at sea, and other dangerous actions”—between Russia and the West, a European Leadership Network (ELN) brief noted that NATO had already conducted over 100 intercepts of Russian aircraft by late October 2014, three times more than in 2013. The brief identified and categorized three types of incidents: 2 High Risk (a high probability of casualties or direct military confrontation) ones; 11 Serious Incidents with Escalation Risk; and 15n Near Routine Incidents, whose growing frequency added to “an atmosphere of tension.” The ELN policy brief also noted that “Russia has also been conducting a series of major exercises involving various units from the Western and Southern Military Districts. The geographical extent of these exercises ranges from the Black Sea littoral through the Russian border with Ukraine, and involves units from not only the Army, Navy, and Air Forces, but also from Russia’s Strategic Nuclear Forces. These activities . . . have been rightly perceived as threatening actions by Russia’s neighbors.”

—Thomas Frear, Łukasz Kulesa, and Ian Kearns, “Dangerous Brinkmanship: Close Military Encounters Between Russia and the West in 2014,” (London: European Leadership Network, November 2014), 9.

discriminate nuclear response options conveys the message that the United States will “respond in kind” and proportionately to nuclear attacks upon its allies. The credibility of that message is reinforced because the U.S. homeland would not be engaged in the U.S. response to a nuclear attack on a regional ally, which leaves the burden on the regional aggressor to escalate to the level of “homeland exchanges.”²⁹ The price, however, for this more credible U.S. “nuclear umbrella,” is the ally’s willingness to host U.S. nuclear weapons.³⁰ This is what constitutes “nuclear burden sharing” in 2025–2050.

29. One SME I consulted believes that it would not matter to China, for example, if the United States responded to its employment of a nuclear weapon against Japan with a U.S. nuclear weapon deployed in the region rather than one based in the continental United States (CONUS) or on a submarine. I disagree. I think it mattered to the Soviet leadership during the Cold War and it would matter to the Russian or Chinese leadership in 2025–2050. A retaliatory strike from a forward-deployed system, particularly if it is based on the territory of the ally that was attacked, is a more proportional response to the initial attack and, hence, more likely than one from a CONUS-based system. It is also still a step (or more) short of a homeland-to-homeland exchange and its risk of escalation to general nuclear war. As another SME commented, the Russians are “mov[ing] toward a doctrine of early, discrete nuclear weapons use,” but many American planners (in the view of another SME) believe that the war would escalate quickly once the nuclear threshold is breached. As I observed earlier in this report, there is no evidentiary basis for thinking about nuclear war. As with many nuclear issues, it is theological in nature. One either believes that escalation can be controlled at the nuclear level or not. I do. The globally shared awareness of the cataclysmic effect of “unrestrained” (to use Vic Utgoff’s terminology) nuclear war has certainly (in my view) contributed to the nonemployment of nuclear weapons since 1945. It is likely (again, in my view) to keep any nuclear exchange “restrained” if such an awful tragedy should occur.

30. Vic Utgoff believes that hosting U.S. forward-based nuclear weapons represents a political burden that most, if not all, potential host nations will be reluctant to bear. As an alternative, he argues that if extensive preparations are made for forward deployment, U.S. nuclear weapons could be brought forward in a crisis. (See

How Russia is thinking about its nuclear weapon: heavy handed diplomacy

“I want to remind you that Russia is one of the most powerful nuclear nations. This is a reality, not just words . . . [other countries] should understand it’s best not to mess with us.”—Vladimir Putin, August 29, 2014

“We hope that our partners will realize the recklessness of attempts to blackmail Russia, will remember the risks that a spat between major nuclear powers incurs for strategic stability.”—Vladimir Putin, October 15, 2014

“You can do a lot more with weapons and politeness than just politeness.”
—Vladimir Putin, November 19, 2014

“Sometimes I think, maybe it would be better for our bear to sit quiet, rather than chasing around the forest for piglets. To sit eating berries and honey instead. Maybe they will leave it in peace. They will not. Because they will always try to put him on a chain, and as soon as they succeed in doing so they tear out his fangs and claws. [By “fangs and claws,” Putin said he meant Russia’s nuclear weapons.] Once they’ve taken out his claws and fangs, then the bear is no longer necessary. He’ll become a stuffed animal. The issue is not Crimea, the issue is that we are protecting our sovereignty and our right to exist.”—Vladimir Putin, December 18, 2014

Some U.S. allies will be tempted to get their nuclear deterrence “on the cheap.” Preferring to remain a nonnuclear state and unwilling to host U.S. nuclear weapons, they will do the “assurance dance” and press the United States to bolster the credibility of its extended deterrent by adopting a “stronger” declaratory policy, engaging in more intensive alliance consultations, and the like. This may “work” today but is increasingly less likely to in the more perilous security environment of 2025–2050. “On the cheap” extended deterrence in the twenty-first century will be less credible, if only because it requires that the United States accept a disproportionate share of the risks associated with nuclear deterrence.

In regions containing a nuclear-armed aggressor, the choices facing nonnuclear states are likely to be increasingly stark: acquire one’s own nuclear weapons, host nuclear weapons from a nonregional actor (and pay the price of alignment), or accommodate the regional aggressor (by appeasement, realignment, etc.). The post-Cold War era seems to be coming to an end; the realities of the “post-post-Cold War era” will be harsher and the tradeoffs will be clearer to all, including allied and American publics.³¹

Chang Kwoun Park and Victor A. Utgoff, “On Strengthening Extended Deterrence for the ROK-US Alliance,” *Joint Force Quarterly* 61, no. 1 [2013]: 18–24.) However, I believe that moving a U.S. nuclear weapon forward during a crisis would be seen as too provocative by both the United States and the host nation. A “nuclear umbrella” that works when it really matters needs to be in place before the crisis occurs.

31. The author first heard this characterization in an off-the-record conference in late January 2015.

The nuclear strategy being recommended here is called “Measured Response.” This is not a new strategy—it is grounded in the U.S. strategy of escalation control that evolved as the United States adopted its flexible response strategy in the 1960s. As Kerry M. Kartchner and Michael S. Gerson observe:

The underlying logic of escalation control originated in the Kennedy administration, when Secretary of Defense Robert McNamara shifted U.S. nuclear war plans away from a single, all-out nuclear attack against the full range of military, economic, and civilian targets in Warsaw Pact countries, to a strategy that emphasized initial strikes only on Soviet nuclear forces. The central idea was that, rather than using its forces all at once, the United States would first execute a more limited strike and use its remaining weapons to deter Soviet escalation by threatening additional attacks. . . . The combination of smaller, controlled nuclear strikes and a large, survivable reserve force that would be used to threaten further attacks was at the heart of strategies for escalation control. Subsequent revisions to U.S. nuclear war plans, especially in the Nixon and Carter administrations, were intended to provide increasingly limited and flexible nuclear options to enhance the credibility of deterrence and, if deterrence failed, to control escalation and terminate the war at the lowest possible level of violence.³²

Russia’s growing reliance on nuclear weapons has led it to plan for and exercise the early employment of a nuclear weapon in a conflict with a superior conventional foe. China is modernizing and expanding its nuclear forces, in part to ensure their survivability against the combination of U.S. advanced conventional weapons and improving ballistic missiles defenses. Despite the veil of opaqueness on any Chinese thinking about how it might employ its nuclear weapons against the United States, I have little doubt that they are. The United States needs to think about how to counter that.

However, this is not a strategy of “escalation dominance,” which was defined by Kartchner and Gerson as the ability “to fight harder, longer, and more effectively than the Soviets at all levels of conflict short of general nuclear war,” a capability that, in effect, required nuclear superiority.³³ Deterring an adversary from breaking the nuclear threshold is not the same as preparing for limited nuclear war. It’s about ensuring that there are no gaps in U.S. nuclear response options that would prevent it from retaliating proportionately to any employment of a nuclear weapon against the United States and its allies. If unable to respond proportionately, the United States could be “self-deterred,” because responding in kind (i.e., with a nuclear weapon) might be seen (by American decisionmakers) as going “too far” up the escalatory ladder.

U.S. conventional superiority lowers the nuclear threshold, because it tempts conventionally weaker adversaries to early (rather than as a last resort) employment in order to

32. Kerry M. Kartchner and Michael S. Gerson, “Escalation to Limited Nuclear War in the 21st Century,” in *On Limited Nuclear War in the 21st Century*, ed. Jeffrey A. Larsen and Kerry M. Kartchner (Stanford, CA: Stanford Security Studies, 2014), 156.

33. *Ibid.*, 157.

avoid adverse results at the conventional level. By having a robust set of proportionate nuclear responses, the United States raises the nuclear threshold because it reduces the attractiveness of nuclear escalation. This may seem paradoxical, to be sure, but paradoxes seem to be endemic to any nuclear era.

While the United States should continue to maintain “strategic ambiguity” about the universe of circumstances that could lead it to employ a nuclear weapon, it should be absolutely clear that it will respond in kind to any nuclear attack. Failing to do so, even when there might be a nonnuclear response capable of achieving the same military effects (minus the radiation) weakens the U.S. nuclear deterrent, both with the perpetrator of the attack and any other state trying to assess U.S. willingness to cross the nuclear threshold. There should be no ambiguity about this contingency—“nuke us and we’ll nuke you.” It is Deterrence 101.³⁴

2025–2050: Recommended U.S. Nuclear Posture

Before identifying the nuclear weapons—that is, the nuclear warheads and delivery systems—that the United States will need to execute this strategy, this list of ancillary assumptions about supporting capabilities and boundary conditions needs to be enumerated, because they (in addition to the right nuclear capabilities) are also necessary if the proposed strategy is to succeed:

- *Responsive infrastructure.* A healthy nuclear complex capable of supporting the recommended posture.
- *Robust Nuclear Command and Control (NC2) System.* Conducting a limited, tightly controlled nuclear exchange would stress the NC2 system, which would have to be fully effective and resilient.
 - Advanced conventional weapons, cyber- and electronic-warfare capabilities could significantly degrade the U.S. ability to conduct controlled nuclear operations, but the assumption here is that DoD will make the investments needed to cope with them.
- *Affordable Nuclear Modernization Program.* DoD and Department of Energy (DoE) spending on nuclear weapons remains roughly at current levels—that is, \$30–35 billion per year (in 2015 dollars), about 4–5 percent of the overall defense budget.
- *Improved, but not fail-proof, defenses against small-scale nuclear attacks.* Effective defenses—against ballistic and cruises missiles, anti-aircraft and unconventional delivery means (e.g., smuggled into CONUS in a ship container)—would raise the barrier for conducting a nuclear attack against the United States, but would not

34. An external SME observed that a collapsing adversary (such as North Korea) could employ a nuclear weapon as a last-gasp, in-your-face act of anger and revenge, in which case the United States might not want to respond in kind. Perhaps. But this contingency is not one that should be explicitly accounted for as part of U.S. declaratory policy for how it will employ nuclear weapons.

cancel the threat. The United States remains vulnerable to large-scale nuclear attacks.

- *A revitalized nuclear mission in DoD.* In adopting the recommended strategy of Escalation Control, the DoD successfully addresses the drift and malaise that characterized the nuclear enterprise in 2007–2014. There is no point in developing and acquiring more employable nuclear weapons unless the DoD has trained and exercised with them and is seen as willing and able to employ them.
- As recommended in the author’s March 2008 report on *DoD and the Nuclear Mission*, this could involve creating a U.S. Nuclear Operations Command modeled after the U.S. Special Operations Command.³⁵

These assumptions are not self-fulfilling and are not trivial. But if the U.S. government fails to make these assumptions come true, the recommended 2025–2050 nuclear strategy and posture will lose much of its effectiveness and credibility.

SHAPING THE FORCE

The “second-to-none” yardstick for measuring rough parity with Russian nuclear forces does okay at the strategic level: despite Russia’s robust nuclear modernization program, most (but hardly all) U.S. analysts believe that U.S. strategic nuclear forces meet the “second-to-none” standard for maintaining rough parity with Russia.³⁶ Russia’s nuclear forces will be considerably younger than that of the United States and will include systems (e.g., road- and rail-mobile intercontinental ballistic missiles [ICBMs]) not in the U.S. arsenal. But the U.S. nuclear triad of submarine-launched ballistic missiles (SLBMs), ICBMs, and bombers is sufficiently strong and flexible that few analysts believe that the United States has inferior strategic nuclear forces. Plus, the U.S. nuclear triad is being modernized, albeit at a significantly slower pace than Russia’s.

That is not the case with nonstrategic nuclear weapons (aka “tactical nuclear weapons”)—the United States has one system, the B61 bomb, in its inventory, while Russia retains the full range of its battlefield nuclear weapons and is modernizing them (e.g., the new Russian *Iskander-M* is said to be nuclear capable and has been used in exercises involving strategic nuclear forces).^{37, 38} The issue is not whether the Russians are superior in this dimension of nuclear weapons; the issue is whether that superiority matters. While I do not believe that the United States needs to match Russia quantitatively, I do believe that

35. Murdock, *Department of Defense and the Nuclear Mission in the 21st Century*.

36. See Mark B. Schneider, “The State of Russia’s Strategic Forces,” *Defense Dossier* 12 (October 2014), http://www.afpc.org/files/defense_dossier_october_2014.pdf.

37. Schneider reports that the former Duma Defense Committee vice chairman Alexi Arbatov claims that Russia’s inventory of TNWs “includes short-range nuclear missiles, nuclear artillery, nuclear landmines, nuclear air and missile defense weapons, nuclear anti-ship missiles and bombs, nuclear depth charges, nuclear antisubmarine warfare missiles, nuclear torpedoes, nuclear bombs, coastal missile complexes and the missiles of the Russian Air Force’s and Navy’s non-strategic aviation.” See Schneider, “The State of Russia’s Strategic Forces,” 15–16.

38. *Ibid.*, 16.

Table 1. Warhead yields

Designation	Warhead	Yield (Kilotons)
NUCLEAR		
B-29 Superfortress	Little Boy	15
B-29 Superfortress	Fat Man	21
Current Inventory		
ICBM–LGM-30G Minuteman III	Mk-12A	335
ICBM–LGM-30G Minuteman III	Mk-21/SERV	300
SLBM–UGM-1323A Trident II D5	Mk-4: 4 W76 MIRV	100
SLBM–UGM-1323A Trident II D5	Mk-4A: 4 W76-1 MIRV	100
SLBM–UGM-1323A Trident II D5	Mk-5: 4 W88 MIRV	455
B-52H Stratofortress	ALCM: W80-1	5-150
B-2A Spirit	B61-7/B61-11, B83-1	10-360/400, low-1,200
Nonstrategic–F-16 DCA, F-15E, Tornado	B61-3/B61-4	0.3-170/0.3-50
UNDER DEVELOPMENT (Nuclear)		
F-15E, F-16 DCA, Tornado, F-35A	B61-12	0.3-50
CONVENTIONAL		
Massive Ordnance Penetrator (MOP)—carried aboard B-2A and B-52H	GBU-57A/B	0.003

Russia’s qualitative superiority in nonstrategic nuclear weapons does undercut the proposed Measured Response strategy.

As illustrated in Table 1, there are several potentially significant “gaps” in U.S. nuclear response options. ICBM warheads are three times as powerful as those carried by Ohio-class submarines, but, at 100 kts, the W-76 is hardly a discriminatory weapon and is 20 times more powerful than the 5 kt version of the ALCM-delivered W-80 warhead, which is the lowest-yield weapon in the strategic stockpile. As a point of comparison, the 15 kt weapon that incinerated Hiroshima was about twice (2.08) as powerful as the 5 kt variant of the W-80 warhead on an ALCM. These weapons were designed for the Cold War threat posed by the Soviet Union, which had an inventory that included weapons even larger than the American ones. These weapons are not very relevant to the nuclear employment scenarios that are likely in 2025–2050.

At the nonstrategic level, the United States does have subkiloton options in the “dial-a-yield” B61-3/4 bomb deployed on dual-capable F-16s. While the smallest variant of the B61 bomb is “only” 0.3 kt, that is still 20 times (21.5) more powerful than the largest-yield conventional weapon (the 30,000-pound Massive Ordnance Penetrator [MOP]). The B61-3/4 is slated to be replaced by the B61-12, which is also a variable-yield weapon with options that are not yet known (or perhaps to be determined). If current nuclear modernization plans hold firm, they will be delivered initially by the B-2A and then by the new long-range bomber (LRS-B) and dual-capable F-35As. The “life-extension” program for the B61 bomb

will likely result in a weapon that has at least 2-kiloton-or-smaller variations, but aside from greater accuracy, no additional “special effects” such as enhanced-radiation, earth-penetration, or low-radiation, all of which appear to be in active development in Russia (and elsewhere). Moreover, unlike their counterparts elsewhere, the U.S. military (with the likely exception of a few cells of planners sprinkled throughout DoD) are not seriously engaged in thinking through (by war-gaming, simulations, etc.) how nuclear weapons might be employed, much less training and exercising U.S. forces in their employment.³⁹ The United States is simply not preparing to counter how its potential adversaries are (or may be) preparing to counter its conventional superiority.

The nuclear posture needed for the recommended strategy of Measured Response is quite similar to that recommended by the CNAS think tank team:

The ideal U.S. nuclear force 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 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 . . . under 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.⁴⁰

A robust set of discriminate nuclear warheads deliverable by ballistic missiles, cruise missiles, and aircraft would ensure that the United States could respond in kind and proportionately to any nuclear attack against the United States and its allies. Special-effects weapons include low collateral, enhanced radiation, earth penetration, electromagnetic pulse, and others to be determined (as technology advances and the renewed nuclear enterprise matures). While the CNAS injunction to pursue the “greatest feasible variety of weapons effects” is probably too ambitious, as well as unaffordable, the aggressiveness of the research and development (R&D) program for nuclear weapons is a key indicator of how seriously the United States is pursuing this recommended strategy.⁴¹

Preparing for twenty-first-century nuclear employment scenarios requires more than extending the life of a nuclear posture designed for the Cold War era. After thinking through how nuclear weapons might be employed against the United States and its allies, the DoD must develop the concepts of operation (CONOPs) for countering them and then acquire the requisite capabilities. U.S. forces need to be trained (and exercised) in how to employ nuclear weapons in the manner prescribed by the CONOPs. This is what it means to have an “effective deterrent as long as nuclear weapons exist.”

39. In the U.S. military, the planning and conduct of military operations is anchored in the regional commands. The lack of attention given to nuclear issues by the regional commands has been a constant refrain for decades.

40. See Appendix D.

41. *Ibid.*

SHAPING THE FORCE

The design principles for the nuclear posture recommended here are grounded in common sense—form follows function, get the right capabilities for critical jobs, and capabilities (actions) speak louder than declaratory policy (words). The two primary missions for U.S. nuclear weapons are deterrence and extended deterrence, and the future force should be structured accordingly. In order to execute its Measured Response strategy, both forces should have low-yield, accurate, special-effects (Enhanced Radiation Weapon [ERW], Electromagnetic Pulse [EMP], “clean,” etc.) options that are employable at the lower end of the nuclear continuum.

- *Strategic Deterrent Force (SDF)*, consisting of *Ohio*-replacement class submarines, Minuteman III ICBMs (or a follow-on ground-based strategic deterrent [GBSD]), and B-52s and B-2s (and a new nuclear-capable bomber at some point) is the highly survivable, assured destruction force that is the foundation on which U.S. nuclear deterrence resides. This is the “strategic triad” that deterred the Soviet Union during the Cold War and provides the United States its “nuclear shadow.”
 - Both the American people and policymaking elites have great confidence in the “second-to-none” status provided by its superior submarine-based nuclear forces. They are expensive, to be sure, but highly valued (and feared).
 - ICBMs stabilize the “balance of terror” by raising the bar for a successful pre-emption attack to very high levels.
 - ICBMs also hedge against the potential vulnerability of SLBMs (and their small number of aim points), because technological advances could render them visible.
 - Discriminate employment options, delivered both by gravity bombs and a new cruise missile, would be provided by the same suite of air-delivered discriminate warheads used for extended deterrence.
 - While most of the low-yield warheads would be deployed on forward-based forces, the SDF should have a capability for discriminate employment to ensure that the full range of nuclear attacks against the U.S. homeland can be responded to proportionately.
- *Extended Deterrent Force (EDF)*, consisting of forward-based and rapidly deployable platforms would enable both permanent and temporary “coupling” of the U.S. nuclear deterrent to host-nation security.
 - Dual-capable F-35As (based on land) and F-35Cs (based on carriers) would provide visible manifestations of U.S. extended deterrence and allied burden-sharing.
 - Discriminate employment options would be provided by a suite of low-yield, special-effects warheads (low collateral damage, enhanced radiation, earth penetration, electromagnetic pulse, and others as technology advances),

including possibly a smaller, shorter-range cruise missile that could be delivered by F-35s.

In this recommended 2025–2050 nuclear posture, bombers serve as an all-purpose hedge force that can enable, complement, and hedge for the other three “legs” (SLBMs, ICBMs, and dual-capable F-35s). They provide extended deterrence presence and discriminate nuclear options in regions where there are no forward-based or deployed F-35s. They can also provide weapons and mobility to deploying F-35As. As the traditional complement to SLBMs and ICBMs in the SDF, bombers are the most flexible leg of the strategic triad and can be used for signaling.

Currently, the United States has a nuclear force that consists of SLBMs, ICBMs, and two air-breathing variants (bombers and forward-based F-16s). This recommended 2025–2050 posture would have the same mix of systems, but with a much enhanced capability for discriminate nuclear responses and forward deployment.

The capabilities envisioned for this recommended nuclear posture include weapons intended to deter nuclear attacks at the lower end of the nuclear continuum; forward-based and forward-deployable delivery systems intended for extended deterrence; and assured destruction weapons that have intercontinental range, larger payloads, and are deployed in numbers sufficient to ensure stability and survivability. These are the right capabilities for nuclear deterrence in the twenty-first century because they counter the “nuclear offset” that U.S. adversaries might adopt for coping with U.S. conventional superiority.

SIZING THE FORCE

Years 2025–2050 are too far into the future to project specific numbers. There are too many uncertainties—the state of U.S.-Russian arms control, the number of regional nuclear powers, and the mix of conflict, competition, and cooperation between the major powers, to name a few. However, the following are offered as guidelines for sizing the 2025–2050 U.S. nuclear force:

- *Maintain rough parity with Russia.* Sustaining strategic stability, as well as regional stability in Europe, with a Russia that believed it had nuclear superiority would be significantly more difficult, if only because of the likely impact on Russia’s propensity to take risks.
- In order to build nuclear forces capable of responding proportionately to a nuclear attack at any rung of the escalatory ladder, the United States will have to address the significant disparity (with Russia) in nonstrategic nuclear forces. In light of Russia’s rather crude nuclear diplomacy during the 2014 Ukraine crisis, the United States needs to address this capability gap as it strengthens the portion of its nuclear forces that are tailored for the extended deterrence mission (to be discussed shortly).

- *Maintain nuclear superiority with China.* Despite a numerical disparity that might be 10 to one, China’s assured-retaliation capability has gained it a strategic-stability relationship with the United States that, as DoD acknowledges in the 2010 NPR report, is similar to that between the United States and Russia.⁴² However, China’s overt achievement of nuclear parity with the United States (and Russia) would likely trigger regional proliferation by American allies, much as the Soviets did in Europe during the Cold War. Avoiding this outcome could help explain China’s relative moderation in growing its nuclear forces.
- *Maintain sufficient capability to cope simultaneously with nuclear-armed “regional rogues.”* States willing to contemplate employing a nuclear weapon in a conflict with the United States will also be willing to “bandwagon” against the United States or “pile on” if the United States is distracted by another crisis.
 - A world of 18 nuclear powers could include, in addition to the current nine members, Iran, Saudi Arabia, Egypt, Turkey, Japan, South Korea, Poland, South Africa, and Brazil.
- *Maintain a smaller stockpile, which is enabled by responsive infrastructure.* The nuclear complex supporting a strategy of Measured Response is one that will design, develop, and produce new capabilities and new weapons. No longer will Cold War-era weapons have to be retained as a technological hedge in the stockpile, which now has about 5,000 weapons in it.

Under New START limits and counting rules, the United States will have 1,550 operationally deployed nuclear weapons (with intercontinental range). With a responsive infrastructure, it could have a similar number of reserve warheads. However, this does not address the disparity in U.S.-Russian nonstrategic nuclear weapons.

Final Thoughts

Nuclear weapons have awesome destructive power—so awesome, in fact, that the leaders of nation-states have been inhibited in their willingness to risk their actual employment. While this has often been characterized as the “nuclear taboo,” the unwillingness to risk nuclear escalation has been a rational calculation, not a values-based one. The contestants during the Cold War were afraid to break the nuclear threshold because they believed it would escalate quickly to general nuclear war. This fear contributed greatly to keeping the Cold War cold.

U.S. conventional superiority, even if less dominant than it was at the time of the first Gulf War, is making the nuclear option more rationale for potential U.S. adversaries. For those countries that do not want to live under Pax Americana and do not want to lose a conventional conflict with the United States, a plausible move is to employ a nuclear

42. As former National Nuclear Security Administration (NNSA) administrator Linton Brooks has frequently observed, “Mutual vulnerability is not a policy; it’s a fact.”

weapon and break the nuclear threshold in a manner that demonstrates their resolve but without triggering the mass destruction of a nuclear war. The United States needs to undercut the desirability of the nuclear escalation to would-be opponents. By adopting the nuclear strategy and posture recommended here, the United States will have demonstrated its willingness (if necessary) to engage at the nuclear level and, by doing so, will make it less likely that its opponents will do so. As was the case during the Cold War, preparing for nuclear war, if done seriously, made it less likely to happen. Hopefully, that will prove to be the case in the “second nuclear age” as well.

Appendix A. Project Atom Participants and Subject Matter Experts

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Appendix B. Project Atom Timelines

Session 1: Overview of Project Atom Deliverables and Research Agenda

13 May 2014, 1200–1400, CSIS

Session 2: Project Atom Framework Meeting: Security Environment

9 June 2014, 1130–1530, CSIS

The CSIS study team briefed the CSIS paper on the likely future security environment and several alternative worlds. The paper was designed to establish a common understanding among the think tank teams of the future security environment to ensure that each team was planning for the same future, including strategic uncertainty.

Session 3: Project Atom Framework Meeting: Technological Possibilities

23 June 2014, 1130–1530, CSIS

The CSIS study team briefed the CSIS paper on future technological possibilities. The paper was designed to demonstrate what technological advancements were possible in the agreed-upon future security environment and framed some of the possibilities for the teams in choosing their force structure for the future.

Session 4: Presentation and Discussion of Think Tank Papers

11 August 2014, 0900–1630, CSIS

Each think tank team briefed the group on their paper and their recommended force structure and posture for the future.

Session 5: Project Atom Wrap-up

22 October 2014, 1130–1530, CSIS

Appendix C. Protecting U.S. Security by Minimizing the Role of Nuclear Weapons: A New U.S. Nuclear Policy

*Barry Blechman and Russell Rumbaugh
The Stimson Center*

Nuclear weapons remain the most potent destructive force known to humanity. Yet, U.S. nuclear policies and doctrines remain encumbered by Cold War beliefs in the potential utility of nuclear weapons, even though the United States enjoys a dominant geopolitical position in the world, underpinned by a conventional military superiority greater than any ever known before. These false hopes that nuclear weapons can play a range of political and military roles in U.S. security policy cause the United States to mistakenly pursue a nuclear strategy that is costly—not only in material terms but also in geopolitical terms. In the worst-case scenarios, the strategy could be catastrophic in terms of human lives and the nation’s future. The overarching goal of U.S. nuclear policy and strategy should be to seek to minimize the roles played by these weapons, both in our own policies and in the policies of all other nations.

The United States enjoys conventional military superiority over every other nation in the world. As a result, in all situations in which military instruments are relevant means of defending American interests, conventional armed forces are the preferred means of protecting those interests. For the United States, nuclear weapons’ only role is to deter nuclear attacks on the United States and its allies. They provide no military or political advantage for the United States against any other threat. In addition, any use of nuclear weapons, no matter how limited, would end the long-standing taboo on their use and make devastating nuclear wars more likely. Consequently, U.S. political and military strategy, diplomacy, military doctrine, and military force structure should all aim to minimize the importance accorded to nuclear weapons by the United States and all other nations.

To demonstrate why U.S. interests would be served best by a policy of minimizing perceptions of the utility of nuclear weapons, we first examine current U.S. conventional

military superiority and the likelihood that it can be maintained well into the future. Next, we consider what military—or political—advantages the United States could gain from nuclear weapons beyond deterring nuclear attacks by others. We then consider the nuclear policy that would best serve U.S. interests. To summarize, we argue that U.S. nuclear policy should state clearly that U.S. nuclear weapons serve only to deter others' use of nuclear weapons against the United States and its allies. Furthermore, that the United States should (a) as political circumstances make possible, pursue negotiated measures that could lead eventually to a verifiable international regime to eliminate all nuclear weapons from all nations; (b) adopt declaratory policies and pursue diplomatic arrangements that strengthen the nuclear taboo; and (c) focus its force structure solely on maintaining a secure, second-strike capability. We provide a detailed description of this force structure and, finally, consider how specific contingencies would affect both the policy and force structure we advocate.

U.S. Conventional Military Dominance

The key attribute of the U.S. military posture is the conventional military dominance it currently enjoys and will likely be able to maintain for the next several decades, assuming the U.S. population is willing to invest sufficient resources to preserve the nation's current advantages. Although military instruments are inherently limited in the strategic and policy goals they can achieve alone, conventional military superiority provides the United States with the ability to defend itself, its allies, and its global interests whenever military means are relevant.

The United States enjoys conventional superiority because of the scale and longevity of its investments in relevant technologies, the size of its forces, and the qualities and training of its people. The United States leads the world in military technologies. Sensors on satellites and manned and unmanned aircraft, paired with redundant global command, control, and communications networks provide unprecedented and unparalleled situational awareness to U.S. political and military leaders. Precision-guided munitions launched from air, sea, and land platforms offer the potential for U.S. armed forces to eliminate targets with a degree of speed and accuracy that was unimagined only a few decades ago. Furthermore, the United States maintains unmatched capabilities to project military power around the world, including large and small aircraft carriers, sea- and air-launched cruise missiles, penetrating strike aircraft and bombers, a large fleet of cargo and tanker aircraft, and mobile theater missile defenses. The United States can move large numbers of marines and/or army forces rapidly to distant regions. And, finally, the United States has unique capabilities to deploy significant numbers of technologically advanced special operations forces almost anywhere in the world on short notice.

The United States can capitalize on these advanced military technologies because of its investment in people and its unique military culture. As one of the first nations to abandon conscription, the U.S. all-volunteer force provides greater selectivity and longer tenures than conscripted forces, resulting in the high caliber of individuals serving in the military.

The qualities of these individuals are further enhanced by the significant and unmatched investments in training made by the United States. No other nation provides as frequent opportunities for its fighting men and women to conduct training operations on their equipment or in simulators, both in small units and in larger exercises. Finally, an American culture of individual initiative, combined with high-quality, well-trained personnel, produces the ability for U.S. armed forces to conduct complex, decentralized military operations more effectively than any other state.

Besides the quality edge in both people and equipment, the United States also has a massive quantitative advantage in most types of military capabilities. The United States has long been the greatest spender on the armed forces. The United States maintains more people in active service than any country other than China, and much of China's military consists of domestically focused conscript forces. The United States maintains larger numbers of warships, bombers, and advanced tactical fighters than any other nation, and its forces of armored and wheeled ground vehicles are at least comparable in size to other nations. Moreover, each of these pieces of equipment also is qualitatively superior to any other counterpart.

U.S. conventional dominance is not guaranteed and depends on a continued high level of investment, efficient use of resources, and the continuing willingness of U.S. citizens to sacrifice personal resources to provide sufficient national resources. But the previous high levels of investments do mean the United States has conventional military superiority today in almost every respect.

Assuming continuing high levels of investment in military capabilities, U.S. conventional superiority is likely to endure for at least several decades. Relative U.S. economic dominance is declining as other nations develop, but the United States will remain a very wealthy nation with vast resources throughout the period in question (2020–2050). The United States has untapped capacity to expend significantly greater resources on defense, as it has demonstrated repeatedly during past wars and crises. U.S. technological superiority can be maintained by continuing to invest in relevant research and development—the nation has a vibrant private technological sector that can be drawn upon to support that R&D. Moreover, the large, well-educated U.S. population offers a pool for military service that no other nation can duplicate in the near term.

U.S. conventional dominance is not uncontested. Russia and China are actively seeking to erode U.S. military advantages but remain unlikely to pose anything more than limited regional challenges to American conventional superiority, if that, for many years. Chinese investment in equipment modernization is paying off, but its modern military forces remain small and qualitatively inferior to those of the United States. China does not today have the ability to contest the United States successfully, even in specific areas near U.S. allies off China's coasts. Still, given its 20 years of investments in building a more modern military and continuing economic growth, China could plausibly threaten the United States' ability to conduct specific military actions in regions near China's coasts within the

next several decades. If realized, such threats could jeopardize America's ability to fulfill its commitments to defend certain allies. But the realization of these threats is far from assured.

For China to acquire even a limited ability to deny local U.S. military actions, it will need to sustain the unprecedented economic growth and rising military spending it has enjoyed in the last several decades, and both types of growth appear increasingly uncertain and unsustainable.

To forecast China's ability to disrupt U.S. military dominance, moreover, observers must extrapolate from recent advances in China's military equipment. First, those projecting Chinese capabilities assume China will put its resources into capabilities designed to offset U.S. advantages. Yet China's construction of an aircraft carrier and early signs of a fifth-generation stealth fighter are two examples of Chinese efforts to ape—not counter—advanced U.S. forces, forces in which the United States has huge qualitative and quantitative leads. China is currently constructing a single, small aircraft carrier off the keel of an older carrier purchased from Russia. The United States has conducted carrier operations for 70 years and currently has 10 much larger aircraft carriers in operation and is building replacements with even greater capabilities. (Indeed, the United States has nine aircraft carriers the size of the one being built by China, but does not even call them carriers as they are used only by vertical and short-takeoff and landing aircraft to support U.S. Marine operations.) Similarly, China currently has four fifth-generation prototype fighters, and has yet to develop an indigenous capability to build jet engines. In contrast, the United States already fields nearly 200 F-22 fifth-generation fighters, plus more than 100 developmental model F-35s, with plans for nearly 2,000 production models in the coming decade.

Second, those projecting Chinese capabilities to disrupt U.S. operations near China's coasts must assume China will make the organizational changes necessary to field a power projection force. China's current military structure is heavily dominated by the People's Liberation Army (PLA), closely controlled by the Chinese Communist Party and still domestically oriented in order to ensure the Party's continued rule by suppressing any internal unrest. To become a power projection force, larger leadership roles and greater freedom of action would have to be given to the PLA navy and air force. In contrast, the United States has had a joint and global force since World War II, and is already 30 years into its last major organizational change that clarified its worldwide, operational command chain.

Third, those projecting a Chinese capability to prevent the United States from protecting allies near China's coasts must assume the United States is unable to respond to disruptive technologies now being developed by the Chinese. This case is usually made by assuming China develops a certain capability and the United States does not respond—the fallacy of the “last move.” For example, much has been made of China's development of cruise, and possibly ballistic, missiles that could be targeted against U.S. aircraft carriers and other warships to prevent them from aiding U.S. allies under attack. Quite apart from the difficulty of locating, targeting, and hitting moving warships in wartime conditions,

this scenario neglects possible U.S. countermoves, including learning to decoy, jam, or destroy such antiship missiles in flight. In fact, the United States is already developing such capabilities in its family of sea-based standard missiles. Alternatively, the United States could develop different strategies, such as conducting air sorties against missile launch points to destroy or at least significantly degrade China's missile launchers before bringing U.S. warships within range to support further operations. In short, as long as the United States did not count a Chinese assault against an ally as a *fait accompli* not to be contested, the United States could adapt to disruptive technologies and seek to blunt any advantages China does gain.

Few assert Russia will be able to contest U.S. (and NATO) conventional military dominance, even locally, within reasonable time horizons. Even if successful, Russian military reform efforts will likely take decades to produce a modern, professional force, as the Russian military largely remains an ill-trained conscript force reliant on older equipment. Those pessimistic about relative NATO/Russian conventional capabilities point out that the Russians have quantitative advantages in ground forces at several points along NATO's borders. Such calculations ignore the alliance's ability to move forces around during the crisis that would precede any conflict, as well as the inherent flexibility and mobility of NATO's superior air power. The only plausible scenario is again one of a *fait accompli* that capitalizes on a local imbalance in force postures that the United States then accepts. But this scenario requires assuming the United States would not react to such an attack, an assumption not borne out in U.S. history, and given lie by the U.S. 70-year commitment to NATO and sustained deployment of forces on the continent.

While the United States obviously needs to work diligently to address potential shortfalls in its conventional military technologies and force structure, history demonstrates that projections of precipitous American military decline should be regarded with considerable skepticism. Over the nearly seven decades since the end of World War II, many analysts have warned of American military weakness, only for these projections to prove either false or irrelevant.

The Limited Role of Nuclear Weapons

The conventional military superiority described in the last section ensures the United States has robust and flexible military tools. Because of the exceptionalism of these tools, nuclear weapons add few options for the United States. Indeed, given U.S. conventional military superiority, nuclear weapons serve no military role for the United States beyond deterring nuclear attacks on itself and its allies.

Unfortunately, nuclear weapons do remain indispensable in order to deter other nations from contemplating nuclear attacks on the United States and its allies. Conventional forces are an inadequate deterrent for adversaries with significant nuclear forces, as they could not impose a comparable scale of destruction. Deterrence of nuclear attacks will always be a risky proposition, particularly during crises or wars, as it assumes informed

and rational decisionmakers, effective communications, and a host of other enabling conditions. Still, the fact that the United States and Soviet Union generally behaved cautiously during the Cold War, when they each faced existential threats from the other's nuclear weapons, suggests nuclear threats do have deterrent value. At the same time, the facts that nonnuclear states have been willing to attack and wage conventional war on nuclear powers, and that nuclear weapons have never been used since 1945, demonstrate the limited utility of these weapons in the real world, as opposed to the world of nuclear theoreticians.

Other than deterring nuclear attacks, nuclear weapons offer no advantage to the United States over conventional forces. To summarize the many potential military and political uses of nuclear weapons, we consider their potential roles in four overarching categories: defense, deterrence, coercion, and assurance. Though these categories of potential military roles are not absolute, they are analytically useful and roughly correspond with most assessments of the use of force for policy goals. In each category, nuclear weapons provide the United States with no advantage as compared with its conventional military capabilities.

Defense includes the broad range of possible means of stopping an attack. The United States can defeat any conventional attack on itself or its allies using conventional means. Even if a competitor challenged U.S. conventional dominance in a particular situation and gained a temporary advantage, the United States would be able to prevail conventionally over time by repositioning forces and, if necessary, drawing on its substantial demographic and economic resources. Because of this essentially absolute conventional defense capability, nuclear weapons add no further military advantage. Unlike every other major power, the United States does not have to rely on nuclear threats to defend itself from conventional attacks—a tactic of weak states. In addition, for defending against unconventional attacks, such as the 9/11 attack or any other terrorist attack, nuclear weapons are irrelevant.

Deterrence seeks to prevent adversaries from initiating attacks in the first place, instead of directly stopping them with military force, and clearly is preferable to *defense*. The United States' ability to defend itself and its allies successfully, combined with the capability to retaliate conventionally anywhere in the world, serves as a powerful deterrent against any conventional attack. As with defense, since U.S. conventional capabilities are near absolute, nuclear weapons add no value in addition to conventional threats. Moreover, since the United States has used conventional forces repeatedly, but has not used nuclear weapons, over the past nearly 70 years, the deterrent threat of a conventional response is more credible than a threat of responding to conventional attack with a nuclear strike.

In the unlikely event that American security guarantees were disbelieved by an adversary and deterrence failed, it would be the result of a perception of insufficient American will, not insufficient American military capability. Threats to respond to conventional aggression with nuclear weapons would not enhance the credibility of American deterrence. If the United States were seen as unwilling to commit conventional forces to defend

an ally, there is no reason to believe that threats to risk a nuclear war on an ally's behalf would be seen as more credible. Conversely, an adversary may believe it necessary to counter U.S. conventional superiority with the threat or actual use of tactical nuclear weapons. U.S. policy should make clear that crossing the nuclear threshold by any means—with any type of warhead or weapon system, strategic or tactical—would bring into play the possibility of a response from the United States' strategic nuclear arsenal.

In the unlikely event that American conventional capabilities to defend an ally in a specific theater or scenario eroded, threatening a nuclear response to a conventional attack on an American ally would still be a highly questionable strategy. A threat to risk nuclear escalation for the sake of an ally, and thereby risk extensive damage to the United States, would likely be seen as lacking credibility. A far preferable strategy would be to take urgent measures to offset whatever development on the part of the adversary had brought into question U.S. conventional capabilities, and to demonstrate the United States' continuing firm commitment to the ally through the forward deployment of significant American forces.

In recent years, some have argued that the United States should not restrict the purposes of its nuclear arsenal to deterring nuclear attacks, and instead threaten their use in response to a wider range of threats, such as chem/bio attacks, cyber attacks that cause physical damage to infrastructure, or efforts by states to provide terrorist organizations with nuclear weapons that would be used on U.S. or allied territory through unconventional means (e.g., smuggled in a container).

Apart from questions about the efficacy of these threats, deterring them by threatening massive retaliation with conventional forces remains far preferable than broadening the stated role of nuclear weapons. Elevating the importance of nuclear weapons by widening their roles establishes precedents and perceptions of nuclear utility that can only encourage their emulation by others and vertical and horizontal proliferation. In contrast, the United States has the ability to respond to any of these threats with devastating conventional force, thus achieving all the military utility without any of the political drawbacks.

Coercion is the use of force, or the threat of its use, to achieve specific policy goals. The United States can apply precise, scalable, and overwhelming conventional force to back up coercive threats or to directly coerce other states. Such actions can range from isolated air strikes to destroy a target or to warn a government or terrorist organization about a threatened action, to the actual invasion of a country to topple its government—or the threat to do so. The United States has conducted the full range of such coercive actions frequently since the end of the Cold War, and nuclear weapons or threats were not involved in any of these actions. Indeed, in these types of situations, coercive threats backed by nuclear weapons would likely be seen as less credible than conventional threats.

Obviously, there are limits to U.S. coercive power, particularly in situations in which the sitting administration seems irresolute or the U.S. population reluctant to become involved. But incorporating nuclear threats into the coercive action would not ease those

limits. The risk of nuclear war already limits the United States' ability to coerce nuclear states, particularly those with significant nuclear arsenals. After 70 years, nuclear threats against nonnuclear nations or in lesser contingencies are simply not credible. After all, the United States accepted a humiliating conventional defeat in Southeast Asia without using nuclear weapons. Moreover, even though U.S. ability to stabilize nations with conventional forces and build effective governments is limited, as has been demonstrated in Iraq, Libya, and Somalia, nuclear weapons are also irrelevant in all such scenarios.

Assurance is diplomacy, combined with the symbolic use of force to persuade allies that U.S. commitments to their security are sincere and credible, and that the United States is capable of fulfilling them. Allies, particularly officials charged with security in the allied nation, always will harbor some doubts about whether the United States would risk American lives to defend their sovereignty. Such doubts will wax and wane over time depending on the quality of relations between the United States and its ally, perceptions of U.S. strength and leadership, and events around the world—over most of which the United States will have only limited influence.

Maintaining allies' confidence in U.S. commitments requires frequent consultations, political reassurances, high-level meetings, and cooperation in military planning. U.S. conventional forces also provide a global, visible, flexible, and credible means of reassuring allies—particularly when they are deployed on the ally's territory or conduct temporary deployments to exercise jointly with allied forces. Though nuclear guarantees are an important component of U.S. security commitments, allies doubt them more than they doubt U.S. conventional commitments because of the greater risk they pose to the U.S. homeland. If an adversary in fact attacked a U.S. ally with conventional forces, the adversary would have already discounted the U.S. commitment to defend the ally. And if U.S. credibility had already been discounted, the potentially graver consequences of a nuclear response would make nuclear guarantees even less credible in the eyes of the adversary. Consequently, the United States should make clear repeatedly that it will fulfill all of its treaty obligations and would respond conventionally to conventional attacks against allies, and with nuclear weapons in the event of nuclear attacks. The long history of U.S. security commitments, and the sacrifices in blood and money that the American people have repeatedly made in defense of these commitments, provide ample evidence that U.S. security guarantees are credible.

Although the United States should pursue all feasible conventional and diplomatic means to assure allies, there is no level of force deployment, whether conventional or nuclear, that can guarantee allies' confidence in American security commitments. Some allies have expressed concerns about American security commitments despite the presence of tens of thousands of permanently based U.S. forces, underscoring the dependence of allied confidence on factors beyond military presence. Joint command and control of tactical nuclear weapons under NATO nuclear-sharing arrangements has apparently failed to reassure some NATO members, which demonstrates that the forward deployment of nuclear weapons may also be insufficient to assure allies. Furthermore, though it is

undiplomatic to acknowledge, allies often express grave concerns about potential threats and worry about U.S. security commitments, but then fail to take steps to significantly increase their own defense capabilities, raising questions about the seriousness of their concerns. And the frank truth is that the alternatives to dependence on U.S. security guarantees are even less palatable for most U.S. allies. Allying with Russia or China is not a reasonable alternative to a U.S. alliance, attempting to balance Russian or Chinese military capabilities unilaterally or in combination with neighboring states would be a difficult and unnecessary choice, and developing nuclear weapons of their own is in most cases too far a stretch financially or politically.

By making clear that the United States believes nuclear weapons can serve only to deter nuclear attacks, the United States would also be helping to weaken perceptions of the importance of these weapons and to strengthen perceptions of the dangers they pose, thereby facilitating efforts to limit/reverse proliferation and reduce nuclear arsenals. In contrast, if the United States would make clear it relies on nuclear weapons for a larger set of roles, it legitimates these weapons, falsely draws attention to their potential uses, and thereby encourages nuclear proliferation. U.S. threats to respond to conventional attacks with nuclear weapons exaggerates the utility of nuclear weapons and could reinforce other states' inclination to acquire nuclear arsenals. If the United States threatened with nuclear weapons despite its conventional superiority, other states with weaker conventional forces would have even more incentive to follow suit. The repetition of explicit threats to make the first use of nuclear weapons in a conflict could render such threats more credible and gradually weaken the taboo against the use of nuclear weapons.

In all of these scenarios, save nuclear deterrence, nuclear weapons do not provide any capabilities or attributes U.S. conventional superiority does not also provide. In short, nuclear weapons do not advance U.S. interests and U.S. diplomacy, nuclear policy, and its nuclear posture should therefore minimize them.

Minimizing the Roles of Nuclear Weapons in U.S. Policies and Those of Other Nations

Given this analysis of the single purpose served by nuclear weapons in protecting the security of the United States and its allies, the United States should orchestrate its diplomacy, nuclear declaratory policies, and force posture in order to minimize perceptions of the utility of nuclear weapons in world affairs. Among other things, such a policy would include (a) as political circumstances make possible, pursuing various types of negotiated arrangements that could lead eventually to a verifiable international regime that eliminated nuclear weapons from all nations; (b) adopting declaratory policies that make clear the U.S. belief in the narrow utility of nuclear weapons; and (c) focusing its force structure solely on maintaining a secure, second-strike capability.

The primary objective of U.S. policy on nuclear weapons should be the establishment of a verifiable international regime eliminating nuclear weapons globally. Since nuclear weapons only provide strategic value as a deterrent against nuclear use, while the potential effects of even a limited nuclear exchange could be devastating, U.S. and global security would be enhanced substantially by the elimination of nuclear weapons from all nations. A functioning nuclear disarmament regime would better protect U.S. interests than deterrence, as deterrence is inherently a risky and uncertain phenomenon. As long as nuclear weapons exist, their use is a possibility. Only by making them cease to exist can this possibility be ruled out.

Moreover, modern surveillance and reconnaissance capabilities and the long experience with U.S.-Russian and multilateral arms control treaties demonstrate that verifiable regimes are possible. The risk of cheating under such a regime could be curtailed by creation of an international body charged with monitoring treaty compliance, backed by the power to impose punitive sanctions and the possibility of collective military action by the treaty's signatories against nations that cheat or seek to break out of the agreement.

The elimination of nuclear weapons can only occur when underlying political conflicts among nations that have nuclear arsenals are resolved. Most important would be the achievement of understandings among Russia, the United States, and the nations of Europe about Russia's role on the continent, and the political and economic integration of Russia into European affairs. A similar process concerning China's role in East Asia and its continuing economic and political integration into world affairs is also essential. As these broad international issues are worked out, however, a process that will no doubt take years, it would be possible to take steps toward the establishment of a verifiable elimination regime. Such steps would include reducing the size of nuclear weapon stockpiles, beginning with those of the United States and Russia, erecting tighter controls on civilian nuclear facilities and fuel cycles, developing and testing verification methods, particularly those pertaining to verifying limits on warheads (current limits pertain mainly to weapon launchers), broadening and strengthening existing nuclear weapon free zones, strengthening the Non-Proliferation Treaty, and developing common international understandings about the humanitarian consequences of nuclear use and the means through which nuclear disarmament might be achieved.

Although the United States should not eliminate its nuclear weapons unilaterally as it pursues this diplomatic agenda, it could reduce the size of its arsenal and still have confidence in its capability to deter nuclear attacks. Complete unilateral disarmament, on the other hand, would make it impossible for the United States to deter nuclear attacks through the threat of nuclear retaliation and thereby might increase the risk of a nuclear first strike and encourage nuclear proliferation by allies who no longer feel secure without the American nuclear deterrent umbrella. While in pursuit of a fully implemented and verifiable disarmament regime, the United States has an interest in limiting the proliferation of nuclear weapons and therefore must work to maintain allies' confidence in nuclear deterrence guarantees.

That said, the United States should refrain from the permanent forward basing of nuclear weapons, which impose additional costs and risks and increase political tensions, without providing capabilities beyond those offered by U.S.-based strategic forces. Instead, the United States should assure allies of its nuclear deterrence guarantees by maintaining (or establishing where they do not yet exist) standing consultative mechanisms with nations to whose defense we are committed to discuss threats to their security and plan on how to counter them, including the nuclear component of such plans; frequently demonstrating the global reach of U.S. nuclear capabilities through exercises, temporary deployments of bombers, and port visits by strategic submarines; and frequently demonstrating U.S. conventional capabilities by temporary deployments of ground, air, and naval forces to allied nations for joint exercises.

By taking these concrete and practical steps, U.S. nuclear policy and diplomacy can set a course for a truly secure future.

The second prong of U.S. nuclear policy should rule out the use of nuclear weapons except as a response to others' use of nuclear weapons. U.S. nuclear policy and doctrine should seek to strengthen the taboo against nuclear use by creating starkly clear redlines that would raise the thresholds for nuclear use.

U.S. declaratory policies should emphasize both the grave humanitarian consequences of nuclear use and the military disutility of nuclear weapons.

U.S. nuclear policy and doctrine should state clearly that the United States would not use nuclear weapons unless a nuclear weapon had already been used against the United States or one of its allies. Whatever marginal tactical or operational advantage the United States might gain from envisioning broader roles for nuclear weapons would not offset the greater negative consequence: encouraging other states to look favorably on acquiring nuclear weapons and weakening the nuclear taboo.

At the same time, the United States must make clear beyond the shadow of a doubt that any nuclear attack on the United States or an ally under the United States' nuclear deterrence umbrella would be met with a nuclear counterattack of equal or greater severity. A nuclear attack should be defined as any attack that incorporates a nuclear explosion, including an EMP attack, an attack with low-yield weapons, or an attack with weapons launched by short-range systems, no matter how few in number or limited in yield.

The United States should reserve the option to respond to a tactical nuclear strike against in-theater conventional forces with the use of strategic nuclear weapons against tactical military targets, such as command and control nodes, large troop formations, or military bases. U.S. policy should make clear that any step onto the nuclear escalation ladder would bring all of the dynamics of nuclear deterrence into play. Doctrine aside, the United States might choose, in fact, to respond to a very small, battlefield use of nuclear weapons with conventional forces. But that would be a tactical decision that could only be made in the circumstances. Although a logical possibility, such a battlefield option should

not be stated explicitly as part of U.S. doctrine, in order to avoid weakening the perception that any nuclear use would prompt a U.S. nuclear response, and thereby weaken deterrence of limited nuclear strikes.

Given U.S. conventional capabilities, it is extremely unlikely the United States would find itself in a position where it would be unable to preserve the sovereignty and territorial integrity of the United States and its allies with conventional forces alone. It is therefore extremely unlikely the United States would find itself in a position to even contemplate the use of nuclear weapons to terminate a conventional conflict.

The United States also should make clear that it does not plan to use nuclear weapons in response to conventional, chemical, biological, or cyber attacks on the United States or its allies; instead, that it would respond to such attacks with passive defenses and its dominant conventional capabilities. The effects of these types of attacks, while potentially severe, would be neither as immediate nor as complete as the effects of a nuclear strike, which would instantaneously annihilate nearly everything within its blast radius. While there are essentially no means to mitigate against or contain the effects of the successful delivery of a nuclear weapon, there are such means available in the case of a chemical or biological attack, such as gas masks, vaccines, and quarantines. And while reliable unclassified information about relative U.S. and potential adversary cyber capabilities does not exist, given the United States' vibrant and innovative commercial information technology (IT) sector and the resources allocated to cyber warfare in the U.S. defense budget, one would assume that the United States is at least competitive with other nations in both offensive and defensive cyber warfare.

While not as absolute as a fully verifiable regime for eliminating all nuclear weapons, these declaratory policies are implementable immediately and would advance the marginalization of nuclear weapons by making clear the United States has confined them to a single role—deterring nuclear attacks.

Finally, reflecting the narrow role conceived for nuclear weapons, the U.S. nuclear force structure should be focused on maintaining a secure second-strike capability. This focus would be reflected in the size, composition, and attributes of its nuclear forces, and their interactions with other nonnuclear, but strategic, capabilities.

In the absence of major progress toward the global elimination of nuclear weapons or additional bilateral arms control agreements with Russia that sharply reduces the size of both nations' nuclear forces, the United States should maintain a strategic nuclear triad of ICBMs, submarines, and bombers.

FORCES

In the 2020–2030 time frame, the United States should reduce its arsenal to roughly 1,000 deployed nuclear warheads, as counted under the rules of the New Start agreement, or to the size of the largest nuclear arsenal in the world, whichever is smaller. An arsenal of

1,000 deployed warheads would represent an approximately one-third reduction from current deployed warhead levels, as counted by the rules of New Start. A force of this size would be capable of inflicting massive devastation on any nation, thus constituting a more-than-minimal deterrent, leaving no doubt of the United States' ability to retaliate against a nuclear attack and continuing to provide extended deterrence for its allies. Illustratively, a 1,000-warhead force could consist of 300 ICBMs with single warheads, 10 ballistic missile submarines carrying missiles with 640 warheads, and 60 long-range bombers.

Additionally, the United States should maintain a reserve of 1,000 nondeployed warheads to hedge against the degradation of operational warheads and the possibility of a nuclear crisis. While the United States should not reduce its forces below 1,000 deployed and 1,000 reserve warheads unilaterally, it should seek whenever possible to make further reductions through arms control treaties, with the ultimate goal of the global elimination of nuclear weapons.

IMPORTANCE OF THE TRIAD

The United States should seek to maintain the nuclear triad for as long as possible, even if agreements cause deployed forces to be reduced below 1,000 warheads, as each component provides unique attributes to the overall U.S. nuclear deterrent.

ICBMs provide reliability, as they are based on tried-and-true technology and, unlike bombers that can be shot down, are extremely difficult to intercept. The wide geographical dispersion of ICBM silos and the fact that they are each equipped with one warhead also means that destroying one launcher in the event of a nuclear exchange would require at least one warhead. (In fact, as no missile can be expected to perform perfectly at all times, multiple warheads would probably be targeted against each silo.) This calculus strengthens the deterrence dynamic by casting into doubt an enemy's ability to preemptively destroy the U.S. ICBM force without utilizing a large portion of its own forces. Through 2050, the U.S. ICBM component should be composed of existing Minuteman III missiles, their components updated as needed with service-life extension programs or replacement parts, as this is the lowest-cost option. Reduction of the force from the current 400 to 300 would also provide replacement parts and test missiles during this period.

Bombers offer flexibility. Unlike ICBMs and SLBMs that cannot be recalled once launched, bombers can be launched toward their target in a nuclear crisis and maintained near, but outside enemy air defenses, while political leaders sought to end the crisis without a nuclear strike. The bombers could be recalled should there prove to be a diplomatic solution or if the initial crisis was based on error, such as an erroneous interpretation of radar data. B-2s will remain the mainstay of the bomber fleet. If advances in Russian or Chinese air defenses raise doubts about the B-2s' ability to penetrate to its targets, it should be equipped with a new, nuclear-capable cruise missile. B-52s, while aging, offer volume in the delivery of nuclear weapons. A new nuclear-capable cruise missile will be necessary to ensure the B-52s' continuing effectiveness. The LRS-B next-generation bomber should be

designed so that it could be made nuclear capable, but it should not be so equipped unless serious doubts are raised about the continuing capabilities of the B-2s and B-52s.

Submarines offer survivability when at sea. Whereas airfields and missile silos are stationary and easy to locate and target, deployed submarines are extremely difficult to track reliably. This enhances the nuclear deterrent by reducing the enemy's confidence in its ability to avoid a retaliatory strike. A force of 10 *Ohio*-class and *Ohio*-replacement submarines, two below currently planned levels, should be sufficient. A reduced fleet of ballistic missile submarines would be proportionate to reductions in the overall nuclear force. A slightly reduced fleet would also hedge against the possibility of overinvesting in the sea-based leg of the triad in the unlikely event that new technological developments fundamentally diminished submarines' ability to operate undetected. Reducing the purchase of *Ohio*-replacement submarines, which are very expensive platforms, also would ease long-term pressures on the navy's shipbuilding budget.

Proponents of current *Ohio*-replacement building plans argue that a fleet of 12 submarines is the minimum necessary to meet (classified) nuclear coverage requirements. These requirements should be revised downward, however, as the value of ballistic missile submarines lies more in their ability to survive a nuclear first strike than in their ability to retaliate immediately. So long as the submarines remain survivable, it is unnecessary to maintain a nuclear submarine fleet that is capable of holding all nuclear-armed adversaries at risk at any given time; some transit delay before a retaliatory strike would be acceptable.

TACTICAL NUCLEAR WEAPONS

The United States should not modernize its tactical nuclear weapons, permitting them to be phased out at the end of their current lifetimes in the mid-2020s. The role currently presumed to be played by these weapons can be played by U.S. strategic nuclear forces. Tactical nuclear forces offer no operational or strategic advantage as compared with either strategic nuclear forces or conventional forces, while generating additional costs for modernization and maintenance, and training/certification of flight crews and aircraft. Implementing this recommendation means canceling plans to extend the lifetimes of tactical versions of the B61 bomb and canceling the planned development of a nuclear delivery capability for the F-35.

Most importantly, reductions in the size of the U.S. strategic nuclear forces and the phasing out of tactical nuclear weapons will facilitate the allocation of resources necessary to maintain U.S. conventional military superiority.

OTHER STRATEGIC TECHNOLOGIES

While the United States should continue to invest in other technologies with potential strategic implications, such as cyber warfare, electronic warfare, and conventional global strike, these technologies do not supplant the need to maintain a nuclear deterrent as long as other states maintain nuclear arsenals.

Although cyber warfare and electronic warfare will likely play an increasingly integral role in future conflicts, the United States should distinguish between cyber war and nuclear war. If a cyber attack on the United States does not involve nuclear weapons, the United States should not respond with nuclear weapons even if the cyber attack is on U.S. nuclear command and control. Rather, the threat of a punitive response using conventional means would provide deterrent enough. To preserve confidence in nuclear second-strike capabilities essential for mutually assured destruction, the United States should state a policy of not launching cyber or electronic attacks on other states' nuclear command and control or targeting capabilities.

The United States should continue investing in conventional global strike systems, including research into hypersonic weapons, as they promise enhanced tactical options for conventional responses to attacks, crises, or provocations. As missile defense systems are likely to remain limited in their ability to defeat an attack by any sizeable ballistic missile arsenal, there is no need to develop nuclear-capable hypersonic weapons.

The United States should ardently pursue missile defense technologies at both the theater and national levels. As technology permits, the United States should deploy theater missile defenses in or near allied nations that can protect against, or at least limit the damage from, attacks by small nuclear forces. The United States should continue to develop incremental improvements to existing theater missile defense systems, such as the Terminal High Altitude Area Defense (THAAD) and SM-3 systems. Investment should be continued in potentially breakthrough missile defense technology, such as laser technology, that potentially could reverse the existing cost imbalance between offensive and defensive capabilities.

The United States should also pursue a robust R&D program for national missile defense but stop short of fielding additional continental-based systems until new technologies prove to be effective. The United States should freeze the Ground-Based Missile Defense program and redirect funding to R&D efforts. The United States should not field additional or replacement interceptors at existing West Coast sites, and certainly not develop a new site on the East Coast, until developmental versions of the interceptors achieve consistent success under real-world conditions, including the ability to distinguish incoming warheads from debris or chaff or decoys.

The United States should maintain a stockpile maintenance program to ensure that U.S. nuclear weapons are safe, effective, and reliable, and a nuclear infrastructure of sufficient capability to repair or, if necessary, replace warheads and delivery systems as required. Although the aging of existing warheads may at some point require the fabrication of new warheads, any new warheads should be designed following an extremely conservative approach that provides higher margins for error without adding new capabilities to existing designs.

A conservative design approach not only would send a strong message about the disutility of these weapons but also provides a high degree of confidence in warheads' reliability

without resuming nuclear testing. Since nuclear weapons should be used only as a strategic deterrent with an extremely high threshold for use, any new or overhauled warheads should be relatively high-yield warheads, like those now deployed on Trident and Minuteman missiles. Bomber weapons might be designed with variable yields so that they could be used in response to the use of tactical weapons on battlefields without excessive collateral damage. Other design features that might present hope of making nuclear weapons more “usable,” such as extremely low yields, electromagnetic pulse, or neutron bomb designs, should not be incorporated as they would present the appearance that the United States shares others’ claim that limited nuclear wars could be fought without catastrophic consequences. (Although variable yields on bomber weapons can be seen as an exception to this rule, the lowest available yield on existing weapons is still beyond what might possibly be considered appropriate for nuclear war fighting.)

The United States should maintain effective warning and command and control systems, including space-based systems that are protected against disruption by cyber or electronic warfare or by physical interception. This goal can be furthered by investing in hardening, redundancy, and defensive measures, as well as by developing lower-cost space launch capabilities, provided by several launcher manufacturers, to make possible the rapid replacement of disabled satellites.

The United States should invest R&D funds in methods to protect command and control systems, especially satellite systems, from physical attack, as demonstrated by China’s shoot-down of one of its own satellites, and electronic disruption, as might result from the use of an EMP weapon. Hardening, however, cannot be expected to prevent any and all disruptions, and hardened systems should be developed and fielded with a high sensitivity to cost-effectiveness.

Redundancy applies not only within warning and C2 systems but also across systems. The United States should ensure that any given system, such as communications or Global Positioning System (GPS) satellites, are redundant enough (i.e., numerous enough) that the system as a whole can still function even if a significant fraction of those satellites are destroyed or otherwise incapacitated. At the same time, command and control and targeting capabilities must be layered across different systems to ensure that nuclear second-strike capabilities cannot be severely degraded or eliminated by the failure of any one given system. For example, satellite communications should be layered with ground-based radio and telephone communications and potentially even physical courier systems, all supported by appropriate command and control protocols, while ensuring that all nuclear systems continue to incorporate secondary inertial navigation systems.

Finally, the United States should invest R&D funds in the creation of active defensive capabilities for satellites critical to nuclear command and control, while shifting the emphasis of cyber warfare programs toward developing more robust defenses against cyber attacks. Defensive measures for key satellites might include the ability to maneuver, deploy decoys, and potentially even employ limited missile defenses. These missile defenses

would only be designed to be capable of intercepting missiles targeted at the satellite and might include hit-to-kill and, in a more distant time frame, laser-based systems.

The force size, composition, and attributes outlined here set out a force designed solely as a secure, second-strike capability. Without degrading U.S. nuclear deterrence, such a force would refocus U.S. nuclear posture and better achieve U.S. interests.

Together with the other two prongs of U.S. nuclear policy—a more narrow nuclear doctrine and pursuit of a verifiable disarmament regime—the force posture described in this section would sustain a credible U.S. nuclear deterrent, but acknowledges the limited utility of nuclear weapons in all other military applications.

CONTINGENCIES

The nuclear policies and forces described in this paper presume that only evolutionary changes take place in relevant technologies, world politics, and the conventional military balance.

TECHNOLOGICAL CHANGES

Two conceivable, if unlikely, technological developments could cause substantial changes in the policies and forces recommended in this paper.

1. *Development of cost-effective missile defenses.* A cost-effective missile defense system would be one in which it is cheaper to deploy increments of defensive capabilities than it is to acquire increments of offensive capabilities to offset the increase in defensive capability. One such possibility would be the development of a kinetic or laser system deployed on satellites that could destroy missiles in their boost-phase. Such a capability also presumes a self-defense capability for the satellites against kinetic, electronic, and cyber threats, as well as the acquisition of cheap satellite launch capabilities that would permit the rapid replacement of satellites at the end of their orbital lives and steps to expand the network if additional offensive missiles were deployed.

If a potential adversary acquired such a capability and the United States did not, the United States could no longer depend on nuclear retaliatory capabilities to deter nuclear attacks on its allies, or on itself, and the choices facing the nation would be grim. One possibility would be to withdraw from involvement in the affairs of other nations, returning to the isolationist policies of the 1920s and 1930s, and attempt to reach political accommodation with the adversary—not a happy prospect. On the other hand, if the United States developed such a capability and it was not in the hands of an adversary, the United States would be well-positioned to push hard for its goal of eliminating nuclear weapons from all nations. As their nuclear arsenals could no longer be used to threaten massive destruction, but the United States would retain such a destructive capability, Russia and China—and other nuclear powers—might well see it in their interest to negotiate a nuclear disarmament pact.

Some might argue for capitalizing on this monopoly to push for other U.S. policy goals, relying on an extreme version of nuclear coercion. As described in the earlier coercion section, military coercion—even short of nuclear weapons—has limited viability in achieving U.S. policy goals. Nuclear coercion has a historical antecedent: the period of U.S. monopoly of nuclear weapons following World War II. Soviet behavior, however, in that time period does not augur well for the effectiveness of nuclear coercion. Better to focus on the distinct policy goal—abolition of nuclear weapons—that can be tied directly to their use.

If a cost-effective defensive capability were available both to the United States and to one or more adversaries, the situation would be more complicated. One of two things might happen.

If political relationships were tense and conflicts unresolved, the great powers no doubt would expend considerable resources seeking to overcome one another's defenses while retaining their own, leading to massive investments in offensive and defensive forces, unstable relationships, and a high risk of misunderstandings and even nuclear exchanges. If, on the other hand, political relations were relatively peaceful, the availability of cost-effective missile defenses to the United States and adversaries would facilitate nuclear disarmament as the great powers would be confident that they could defend themselves against any state that sought to cheat or break out of the nuclear disarmament regime. This would be the fulfillment of Ronald Reagan's vision. Obviously, U.S. policy should push for the latter outcome.

2. *Development of effective antisubmarine weapons.* Equally implausible, but similarly consequential in its effects, would be the development of capabilities to find and destroy submarines carrying nuclear-armed missiles with a high degree of confidence. In the 1980s, for example, some claimed that the Soviet Union had developed satellites that could detect anomalies in the earth's magnetic field caused by the movement of submarines through the ocean and target the submarines effectively with ballistic missiles—a claim that had no basis in fact. Currently, some believe that in the future an adversary could deploy large numbers of unmanned sensors near U.S. submarine bases to detect when a submarine had deployed and then either track it somehow or attack it immediately with some kind of long-range weapon. Indeed, the United States, which has far-quieter nuclear-powered submarines than any other nation, and has been working intensively on antisubmarine warfare (ASW) capabilities since World War II, may have significant capabilities to locate, track, and if necessary destroy adversaries' submarines—one reason why both Russia and China put greater emphasis on mobile land-based missiles than on the submarine component of their strategic forces.

Still, if an adversary did develop effective capabilities against U.S. strategic submarines, it would have profound implications for the force posture described previously in this paper, in which the bulk of U.S. retaliatory capabilities reside in the submarine leg of the triad. Faced with such a threat, the United States would have to diversify its force posture further. It could build larger numbers of

long-range bombers equipped with cruise missiles, disperse them to more air fields, and keep them on a high alert level, as was done during the Cold War. It could revisit ideas for deploying mobile ICBMs in the United States and develop and deploy such a system. It could replace the *Ohio*-class strategic submarine with much smaller submarines carrying fewer missiles and procure them in larger numbers. All of these options would be expensive and would divert resources from maintaining U.S. conventional superiority unless the nation was willing to increase the resources it devotes to defense significantly.

However, if the United States chooses to offset the ASW threat, assuming it was able to maintain its edge in conventional military capabilities despite the greater resources required for nuclear forces, it could retain the policy of confining the role of nuclear weapons to deterring nuclear attacks on itself and its allies.

GEOPOLITICAL CHANGES

The actual use of nuclear weapons could have major effects on the United States and other nations' nuclear postures, depending on the size of the exchange and its outcome. Beyond that, although hard to imagine, it is conceivable that there could be major realignments in international relationships over the next 35 years, just as the past 35 witnessed the fall of the "Iron Curtain" and the emergence of China as a global economic and political power. In this section we explore some of these possibilities and their effects on the U.S. nuclear posture.

1. *Use of nuclear weapons.* The consequences of the breaking of the nuclear taboo would depend on the size of the exchange and its results. Some of the possibilities are described below:
 - *Major U.S./Russia exchange.* If a U.S.-Russian war began for whatever reason and escalated to a nuclear exchange between the two states, civilization as we know it would no longer exist, at least in the northern hemisphere. It is difficult to envision stopping a nuclear exchange in the chaos that would be unleashed once one had begun. In that scenario, given that the two nations' nuclear arsenals have such destructive power, the questions addressed in this paper would be irrelevant.
 - *Battlefield use of nuclear weapons by Russia or China.* If a military conflict developed in Europe or East Asia in which an adversary attacked a U.S. ally and, for whatever reason, used nuclear weapons in the battle space, the consequences would depend on the U.S. response and its results. If only one or two weapons were used, as a sort of warning, the United States could choose to refrain from responding in kind, continuing to press its advantage in conventional warfare, while warning that another nuclear use would be met with a nuclear response. If the adversary relented and negotiated an end to the conflict, the benefits of U.S. conventional superiority would have been validated and the U.S. nuclear posture advocated in this paper would have been affirmed. If the adversary persisted

with additional nuclear strikes, the United States would have to respond with long-range nuclear forces against military targets in the battle space. At that point, the enemy would either relent or continue to escalate. The latter would likely lead to an all-out exchange and the results noted above. The former would validate the nuclear posture advocated in this paper. If the United States did not respond with a nuclear strike, it would have to concede the conflict and its unwillingness to risk nuclear war in fulfillment of its commitments to the ally under attack. This would lead to an unraveling of the U.S. alliance system and the consequences addressed below.

If Russia or China used nuclear weapons in a conflict between the two, the exchange would either escalate, leaving both nations devastated and U.S. global superiority even more firmly entrenched, or an unanswered attack may cause one of the belligerents to sue for peace. Such an outcome may very well be the most dangerous precedent. However, the United States—if it or its allies were subject to a limited nuclear strike—could still respond as described above achieving a world less inclined toward nuclear use.

- *Use of nuclear weapons by third nations against populated areas.* One could imagine an India-Pakistan war escalating to nuclear use against cities. For example, if India were winning a conventional war, Pakistan might resort to such use in an effort to compel an end to the conflict before its total defeat. India might or might not then retaliate against Pakistani cities. In any event, there would be massive losses of lives. If Pakistan were perceived to have saved itself by its nuclear use, it likely would motivate other nations to seek to acquire nuclear weapons. The United States would then face a more highly proliferated world with the consequences for its nuclear posture described below. If, on the other hand, Pakistan was defeated despite its nuclear use, and the world was repulsed by the massive losses of lives, it could stimulate movement toward nuclear disarmament, which is the goal of the policy advocated in this paper.

3. *Dissolution of the U.S. Alliance System.* Throughout the postwar period, questions have been raised in countries allied with the United States about the credibility of U.S. commitments to their defense. The severity of this questioning rises and falls with world events and the responses of U.S. administrations to them, but it is rarely absent altogether, even though the United States has maintained these commitments for nearly 70 years, stationed military forces far from U.S. borders in support of them throughout this period, and the United States spends a far larger share of its national resources on the armed forces than any of these allies. Moreover, the United States has confronted challenges to its alliance partners in many crises over the years, confrontations that sometimes have resulted in the loss of American lives.

Still, it is conceivable that individual nations or the whole alliance network could choose, one day, to reach accommodation with nations that threaten them and choose a path independent of U.S. security guarantees. Such actions certainly could result from the United States backing down during a confrontation after an initial

series of exchanges, as in the battlefield nuclear use scenario described previously. While the wholesale desertion of U.S. allies would clearly be a grave blow to U.S. interests and values, its impact on nuclear policy would be beneficial. Persuading adversaries that an attack on the United States itself would result in a devastating nuclear retaliation is far easier than assuring allies, and persuading adversaries, that an attack on an ally would result in nuclear retaliation—given the risks this course of action would raise for the United States. Hence, this contingency would not necessitate a change in the U.S. nuclear posture advocated in this paper. If anything, it might make possible further reductions in U.S. nuclear forces.

4. *Resolution of fundamental conflicts between Russia and its neighbors and China and its neighbors.* As far as nuclear policy is concerned, the uncertainties concerning the basic relationship between Russia and Europe and China and its neighbors in East and South Asia are the basic drivers. The conflicts in the Middle East are irrelevant as far as nuclear policy is concerned. In both cases, the adversaries currently seem determined to play a larger role in their regions, and are pursuing aggressive policies toward this end that are creating political tensions, military incidents, and in the Russian case, a war in the Ukraine. It is conceivable, however, that over time, political leaders in these current adversaries will see it in their nations' interest to reach accommodations with their neighbors and to develop closer political and economic relations. In this contingency, it should then be possible to make more rapid progress toward the goal of the nuclear posture advocated in this paper—establishment of a regime to eliminate nuclear weapons from all nations.

CONVENTIONAL MILITARY BALANCE

The nuclear posture presented here is dependent on U.S. conventional military superiority; it is dependent on the notion that the United States is not a weak state, as is every other state currently, including Russia and China, and so does not need to rely on weak-state tactics. Though U.S. conventional military superiority, as described here, is likely very robust, with the United States having the economic strength necessary to maintain that superiority, it is plausible U.S. conventional superiority could erode. For this superiority to erode, however, an adversary would have to achieve both the quality and the scale the United States enjoys. Isolated examples of quality are not enough to upset the conventional superiority. Neither is significant scale at dramatically lower quality. The following are potential signals that an adversary might be achieving both attributes:

- Defense spending on par—at market rates—of the United States for a minimum of five years. The United States enjoys a significant lead. Some of that lead might be cut by capitalizing on second-mover advantages: relying on the United States for doing the basic development and just incurring production costs.
- Successful fielding of asymmetric capabilities reasonably resistant to countermeasures. This countermeasures resistance requires surviving U.S. adaption; simply holding U.S. forces “at risk” would not prevent the United States from risking its

resources to achieve critical U.S. policy objectives, as the U.S. military did when it lost the previously unknown stealth helicopter in order to successfully stage the raid on the bin Laden compound in Abbottabad.

Even in these two cases, the nuclear posture here would not all fall away. These two cases would undermine U.S. conventional coercive ability. But, as already noted, coercion is already a limited military capability.

The most significant change would come if an adversary could mount a credible threat to attack the United States or an ally and survive a counterattack involving all U.S. resources short of full national mobilization. Such a change may require rethinking the no first use of nuclear weapons doctrine advocated in this paper, as the United States may need to rely on nuclear weapons to resist attack.

Assurance is a more complicated case. If not just adversaries, but allies began to better arm themselves, and then the allies defected to adversaries, the conventional balance could swing more dramatically. However, this is an extremely unlikely case.

Even under this far-fetched contingency, the U.S. nuclear posture could remain as described in this paper, with the possible exception of adding a threat to initiate use of nuclear weapons if a conventional attack was launched on the United States or its allies.

Conclusion

Nuclear weapons do not achieve U.S. policy objectives, dominant conventional forces do. The U.S. interest lies in seeking to minimize the importance accorded to nuclear weapons by narrowing the roles they are perceived to play. U.S. doctrine, policy, forces, and diplomacy should all be configured to support this interest. The posture described in this paper achieves just that, in contrast to postures that imagine uses of nuclear weapons that have never actually been demonstrated. After 70 years of indulging fantasies of what nuclear weapons can do, it is high time to acknowledge that they do very little and adapt U.S. nuclear policy, strategy, and forces to those facts.

Appendix D. A Nuclear Strategy and Posture for 2030

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Introduction²

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 NPRs of the post–Cold War era and, before that, in U.S. nuclear policy during the latter stages of the Cold War.³ 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

1. Team members contributed to Project Atom discussions and the development of CNAS thinking but the contents of the CNAS Strategy and Posture document are solely the responsibility of the author/team lead.

2. Thanks to Clark Murdock, Sam Brannen, Angela Weaver, the participants in the CSIS Project Atom initiative, Drew Walter, Jeffrey Lewis, and Linton Brooks for their comments.

3. For official sources on post–Cold War NPRs, see U.S. Department of Defense Office of Assistant Secretary of Defense for Public Affairs, “DoD Review Recommends Reduction in Nuclear Force,” September 22, 1994; Assistant Secretary of Defense for International Security Policy J. D. Crouch, “Special Briefing on the Nuclear Posture Review,” January 9, 2002, <http://www.defense.gov/transcripts/transcript.aspx?transcriptid=1108>; U.S. Department of Defense (DoD), *Nuclear Posture Review: Implementation Plan* (Washington, DC: DoD, February 2003), http://www.dod.mil/pubs/foi/operation_and_plans/NuclearChemicalBiologicalMatters/Nuclear_Posture_Review_Implementation_Plan_Feb2003.pdf; and U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, DC: DoD, April 2010), <http://www.defense.gov/npr/docs/2010%20Nuclear%20Posture%20Review%20Report.pdf>. For secondary sources on the matter, see Michael R. Boldrick, “The Nuclear Posture Review: Liabilities and Risks,” *Parameters* (Winter 1995/96), <http://strategicstudiesinstitute.army.mil/pubs/parameters/Articles/1995/1995%20boldrick.pdf>; Amy F. Woolf, *The Nuclear Posture Review: Overview and Emerging Issues* (Washington, DC: Congressional Research Service, January 31, 2002); Harald Müller and Annette Schaper, “US Nuclear Policy After the Cold War,” PRIF Report no. 69, Peace Research Institute Frankfurt, 2004; and Keith B. Payne, “The Nuclear Posture Review: Setting the Record Straight,” *Washington Quarterly* 28, no. 3 (2005): 133–51. For Cold War continuity, see Elbridge Colby, “The United States and Discriminate Nuclear Options in the Cold War,” in *On Limited Nuclear War in the 21st Century*, ed. Jeffrey A. Larsen and Kerry M. Kartchner (Stanford, CA: Stanford Security Studies, 2014), 49–79.

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.⁴ 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.⁵ 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.

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.⁶ Rather, a growing number of countries are exploiting the opportunities provided by advanced technologies to improve the potency, reach, and

4. 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.

5. For an exploration of the plausible trajectories for this kind of future see, for instance, National Intelligence Council (NIC), *Global Trends 2030: Alternative Worlds* (Washington, DC: NIC, 2012).

6. On the Revolution in Military Affairs, see Andrew Krepinevich, *The Military-Technical Revolution: A Preliminary Assessment* (Washington, DC: Center for Strategic and Budgetary Assessments, 2002); and, more

flexibility of their military forces.⁷ 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.⁸ 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.⁹ 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.¹⁰

recently, Barry D. Watts, *The Maturing Revolution in Military Affairs* (Washington, DC: Center for Strategic and Budgetary Assessments, 2011).

7. Chuck Hagel, “‘Defense Innovation Days’ Opening Keynote” (Newport, RI, September 3, 2014), <http://www.defense.gov/Speeches/Speech.aspx?SpeechID=1877>.

8. 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.

9. 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*.

10. 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

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.¹¹ 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 to revitalize and adapt U.S. nuclear forces begun in recent years.¹² 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.¹³

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.¹⁴ 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.¹⁵ 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.

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).

11. For the 2010 legislative mandate, see 110th Congress, Public Law 110-181, Sec. 1070.

12. For an outline of this ongoing effort, see Frank Kendall, "Air Force Association 2014 Conference and Exposition" (speech, National Harbor, MD, September 17, 2014), <http://www.defense.gov/Speeches/Speech.aspx?SpeechID=1884>.

13. U.S. Department of Defense, *Nuclear Posture Review Report* (2010).

14. *Ibid.*, 15–17.

15. 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.

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.¹⁶

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.¹⁷

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.¹⁸ Furthermore, nuclear weapons have become or are likely to become more salient in the strategies and military postures of Russia, China, and North Korea.¹⁹ 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.

16. 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.

17. 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.

18. 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 Krepinevich, "The Pentagon's Wasting Assets," *Foreign Affairs* (July/August 2009).

19. Former deputy assistant secretary of defense Brad Roberts has been drawing particular attention to this crucial dynamic and explores this issue extensively in his forthcoming book on the proper role of U.S. nuclear weapons in the contemporary environment. See Brad Roberts, *The Case for U.S. Nuclear Weapons in the 21st Century* (Stanford, CA: Stanford University Press, forthcoming).

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 nonnuclear 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.²⁰

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

20. 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>.

material advantages the PRC might attain in the conventional military balance in maritime Asia.²¹

Given existing trends, it is likely that North Korea 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.²² 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.²³ 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

21. 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>.

22. See, for instance, Patrick M. Cronin, *If Deterrence Fails: Rethinking Conflict in the Korean Peninsula* (Washington, DC: 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>.

23. For statements of this classic set of criteria, see the expression of the Western Alliance's “Flexible Response” doctrine, North Atlantic Treaty Organization, NATO MC 14/3, 10–11. For a more refined elaboration of these ideas, see Tanya Ogilvie-White, *On Nuclear Deterrence: The Correspondence of Sir Michael Quinlan* (London: International Institute of Strategic Studies, 2011), part I.

most guarded facilities, such as underground leadership redoubts, to ensure it did not think there were sanctuaries from U.S. reprisal.²⁴

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 stressful 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.²⁵ 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. 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.²⁶ 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).²⁷

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.²⁸ 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

24. This has been an important goal of U.S. nuclear policy at least since the 1970s. For the author's discussion, see Colby, "The United States and Discriminate Nuclear Options in the Cold War," 61.

25. 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.

26. This is in line with the aspiration of the most recent Quadrennial Defense Review to posture the United States appropriately to prevent U.S. adversaries from escalating their way out of conventional defeat. See U.S. Department of Defense, *Quadrennial Defense Review 2014* (Washington, DC: DoD, 2014), 13, http://www.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf.

27. 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).

28. 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).

the presumed precursor for such use, and demonstrate a willingness to end the conflict on mutually satisfactory terms.²⁹

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 U.S. and 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

29. For the author's further elaboration of this logic, see Elbridge Colby, "Defining Strategic Stability: Reconciling Stability and Deterrence," in *Strategic Stability: Contending Interpretations*, ed. Elbridge A. Colby and Michael S. Gerson (Carlisle, PA: Strategic Studies Institute, February 2013), 47–84.

deterrence and assurance, including through mechanisms enabling greater allied participation in the U.S. nuclear deterrent posture.³⁰

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.³¹

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.³² 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

30. See, for instance, Christopher Ford, “Perilous Precedents: Proliferation as Policy in Alternative Nuclear Futures” (paper presented at conference sponsored by the CSIS Project on Nuclear Issues, Los Alamos National Laboratory, NM, June 28, 2012), <http://www.newparadigmsforum.com/NPFtestsite/?p=1343>.

31. For further elaboration of this point, see Elbridge Colby, “Choose Geopolitics over Nonproliferation,” *National Interest*, February 28, 2014, <http://nationalinterest.org/commentary/choose-geopolitics-over-nonproliferation-9969>.

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

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.

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.³³

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 and escalation management in the event of conflict with

33. 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.

Russia and China, which possess 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 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.³⁴ Achieving this in an increasingly perilous and competitive C4ISR environment entails exploring 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.³⁵ 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.

34. For an overview of the U.S. nuclear command and control system and its crucial importance, see U.S. Department of Defense, *The Nuclear Matters Handbook*, expanded ed. (Washington, DC: DoD, 2011), chap. 4, http://www.acq.osd.mil/ncbdp/nm/nm_book_5_11/docs/NMHB2011.pdf.

35. I am grateful to Paul Scharre for this suggestion. For an assessment of such threats, see Defense Science Board, *Task Force Report: Resilient Military Systems and the Advanced Cyber Threat* (Washington, DC: DoD, January 2013), <http://www.acq.osd.mil/dsb/reports/ResilientMilitarySystems.CyberThreat.pdf>. See also the congressional testimony of General Robert Kehler, commander of STRATCOM, “Hearing to Receive Testimony on U.S. Strategic Command and U.S. Cyber Command in Review of the Defense Authorization Request for Fiscal Year 2014 and the Future Years Defense Program,” statement to the Senate Armed Services Committee, March 12, 2013, 10, <http://www.armed-services.senate.gov/imo/media/doc/13-09%20-%2013-12-13.pdf>.

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., 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 long-term viability of stealth and other methods of ensuring penetration.³⁶ 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.³⁷

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 straightforward 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.³⁸

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:

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

37. For the author's more developed argument for the LRSO, see Elbridge Colby, "A New Nuclear Air-Launched Cruise Missile," *War on the Rocks*, November 22, 2013, http://warontherocks.com/2013/11/a-new-nuclear-air-launched-cruise-missile/#_.

38. For the author's more developed arguments for such capabilities, see Elbridge Colby, "Why We Should Study Developing Nuclear Penetrators—and 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.

- 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.³⁹
- 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.⁴⁰

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

- Maintain a Triad of SSBNs, ICBMs, and nuclear-armed bombers.⁴¹
 - *Submarines.* The United States should fully fund the *Ohio* ballistic missile submarine replacement program, with a particular emphasis on maintaining the

39. 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.

40. 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* (Washington, DC: CSIS, March 2013), http://csis.org/files/publication/130307_Colby_USChinaNuclear_Web.pdf.

41. 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=mwNkd1ZSFf4>.

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 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.⁴²
 - 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.
 - *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

42. 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.

effective standoff 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.
- 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.⁴³ 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.

43. 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* (Washington, DC: Center for a New American Security, January 2014), http://www.cnas.org/sites/default/files/publications-pdf/CNAS_20YY_WorkBrimley.pdf.

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.⁴⁴

44. 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>.

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 criteria, but the force as a whole should satisfy the following criteria, which can be usefully used to measure the utility, appropriateness, and other relevant qualities the U.S. nuclear force should exhibit:⁴⁵

- *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.

45. These criteria are drawn from Elbridge Colby et al., *Strengthening U.S. Extended Nuclear Deterrence in the Western Pacific Beyond 2025* (Alexandria, VA: CNA, 2012), 148–50.

- *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 opera-

tional 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 defensive capabilities' ability 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 at 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 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 to do so, 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.

Appendix E. An Adaptable Nuclear Force for the 2030+ Security Environment

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Introduction¹

- The projected 2030+ security environment developed by CSIS features myriad challenges for the United States and its allies. In comparison to the Cold War era, there are great uncertainties in the contemporary security environment and its direction, as correspondingly there must be in the prioritization of pertinent U.S. goals within that environment.
 - The nuclear force should be: (a) structured to address whatever challenges and priorities exist at the time; and (b) adaptable to respond in a timely manner to both rapid and evolutionary changes, and to possible strategic surprises.
- For a highly dynamic threat environment, the nuclear force, in combination with other U.S. capabilities, will be needed to serve multiple priority national policy goals. The requirements to support those goals and the relative priority of these goals may shift depending on the context.
 - To serve those goals most effectively in a dynamic environment, the force must be *able to adapt in a timely manner* to changes in priorities and in the security environment. Adverse changes may be the result of developments initiated by:
 - adversaries, including those that are not content with the status quo as well as those motivated to negate U.S. influence or attack the United States and/or allies;
 - others that take steps to fill perceived capability gaps needed for security (e.g., a cascade of nuclear proliferation triggered by a new nuclear-weapons state, such as Iran);

1. The views expressed here are the authors' and do not necessarily reflect the positions of any institution with which they are affiliated. The authors would also like to thank Matthew Costlow for his valuable assistance in the preparation of this paper.

- employment of new technologies and operational tactics by adversaries, allies, and others; and
 - adverse trends in U.S. capabilities and technologies.
- The theme of the position presented here is that the U.S. nuclear force posture and planning needs to be adaptable *precisely because the threat environment, including technological and/or geopolitical developments, is highly dynamic*. This important principle is well recognized in some quarters. General Robert Kehler, former commander of U.S. Strategic Command has observed, “Surprise is a problem in a constantly changing world environment. In my view, the future requires adaptive and flexible capabilities to respond to unanticipated threats.”² Similarly, another former commander of U.S. STRATCOM, General Kevin Chilton, has observed, “We should always begin with a clear-eyed examination of the geopolitical reality of the day and even more importantly, the geopolitical uncertainty of the future . . . with hedges for our documented inability to precisely predict the future.”³
 - Contemporary developments in the threat environment and its apparent directions provide ample basis for the United States to prioritize force adaptability. These include:
 - Russia’s manifest willingness to overturn violently the post-Cold War territorial boundaries; explicit nuclear threats; robust nuclear weapons programs; reported developments of offensive and defensive forces, including new types of strategic weapons; and the continued lack of Russian reliability with regard to treaty compliance.
 - The lack of transparency into nuclear developments by Russia and China, but particularly China, which pursues opacity as a policy.
 - The explicit nuclear threats to the United States and its allies posed by North Korean and prospectively Iranian nuclear capabilities.
 - *Fundamentally different approaches may be deemed necessary on challenging time lines to support U.S. priority goals in the face of these and other potential threats, including surprising developments*. Enduring U.S. goals include deterrence, extended deterrence, assurance, nonproliferation, and in the event deterrence fails, escalation control and damage limitation. The U.S. nuclear force posture and associated planning needs to be responsive to the possibility that profound technological and/or geopolitical changes could quickly create new and different requirements to support these goals.
 - Identifying adaptability as a primary metric of the adequacy of the U.S. force posture contrasts with the frequent practice of focusing first on a preferred number of

2. See General Kehler’s response to “Advance Questions for General C. Robert Kehler, USAF, Nominee for Commander, United States Strategic Command,” House Committee on Armed Service, Subcommittee on Strategic Forces, March 2, 2011, 9.

3. Kevin P. Chilton, “‘Challenges to Nuclear Deterrence’ Air & Space Conference” (speech, U.S. Strategic Command, Washington, DC, September 13, 2010), http://www.stratcom.mil/speeches/2010/50/Challenges_to_Nuclear_Deterrence_Air_Space_Conference/.

launchers, warheads, equivalent mega-tonnage, or type/level of damage expectancy as the primary metric of force posture adequacy. The quantity and diversity of nuclear platforms and weapons in the U.S. arsenal can be a pertinent measure of adequacy to support U.S. goals; in particular, such qualities can be a contributing factor to the adaptability of a force posture. However, whatever quantity of weapons and launchers is deemed adequate for a specified purpose at a given time, the force posture must be adaptable to meet the diverse and shifting adequacy requirements that will be shaped by the diverse set of U.S. goals in a dynamic threat environment. *Adaptability is a metric that transcends traditional quantitative measures of adequacy and is the focus of the recommendations contained in this report.*

Strategy: Policy Goals Served by the Nuclear Force

For the postulated 2030+ security environment, a flexible and resilient nuclear force will be essential to support U.S. policy goals, including deterrence, assurance, escalation control and damage limitation, and nuclear nonproliferation. To support these policy goals, the United States and its allies will rely on the integration of capabilities that can generate strategic effect. These capabilities include offensive weapons (nuclear and nonnuclear), defenses, cyber, and space control. By exercising prudent leadership and displaying its preeminent military capabilities, the United States can be a trusted leader for key alliances and throughout the world. This paper focuses primarily on future nuclear capabilities, but also identifies some potential benefits from the integration of a broad range of strategic capabilities.

For each policy goal listed below, strategic offensive and defensive capabilities—along with other capabilities such as cyber and space control—can help serve those goals in the 2030+ environment.

- *Deterrence.* Nuclear and conventional strike capabilities can deter aggression against the United States or its allies and friends by threatening responsive strikes against assets that enemy leaders hold dear and/or the goals of their use of force. U.S. strike capabilities can threaten retaliation against an opponent's highest values and, especially when complemented with defensive capabilities, can deny adversaries' desired goals associated with offensive threats against the United States and its allies. By posing punitive retaliatory threats, and the prospective disruption of enemy attack planning, survivable offenses plus defenses can help deter an opponent from aggressive action. In a regional confrontation, defense of U.S. territory and power projection forces can bring into better balance U.S. stakes and risks, thus reinforcing the credibility of U.S. deterrent threats on behalf of allies and friends and reinforcing assurance.
- *Assurance and extended deterrence.* In the past, assurance was often conflated with extended deterrence; it should not be. These two goals are related but

separate—involving different audiences, different desired effects, and measures of U.S. force adequacy.⁴ We may deem opponents to be deterred adequately, and that allies therefore should be assured; but the allies in question may simultaneously remain less than assured. This can be because our understanding of opponents’ calculations, goals, and willingness to run risks may understandably be quite different from the fears of allies who are much closer to direct military threats (and indeed may have a more realistic understanding of the threats they face). To assure allies, U.S. commitments to the security of allies and friends can be demonstrated through a variety of measures, including the overseas deployments of certain nuclear and nonnuclear military capabilities. For a relatively large number of U.S. allies, the United States will continue to extend guarantees to deter their adversaries with the full range of U.S. capabilities.⁵ Key allies in Asia and Europe have stated explicitly that U.S. nuclear capabilities and the credibility of the U.S. extended nuclear deterrence commitment are essential to their security and assurance.

- The fielding of advanced weapons systems (offense and defense, nuclear and conventional) that manifest American preeminence in military technology, and the maintenance of a nuclear force of the first rank, can bolster the credibility of the United States for the purposes of both deterrence and assurance. For both purposes, U.S. strategic capabilities, including nuclear, should be viewed by foes and allies as “second-to-none.”
- Missile defense of allies and friends can reduce the prospective costs of being allied with the United States and thereby contribute to their assurance.
- *If deterrence fails:*
 - *Limit damage.* Nuclear forces and nonnuclear strike systems can help counter an enemy’s war-making capabilities and thus, in combination with defenses, can limit societal damage in the event of the failure of deterrence. This may be accomplished indirectly via escalation control and intra-war deterrence, or directly via active defense measures. These capabilities can offer some level of protection against attacks that cannot be deterred (i.e., for which determined, desperate, misinformed, or delusional adversaries are beyond deterrence). The prospective value of this protection will differ depending on many possible factors unique to the event. But, in general, if deterrence fails, limiting damage to U.S. and allied societies is likely to be the highest immediate priority.
 - *Control escalation and terminate conflict.* A range of nuclear yields, options, and capabilities, in combination with defenses, can support U.S. efforts for selective and controlled responses to help prevent a conflict from escalating and thus

4. As is highlighted in Keith B. Payne, *The Great American Gamble: Deterrence Theory and Practice from the Cold War to the Twenty-First Century* (Fairfax, VA: National Institute Press, 2008), 389–91, 420–23.

5. For a more complete discussion of assurance and U.S. extended deterrence commitments, see Keith Payne, Thomas Scheber, Kurt Guthe, and Mark Schneider, *Nuclear Guarantees, Extended Deterrence, and the Assurance of Allies* (Fairfax, VA: National Institute Press, 2009).

reduce damage. The combination of nonnuclear systems (offenses and defenses) and nuclear weapons can provide flexibility in the design and conduct of intra-war deterrence campaigns to demonstrate that ever more threatening U.S. responses are being withheld, but could be employed, and thereby contribute to escalation control. U.S. missile defenses can provide a response option other than offensive strikes against apparent nuclear missile threats to the United States and its allies. This defensive option may help to control conflict escalation while also contributing directly to the limitation of damage to the United States and its allies.

- *Dissuasion.* Nuclear and other forces with sufficient responsiveness can discourage potential rivals from competing militarily with the United States.
 - Infrastructure readiness and sufficient strategic force structure can be important in convincing adversaries that they could not win an extended nuclear arms race or succeed in achieving an exploitable advantage of military armament over the United States and its allies.
 - Continued advancements in nonnuclear strike capabilities can further enhance military competition in areas in which the United States already enjoys distinct advantages and adversaries are working to emulate, offset, or narrow the gap.
 - Defenses in general can make it more arduous and costly for an adversary to compete militarily or wage war with the United States. Missile defenses deemed by opponents as likely to be effective may help discourage their ballistic missile buildups.
- *Nuclear nonproliferation.* Successful assurance of allies and dissuasion of military competition can also support U.S. nuclear nonproliferation goals. Indeed, the assurance provided to allies via U.S. extended deterrence that is judged to be credible by allies has been one of, if not the, single most effective U.S. instrument of nuclear nonproliferation. The degradation of that credibility is a factor that would contribute to further nuclear proliferation.

Enhancements for the Nuclear Posture

A strategic force that is designed to serve the policy goals discussed above must be adaptable to a myriad of plausible changes in the threat environment and possible shifts in the prioritization of U.S. goals. Some changes may occur predictably over time while others may come as surprises.

ADAPTABILITY: THE COMBINATION OF FLEXIBILITY AND RESILIENCE

- Flexibility enables deliberate and adaptive planning for a variety of options to deter or to counterattack that present a grave danger to U.S. or allied security (nuclear strikes, extensive chemical or biological use, or overwhelming

conventional offensives). In addition, flexibility is enhanced by diverse capabilities and the associated nuclear command and control needed to support a broad range of deterrent threat options.⁶

- Resilience in general is the ability to withstand, recover from, or adjust to adverse change in order to mitigate risk and maintain effectiveness.
 - A 2013 Naval Studies Board (NSB) report examined options to respond to capability surprise. The study was directed at general purpose naval forces, but it is also applicable to resilience for strategic forces. The NSB recommended that future weapon delivery systems be designed to facilitate resilience “to include the capacity for quickly adding or modifying capability.” The report also stated that the force will likely “need to adapt in ways that cannot currently be envisioned.”⁷
 - For strategic forces, this suggests that planning for next-generation weapons systems should consider resilience as an important design requirement.

Force and Infrastructure Attributes⁸

The characteristic of force adaptability, emphasizing the elements of flexibility and resilience, are metaphors with real meaning. The following list identifies nuclear force attributes deemed particularly valuable for flexibility and resilience. These are the U.S. nuclear force characteristics that are key to providing a force posture that can adapt as effectively as possible to the potentially shifting strategic requirements of the contemporary, highly dynamic threat environment.

- *To provide flexibility*, the U.S. nuclear force as a whole—ICBMs, SLBMs, heavy bombers, and shorter-range nonstrategic nuclear forces (NSNF)—require certain basic attributes. These include:
 - *Survivability*. Allows forces to withstand or escape attack on their bases and to evade or overcome enemy defenses. (Survivability can contribute to both flexibility and to resilience).
 - *Intercontinental range*. Prevents targets in enemy territory that are potentially critical for deterrence from enjoying sanctuary by virtue of being out of reach.
 - *Ability to forward deploy*. Allows U.S. nuclear-capable forces to deploy to locations in or near allied countries as a forward presence that can be important to both deterrence, dissuasion, damage limitation, and assurance.

6. As defined in Keith Payne and John Foster, *Nuclear Force Adaptability for Deterrence and Assurance: A Prudent Alternative to Minimum Deterrence* (Fairfax, VA: National Institute Press, 2014), <http://www.nipp.org/wp-content/uploads/2014/12/MD-II-for-web.pdf>.

7. Committee on Capability Surprise on U.S. Naval Forces, *Responding to Capability Surprise: A Strategy for U.S. Naval Forces* (Washington, DC: National Academies Press, 2013), 3, 72–73.

8. Attributes are discussed in greater detail in Payne and Foster, *Nuclear Force Adaptability for Deterrence and Assurance*.

- *Prompt response capability.* Permits the United States to hold a variety of targets at risk with a flight time of an hour or less, which in some situations, can be important for deterrence, damage limitation, and assurance.
- *Variable payload.* Provides the ability of bombers and ballistic missiles to carry different types and numbers of weapons, making possible a better matching of U.S. deterrent threats to supporting U.S. capabilities.
- *Assorted weapon yields.* Allows the United States to hold at risk a wide range of target types for the purposes of deterring conflict or limiting its escalation in a variety of contingencies.
- *High delivery accuracy.* Provides a critical determination of whether a weapon can hold a target at risk, as well as the yield needed to do so.
- *Nuclear command and control.* Provides a robust, secure, survivable system for early warning, attack assessment, senior-leader conferencing, and force direction.
- In addition, *defenses* can complement nuclear strike capabilities to enhance flexibility and resilience by providing national leaders with prudent and possibly more benign options than offensive strike options alone during a crisis, and additional means of survivability for U.S. forces and command and control.
- Sources of *resilience* for the U.S. nuclear force include:
 - *Strength in the extant force posture.* Assures that the different elements that comprise the force structure—SSBNs, ICBMs, bombers, and nonstrategic nuclear forces—are not all vulnerable to a single type of failure or enemy attack. Peacetime deployment of SSBNs and ICBMs on alert contributes to resilience by providing insurance of a devastating response to a surprise attack. Diversity hedges against problems with the safety, security, or effectiveness of a weapon type.
 - *Adaptation within existing capabilities.* Assures that the current nuclear force could be adapted to some adverse military-technical or geopolitical changes through measures short of developing and producing new capabilities or functionally modifying existing weapon systems. For example, nondeployed warheads in the stockpile could also be uploaded on bombers and ballistic missiles in response to an increase in the offensive or defensive strength of an opponent, a stepped-up arms competition, or a confrontation that threatened to escalate to nuclear use.
 - *Modification with hardware changes.* Incorporates new technologies to existing weapon systems for surety, fuzing, guidance, penetration of defenses, or other functions.
 - *Modernization of force elements.* Involves the new development and production of new weapons with improved capabilities in response to evolving adversary capabilities. Development of nonnuclear capabilities—both offensive and defensive—can help keep the industrial base active and responsive.

Weapons and Delivery Systems

For the 2030 time frame, most of the nuclear weapons and delivery systems in the U.S. inventory will be similar to, or modifications of, those currently in service. Given that more than a decade generally is required to develop a new strategic weapon delivery system, new types of nuclear systems are unlikely to be ready for deployment by 2030 unless development is already well under way in 2014. For the United States, the only active development program for strategic forces is the *Ohio*-class replacement SSBN. At present, the first *Ohio*-class replacement SSBN is slated to begin operational deployment in 2031. It may be possible to develop and deploy a next-generation air-launched, nuclear-armed cruise missile by 2030, but the air force is currently only in the study phase for such a weapon.

Therefore, many key features of the 2030 force structure would resemble the 2014 force. To provide greater flexibility and resilience (i.e., adaptability) for the 2030+ security environment and stay within the fiscal guidelines proposed for the study, a number of enhancements to the existing force are manifest in the proposed 2030+ force.

Flexibility-related enhancements include the following:

- For survivability, the SSBN Security Program will have remained a high priority and annual funding increased. The heavy bomber force will be based at several locations and will continue to exercise alert and dispersal missions. Also, the maximum number of ICBMs (limited by the decreasing inventory of life-extended Minuteman III missiles) will be deployed. Although the New START Treaty will have expired, the overarching limits are apparently being observed.
- For various payloads and weapon yields, low-yield options for the ballistic missile legs of the triad—ICBMs and SLBMs will have been developed and certified. Relatively low-cost modifications to existing warheads such as deploying “primary only” versions of warheads, could help provide this option. Also, instead of retiring the B61-11 earth penetrating weapon (EPW), DoD should insist on a modernized nuclear EPW that could be deployed by 2030.
- For forward-deployment options, the ability to base U.S. nuclear capabilities in or near the territory of U.S. allies should be retained and enhanced.
 - In the near term, this calls for proceeding with modernization plans for the dual capable aircraft (DCA) capability, moving ahead with nuclear certification plans for the F-35A and the B61-12 life-extension program, and ensuring that the infrastructure is in place for deploying DCA and weapons from home bases.
 - By 2030, emergency deployments to Northeast Asia or the Middle East might be needed to strengthen deterrence and assurance. Advance preparations for contingency weapon storage sites will be in place and will include infrastructure, logistics, and security features that could be activated, when needed.

- Well before 2030, the United States should have in development a replacement for the B61-12 that provides additional standoff and accuracy for DCA-delivered nuclear weapons. This new weapon will carry the same nuclear warhead as the B61-12. No new warhead development or life-extension program is envisioned.
- For improved delivery accuracy, as forces are life extended and modernized, opportunities to improve accuracy further should continue to be a goal, whenever feasible. In particular, accuracy improvements should be included in planning now under way for the follow-on ICBM and long-range standoff (LRSO) missile.
- For a greater range of offensive capabilities, a diverse stockpile of nuclear warheads should be retained and U.S. conventional prompt global strike capabilities should have been deployed.
 - For some situations, increasing the diversity of explosive yields for prompt U.S. deterrent threats could strengthen deterrence by making more credible the potential of a prompt U.S. offensive response to adversary action.
 - Promising concepts (as of 2014) for nonnuclear, long-range offensive weapons include hypersonic delivery vehicles and nonnuclear payloads that could be carried by missiles based on newer *Virginia*-class attack submarines,⁹ or air-launched, long-range missiles that can be launched from heavy bombers.
- Defenses for the United States and key regions could enhance flexibility by providing national leaders with options, including that of relying on defenses (instead of offenses) when a missile threat appears imminent, but conflict has not begun.

To enhance resilience, proposed actions between now and 2030 include:

- The triad and NSNF capabilities will have been retained and modernized. An upload hedge capability will continue to be important for the 2030+ environment. Therefore, the triad force structure will have been preserved and ICBM silos from which missiles were removed to comply with the New START Treaty and resulting from the declining inventory of Minuteman III missiles will have remained in “warm standby” status. If, as postulated, the nuclear warhead development and production infrastructure has been rejuvenated, some, but not all, of the nondeployed warheads in the stockpile may have been dismantled.
- Because each replacement SSBN will carry 16 SLBMs instead of the 24 missiles capable of being carried on each *Ohio*-class SSBN, the overall upload capacity of the New START force (extended) will be significantly reduced if only 12 replacement SSBNs are procured.
 - The DoD should keep open the option of producing additional *Ohio*-class replacement SSBNs beyond the planned buy of 12. Approximately 16 to 18 would be required to equal the SLBM deployment capacity of the *Ohio*-class force. A larger

9. Keith Payne et al., *Conventional Prompt Global Strike: A Fresh Perspective* (Fairfax, VA: National Institute Press, June 2012), 18.

number of SSBNs would also hedge against possible new developments that might challenge SSBN survivability.

- Since these SSBNs are slated to be operational until about 2080, the navy should also consider an extra margin of weight and volume for potential future payload needs on missiles that will replace D5 SLBMs.
- Similarly, DoD should ensure that designs for weapons for the 2030+ environment do not constrain payload weight and volume to only that needed for the current inventory of highly optimized warheads. Studies for nuclear force modernization, including the follow-on ICBM, LRSB, and LRSO missile, should consider an extra margin of weight and volume for future payload needs, including for penetration of defenses.
- For nuclear command and control (NC2) by 2030, improvements from 2014 will include the evolution of survivable satellite communications to advanced extremely high-frequency satellites; providing survivable communications to forces (e.g., low-frequency and extremely high-frequency terminals for B-2 operations, command and control updates for Minuteman III missiles); deployment of modern early warning satellites (space-based infra-red system satellites); and improved conferencing for senior leaders.¹⁰
- Senior U.S. officials should be explicit that, although there may be no DoD requirement for the development of fundamentally new nuclear weapons at the time, the United States must retain the option and capability to do so, if needed. In addition, innovation at the national laboratories in nuclear weapon design, production, and employment should be encouraged, not discouraged. The national laboratories should continue to explore the potential for new development to sharpen technical skills, understand what adversaries might be developing, and be responsive to rapidly emerging needs.
- With the New START Treaty expired, overarching limits may continue to be observed by mutual agreement. However, other treaty prohibitions, such as those against adapting offensive delivery systems to defensive missions, should be declared nonbinding. Resilience would be enhanced by the elimination of constraints on such adaptability.

Summary of the 2030+ Strategic Force Posture

Given the variety of U.S. strategic goals in the uncertain and highly dynamic environment postulated in the guidance, U.S. strategic capabilities must as a priority be adaptable, as is discussed above. Indeed, adaptability should be a primary metric of adequacy for the U.S. strategic force in the postulated and the actual contemporary threat environments. Consequently, the following discussion is intended to promote the adaptability of the U.S. force posture rather than identify a “right” fixed number of weapons and launchers. The reasoning underlying this discussion is that there is no set of “right” numbers that can

10. From Payne and Foster, *Nuclear Force Adaptability for Deterrence and Assurance*.

predictably define adequacy over time. Rather, we should seek to maximize adaptability within the boundaries of what appears to be feasible technically, politically, and financially. In general, the U.S. force posture in 2030+ should support the goal of tailoring U.S. deterrence and assurance strategies to the unique characteristics of each adversary and threat to be deterred and the spectrum of allied needs for assurance. It also should provide options across a spectrum of plausible contingencies for escalation control and damage limitation in the event deterrence fails. If one or more of the limiting boundaries identified above shifts significantly, the character of the force posture identified below could shift correspondingly for this purpose.

Given the bounding conditions postulated by CSIS for this discussion, the proposed strategic force structure for 2030 and beyond does not differ substantially from 2014 in numbers or types of weapon delivery systems—in large part because the development and deployment of new/different strategic capabilities is a lengthy process and because resource limitations are assumed.

- *Strategic nuclear triad retained/enhanced; nonstrategic nuclear capabilities modernized; and nonnuclear strategic capabilities deployed and highly mobile.*
 - *Four hundred ICBMs.* Minuteman III missiles will have been life extended and empty silos retained in warm standby. The ability to re-MIRV will provide resilience. Next-generation ICBMs will be nearing production and deployment plans will include options for improved survivability and penetration of defenses.
 - *Twelve SSBNs/SLBMs (240 as of 2030).* Retirement of *Ohio*-class SSBNs will have commenced; initial deployment of *Ohio*-class replacement SSBNs is on schedule (2031), and D-5 missiles include warheads that provide lower-yield options and penetration aids. The navy will be developing a replacement for the D-5 SLBM that will include an extra margin of volume and throw-weight to provide adaptability. To hedge against threats to deployed SSBNs, production of more than 12 replacement SSBNs should remain an option.
 - *Heavy bombers.* 20 B-2s will still be an important element of the nuclear force as they will be capable of carrying modern nuclear EPWs as well as other conventional and nuclear weapons. An LRSO missile to replace the ALCM-B will be just entering the inventory. This missile will include an EPW variant and will be compatible with the aging, smaller B-52 force as well as the LRSB. All LRSB aircraft will be nuclear capable.
 - *Nonstrategic nuclear capabilities.* U.S. and NATO allies will retain a DCA capability. The B61-12 will have been replaced by a modern weapon system that provides greater range and standoff for the delivery aircraft, accuracy, penetration capability, and surety features. In addition, to provide U.S. nuclear capabilities for deterrence and assurance in regional contingencies where the United States does not base nuclear forces, the navy should have contingency plans for deploying nuclear weapons on aircraft carriers and capable of being delivered by DCA.
 - *Nuclear command and control.* NC2 will be modernized as described earlier.

- Conventional/nonnuclear strategic capabilities (offensive and defensive)
 - *Offensive.* Prompt global strike missiles with hypersonic glide vehicle payloads will be deployed on *Virginia*-class and follow-on attack submarines as well as on land-based missiles.
 - *Defenses.* Broad area, point, selective, and preferential defenses for ballistic and cruise missiles will be deployed and operated by the United States and its allies. Capabilities will be interoperable and joint exercises will hone skills for mutual defense.

Declaratory Policy

For decades, U.S. declaratory policy for nuclear weapons has not limited U.S. nuclear deterrence objectives to nuclear threats. Rather, U.S. policy has been intended to support the deterrence of a broad range of threats and also contribute to the assurance of allies (as well as nuclear nonproliferation goals).

- “*No First Use.*” In 2009, the bipartisan Congressional Strategic Posture Commission concluded that abandoning this long-standing policy would be unsettling to some allies and could undermine some aspects of deterrence.¹¹
- The 2010 Nuclear Posture Review (NPR) narrowed U.S. declaratory policy by stating that the United States would not use or threaten nuclear weapons against any non-nuclear weapons state that is a member of the Nuclear Nonproliferation Treaty and in good standing.
- Furthermore, the 2010 NPR suggested that the United States would work toward a future security environment in which it would be feasible to further narrow the declared deterrence objective of U.S. nuclear weapons to nuclear threats alone (i.e., a “sole purpose” declaratory policy).¹²

Since the postulated 2030+ security environment appears neither predictably benign nor constant, the United States should neither limit the role of U.S. nuclear weapons to the deterrence of nuclear threats, nor endorse a no-first-use policy.

- In general, U.S. declaratory policy in 2030+ should be tailored for the unique characteristics of each adversary and threat to be deterred, including biological and chemical threats, as well as allied needs for assurance.
- Enhanced U.S. capabilities, offensive and defensive, nuclear and conventional, cyber, and space control should be integrated to provide myriad options for any future

11. William J. Perry and James Schlesinger, *America’s Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Washington, DC: U.S. Institute of Peace Press, 2009), 36, http://media.usip.org/reports/strat_posture_report.pdf.

12. U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, DC: DoD, April 2010), 15–16, <http://www.defense.gov/npr/docs/2010%20Nuclear%20Posture%20Review%20Report.pdf>.

president to respond in a manner that strengthens deterrence of potential adversaries in future conflicts, and assures allies.

- Regarding terrorists and other nonstate actors (NSAs), U.S. policy will hold all supporters and enablers fully responsible for acts committed by NSAs that receive support for WMD and other highly destructive capabilities. Improved cyber methods and ELINT¹³ will provide fidelity for tracking transactions so that state and nonstate supporters of WMD terrorism can be identified and held accountable.
- To support deterrence, dissuasion, and assurance, senior U.S. leaders will need to periodically and publicly state the value of strategic forces to respond to threats to the United States, its allies, and friends. Announced U.S. exercises that involve the integration of strategic capabilities (nuclear and nonnuclear) will enhance the credibility of U.S. deterrence threats.

Arms Control Policies

The proposed 2030+ security environment postulated by CSIS implies that neither Russia nor China have been cooperative nuclear arms reduction partners in the intervening years. The New START Treaty will have expired and, apparently, Russia and the United States continue to observe New START deployed launcher limits. However, given the highly dynamic character of the contemporary threat environment, U.S. arms control policies for 2030 and beyond should seek to advance, or at least avoid, further undercutting adaptability (flexibility and resilience) by preserving key U.S. options and by rejecting “irreversibility” as a governing principle. These recommendations do not preclude future negotiated reductions in or limitations on some parameters of strategic forces, but it does suggest a different goal and measure of arms control success than the typical mechanistic draw-down to whatever is deemed the next lower ceiling for strategic warheads and launchers.

Alternative Future Environments

For the alternative futures identified by CSIS, the U.S. nuclear force structure and policies would change as outlined below.

- AW #1: 18 Nuclear Powers
 - Modify the posture of the strategic nuclear triad to further enhance the survivability of ICBMs and bombers (given FA #3 that submarine survivability is less assured). In addition, depending on the assessed severity of the threat to SSBNs at sea, the inventory of SSBNs may be increased (for a modest threat) or SSBN operations (for a severe threat) might have to resort to a bastion strategy.

13. ELINT refers to “the process of electronic intercept and analysis of electronic intelligence.” See Central Intelligence Agency Library, https://www.cia.gov/library/center-for-the-study-of-intelligence/kent-csi/vol2no1/html/v02i1a06p_0001.htm.

- Increase diversity of NSNF and include naval-based options, including DCA on aircraft carriers and next-generation vertical launch system-based weapons on ships and submarines.
- Increase deployed defenses against cruise missile and ballistic missile threats as well as other new types of threats.
- AW #2A: Postnuclear Use/Nuclear Taboo Strengthened
 - Some nuclear forces would be adapted to carry conventional weapons, defenses, or other military capabilities, but the potential to reverse these modifications would be retained until long-term trends leading to a benign environment are established and intrusive verification measures are in place. Caution and continued adaptability should guide U.S. actions for this alternative future.
- AW #2B: Postnuclear Use/Successful Outcome from Nuclear Use
 - Actions similar to AW #1
- AW #3: Momentum Grows for Global Zero
 - This alternative future implies that many long-term issues that could lead to conflict between states have been resolved. Of course, decades will likely be needed to develop confidence that the positive developments are of a lasting nature. And the need for the capability to adapt to changing threat conditions would remain unless an effective and benign collective security system is established to provide reliable protection on a global basis.
 - Actions needed would be similar to those for AW #2. In addition, very intrusive inspection regimes would be needed to accompany deep nuclear reductions. Intrusive verification measures would be particularly important to confirm the destruction of nuclear systems that are to have been eliminated by all nuclear weapons states.

Technological and/or Geopolitical Developments That Could Compel a Fundamentally Different Approach

CSIS asked if there are technological and/or geopolitical developments that could compel a fundamentally different approach than is described above, and if so, what might be the “drivers” of that change.

The approach described above centers on the need to establish adaptability as a leading priority and measure of adequacy for U.S. forces and the force posture. As already noted, the theme of the position outlined here is that the United States needs to remain flexible and resilient (i.e., adaptable) precisely because technological and/or geopolitical

developments pertinent to the threat environment are highly dynamic. The U.S. capacity to adapt to such developments is not a second- or third-order measure of adequacy; it could be the key to U.S. and allied security, for example:

- If the seas were to become transparent and foes could easily take advantage of that transparency to target U.S. SSBNs, the burden of U.S. responsive deterrence threats could fall much more heavily on alternative platforms and capabilities, particularly including other legs of the triad;
- If an opponent's BMD capabilities were to benefit greatly from a surprising technological advancement and degrade the credibility of U.S. ballistic strike systems, the burden of U.S. responsive deterrence threats and assurance promises could fall much more heavily on alternative platforms and capabilities;
- If analysis identified the need for new U.S. nuclear capabilities to deter a severe threat, (e.g., the capability to threaten deeply buried bunkers), the United States would need the capacity to move swiftly to establish that capability or modify an existing capability to meet that deterrence need; and
- If Russian, Chinese, North Korean, and/or Iranian foreign and defense policy goals move in even more aggressive directions than can be seen today, and if surprising new geopolitical threats emerge, U.S. assurance measures for allies and partners—nuclear, conventional, military, and nonmilitary—would need to respond accordingly and possibly in diverse directions.

The focus on adaptability outlined in this discussion centers precisely on the need for the United States to be capable of responding to these and many other plausible developments. There are few, if any potential “drivers” that could undercut the value of adaptability as highlighted here.

An exception to this rule would be the expectation of a constant and benign threat environment that could foster confidence in modest and essentially static U.S. adequacy measures for U.S. nuclear forces consistent with a constant, benign threat environment. In such a case, the absence of U.S. adaptability would, by definition, pose no problem. Unfortunately, no plausible route to a predictably constant and benign threat environment is apparent from the historical experience of the past two millennia. Short of a revolutionary restructuring of the global political order and its primitive mechanisms for conflict avoidance/resolution, there is no credible basis for predicting the emergence of a constant and benign threat environment.

In short, adaptability need not be a priority if the threat environment is benign and constant, and can be expected to remain so in the future. The prospects for such a threat environment, however, do not now appear promising and presuming such a threat environment as the basis for U.S. planning over the course of decades is highly imprudent.

Indeed, the primary fallacy of frequent recommendations to move to a relatively fixed nuclear force posture of very low numbers (a minimum deterrence posture), with correspondingly limited U.S. flexibility and resilience, is the claim, often made explicitly in such proposals, that an essentially fixed, modest U.S. nuclear force posture will be adequate for deterrence and assurance purposes. This claim could be valid; it also could prove to be catastrophically mistaken. Proponents have no credible basis for asserting their claim of the former because they do not know and cannot confidently anticipate the nature of future threat environments and the corresponding deterrence or assurance requirements of those environments. Nevertheless, they would saddle the United States with a relatively rigid and modest force posture that could present extreme challenges to meeting U.S. and allied deterrence, assurance, and other goals if the security environment evolves in less benign and constant directions than they presume.

The problem here is not a matter of intelligence, methodology, or the credentials of those making the claims. It is the epistemological problem inherent in our common lack of knowledge about the future. The length of time typically required by the United States to bring forward new and different capabilities if the base is relatively small and inflexible magnifies this problem.

As Colin Gray has noted in this regard:

No matter the scholarly discipline and tradition to which a defense planner owes allegiance, he or she needs to recognize and attempt to understand fully a personal and institutional condition of awesome ignorance of detail about the future. Further study, more cunning analytical methodology, yet more powerful computers—none of these can reveal with any certainty what the future brings. . . . Hard science, soft social science, and the humanities, are none of them, severally or together, capable of telling us what we really need to know about the future.¹⁴

The value of and need to prioritize U.S. adaptability as a measure of adequacy underlies the approach presented here. It is the prudent response to the likelihood of dramatic technological and/or geopolitical developments. The value of adaptability is more obvious now than during the Cold War when threat conditions were “unusually predictable” because “the massive Soviet system became largely ponderous and predictable.”¹⁵ Unfortunately, the multidecade Cold War experience appears to have established patterns of thinking in the United States about nuclear policy that are based on the antiquated presumption of a ponderous and predictable threat environment, and upon that presumption spring confident claims about the precise number and types of nuclear forces that will be adequate for deterrence in the future. Yet, the veracity of those claims is as fragile as is the presumption

14. Colin S. Gray, *Defense Planning for National Security: Navigation Aids for the Mystery Tour* (Carlisle, PA: Strategic Studies Institute, March 2014), 1, 3, <http://www.strategicstudiesinstitute.army.mil/pdffiles/PUB1192.pdf>.

15. Richard Danzig, *Driving in the Dark: Ten Propositions About Prediction and National Security* (Washington, DC: Center for a New American Security, October 2011), 14, http://www.cnas.org/files/documents/publications/CNAS_Prediction_Danzig.pdf.

about the threat environment underlying those claims. Hence the focus here on adaptability is in recognition of the impossibility of so predicting the future with precision and the likelihood of dramatic technological and/or geopolitical developments.

Blue Sky: Reduced Fiscal and Policy Constraints

CSIS asked how the force proposed for the 2030+ security environment would change if some fiscal and political considerations were loosened. For the National Institute for Public Policy (NIPP) proposal, the most significant change would be in the proposed sea-based leg of the triad.

- The centerpiece of the nuclear force for 2030+ would be a fleet of “strategic mission submarines.” As already noted above, the United States could benefit from the added adaptability provided by the option of producing *Ohio*-class replacement SSBNs beyond the planned buy of 12. Each new submarine would be designed as a multi-role submarine and adaptable for a variety of offensive and possibly defensive missions. The submarine and its weapons would be designed to provide significant flexibility and resilience.
 - Each submarine would have more than the 16 missile tubes planned for the Trident replacement submarine—perhaps 20 tubes. Each four-pack of tubes could be configured to hold either nuclear-armed or conventionally armed missiles.
 - The load out of missiles for each submarine could be tailored to the security environment and relative priority of policy goals and would include intercontinental-range missiles—such as the D5—as well as shorter-range hypersonic and cruise missiles. For the shorter range missiles, each tube would be capable of carrying multiple missiles; the number of missiles per tube would be dependent on weapon features, such as missile diameter.
 - The multirole capability would enable these submarines to be forward deployed and fully capable of self-defense. This feature would also provide a hedge against some future threats to U.S. SSBNs.
 - The adaptable payload feature would build on the benefits of SSGNs and combine SSGN and SSBN features and missions. In addition, missile-defense capabilities would also be considered as payload options.
 - To strengthen deterrence, a next-generation SLBM will need to have advanced defense penetration features. For adversaries building BMDs, these features would increase their uncertainty regarding the effectiveness of those defenses.
- The multirole strategic mission submarine force would be complemented by a next-generation ICBM force including hypersonic glide vehicles (HGV), as well as dual-capable, long-range bombers and DCA as outlined for the fiscally constrained 2030+ force. In addition, deployable, conventional prompt global strike weapons with HGV payloads would complement the modernized nuclear force.

- For damage limitation, BMD would expand in correspondence to the expansion of regional and intercontinental missile threat numbers, to include boost-phase interceptors, and for national defense, midcourse interceptors equipped with multiple kill vehicles, a third CONUS-based BMD site to provide increased area defense for the eastern portions of the United States against limited or accidental missile attacks, and possibly low-altitude preferential defense capabilities to increase the survivability of U.S. ICBMs, select command and control nodes, and other important strategic assets. In addition, other consequence management programs, civil and military, would be established or expanded to help address the inadequacies in U.S. societal defenses against WMD threats.¹⁶

16. For a useful discussion of the need, see Ashton Carter, Michael May, and William Perry, “The Day After: Actions Following a Nuclear Blast in a U.S. City,” *Washington Quarterly* 30, no. 4 (Autumn 2007): 23–27.

Appendix F. Project Atom Key Points of Comparison

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Nuclear weapons play a role in U.S. national security. Though the exact role they play and their relative saliency are debated, the basic fact remains that they are, and will be for the foreseeable future, an element of a broader U.S. national security strategy. Project Atom aimed to take this basic fact and, with an eye to future, formulate updated and innovative takes on the principal role of nuclear weapons, the nature of deterrence and assurance, and the composition of the U.S. nuclear arsenal. In the time frame of 2025–2050, nuclear weapons will exist in a more complicated and quickly evolving security environment than the one they were born into and the one in which they currently exist.

Project Atom addresses this reality with competing ideas born of discussion, research, and innovative thinking among the think tank teams that participated in this study: Center for Strategic and International Studies (CSIS), the Stimson Center, National Institute for Public Policy (NIPP), and the Center for New American Security (CNAS). This essay compares and contrasts the key issues addressed by each team and how they relate to the optimal U.S. nuclear strategy and posture proposed by the CSIS final report, authored by Dr. Clark Murdock.¹

The Principal Role and Function of Nuclear Weapons

How each team identified the principal role and function of nuclear weapons is key, as it formed the foundation on which their overall strategy would be built. While the CNAS and NIPP teams identified roles very similar, though they contained nuanced differences, to that of the CSIS team, the Stimson Center team identified roles that were quite different. It became clear early on that these differences would be recurring themes throughout the identified strategies as the project moved forward.

1. This paper refers to each think tank paper by think tank team name, however, the views expressed within the papers are solely those of the authors and are not assigned to the think tank itself: The CSIS paper written by Clark Murdock, the Stimson Center paper written by Barry Blechman, the NIPP paper written by Keith B. Payne and Thomas Scheber, and the CNAS paper written by Elbridge Colby.

There was wide agreement among the teams that nuclear weapons are first and foremost deterrence weapons. On this basic level, each team is agreed. However, the teams disagree on the specifics of what it is nuclear weapons deter, and therefore disagree on their role in the future security environment. The CNAS, NIPP, and CSIS papers all agree that nuclear weapons serve multiple national security goals such as deterring major aggression and deterring the use of nuclear weapons and WMD against U.S. territory and allies. The CNAS paper outlines the various ways in which the role of nuclear weapons in U.S. defense strategy will grow and have greater value as the future security environment changes. The author makes the argument that nuclear weapons deter “a wide range of potential forms of aggression” and are relied on to deter more than a nuclear attack. That being said, the CNAS paper argues that they are only employable in “extreme circumstances.”²

The NIPP paper differs slightly by integrating the deterrent effect of nuclear weapons and U.S. conventional strength; the U.S. “nuclear force, in combination with other U.S. capabilities, will be needed to serve multiple priority national policy goals . . . [and] can deter aggression against the United States or its allies and friends by threatening responsive strikes against assets that enemy leaders hold dear.”³ While this argument does not downplay the deterrent effect of nuclear weapons, it creates greater ambiguity in identifying the precise role nuclear weapons play in a broader national security strategy. The CSIS argument falls in the middle: nuclear weapons deter nuclear attacks and large-scale conventional attacks on U.S. territories and allies but their deterrent value is not so closely tied to U.S. conventional power as is suggested by the NIPP paper. In the CSIS paper’s argument, the “strategic ambiguity” element exists in how and when U.S. nuclear weapons would be employed.

The starkest difference in strategy among the think tank teams in terms of the principal role and function of nuclear weapons comes from the Stimson Center paper. The paper argues that nuclear weapons serve no military role or function for the United States beyond deterring nuclear attack on the United States and its allies and their importance should therefore be minimized. The conventional superiority of the United States is capable of deterrence outside of the nuclear realm and is both militarily and politically advantageous in comparison to nuclear weapons. While all teams agree that the United States will most likely remain the preeminent conventional global power, the Stimson paper builds upon this aspect to argue that nuclear weapons should only assume the small niche that conventional strength cannot occupy. “Conventional forces are an inadequate deterrent for adversaries with significant nuclear forces, as they could not impose a comparable scale of destruction.”⁴ While the Stimson paper views nuclear weapons as a supplement to conven-

2. Elbridge Colby, with Shawn Brimley and Ely Ratner, “Appendix D. A Nuclear Strategy and Posture for 2030,” in *Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025–2050* (Washington, D.C.: CSIS, 2015).

3. Keith B. Payne and Thomas Scheber, “Appendix E. An Adaptable Nuclear Force for the 2030+ Security Environment,” in *Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025–2050* (Washington, D.C.: CSIS, 2015).

4. Barry Blechman and Russell Rumbaugh, “Appendix C. Protecting U.S. Security by Minimizing the Role of Nuclear Weapons: A New U.S. Nuclear Policy,” in *Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025–2050* (Washington, D.C.: CSIS, 2015).

tional dominance, the CNAS paper describes the U.S. nuclear force as a “backstop for these conventional forces should they fail to achieve U.S. objectives or if the costs of such an effort became too great.”⁵

The language in these comparisons can be subtle but it is important. The Stimson paper often describes nuclear weapons as an unfortunate but necessary element of U.S. security: “*Unfortunately*, nuclear weapons do remain indispensable in order to deter other nations from contemplating nuclear attacks on the United States and its allies.”⁶ The CSIS, CNAS, and NIPP papers all view the nuclear arsenal in the opposite way. Rather than being a supplemental element, the U.S. nuclear force is a “backstop,” a “critical element of the global distribution of power,”⁷ and necessary “to serve multiple priority national policy goals.”⁸ All four arguments take into account adversary calculation, however, the way in which they analyze and predict adversary decision making is very different. In understanding this, one can begin to see where the arguments above take shape.

The Stimson paper argues that while nuclear weapons have a clear deterrent value, they do not demonstrate an ability to prevent war against nuclear weapons states (by nonnuclear weapons states) and they have “limited utility in the real world.”⁹ The paper argues that “weak states” rely on nuclear threats to deter and defend against conventional attacks, a tactic the United States does not need because the United States can “defeat any conventional attack on itself or its allies using conventional means.”¹⁰ This argument removes the “nuclear shadow” that the CSIS paper argues is imposed on every conventional conflict with the United States. The CNAS paper similarly describes a situation in which an adversary with “significant nonnuclear capabilities capable of imperiling the United States or its allies . . . would be aware (either explicitly or implicitly) that developing a more adversarial relationship with the United States or its allies could well and might likely bring them into the orbit of U.S. nuclear planning.”¹¹

Nuclear Strategy: Declaratory Policy, Employment Strategy, and Extended Deterrence and Assurance

Each think tank team prescribed a nuclear strategy for the future security environment that they determined would not only work to secure U.S. interests but also those of U.S. allies and friends. As nuclear weapons were agreed upon as deterrent weapons, it was also agreed that they are not just a valuable deterrent for the United States but for U.S. allies

5. Colby, “Appendix D.”

6. Ibid.

7. Clark Murdock, *Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025–2050* (Washington, D.C.: CSIS, 2015).

8. Payne and Scheber, “Appendix E.”

9. Blechman and Rumbaugh, “Appendix C.”

10. Ibid.

11. Colby, “Appendix D.”

and friends as well. The role of extended deterrence and assurance and how they relate to U.S. declaratory and employment strategy is vital to one's understanding of the strategies put forth by the four think tank teams.

Extended deterrence and assurance were often grouped together in these papers, as they are part of the same question: How can the United States continue to uphold security guarantees in the future security environment? All four teams agreed that a failure of extended deterrence or assurance constitutes a failure in deterrence writ large. However, the strategies for avoiding such a failure were quite different.

The Stimson Center paper was quick to separate nuclear guarantees from conventional security guarantees and reiterated that nuclear weapons provide extended deterrence in the sense that they deter only nuclear attacks on allies and friends, not conventional aggression. In the same vein, they argue that in the event of failed deterrence on the conventional level, U.S. “threats to respond to conventional aggression with nuclear weapons would not enhance the credibility of American deterrence . . . there is no reason to believe that threats to risk a nuclear war on an ally's behalf would be seen as more credible.”¹² However, declaratory policy should make clear that “crossing the nuclear threshold by any means—with any type of warhead or weapon system, strategic or tactical—would bring into the play the possibility”¹³ of U.S. nuclear response. This strategy harkens back to the Stimson paper assertion that nuclear weapons are not of military value and therefore can have very little credibility in terms of employment anyway.

The strategy prescribed by the CSIS paper looks to circumvent this potential problem through prescribing more discriminate and employable nuclear weapons, “ones that enable the United States to respond directly and proportionately to an adversary's employment of a nuclear weapon,”¹⁴ thereby linking the credibility of extended deterrence and the strength of U.S. declaratory policy to a credibly employable arsenal. U.S. declaratory policy would continue to maintain “strategic ambiguity” about the exact circumstances of employment but state clearly and in absolute terms that any nuclear attack against itself and its allies will be met in kind. The CNAS paper describes a similar, though less demonstrative, strategy. The prescribed declaratory policy emphasizes U.S. resolve and ability to employ nuclear weapons “for strategically defensive purposes”¹⁵ while stressing the U.S. commitment to restraint. This strategy makes clear, however, that nuclear weapons are not necessarily weapons of last resort and emphasizes the U.S. capability for and willingness to employ discriminate nuclear force.

The NIPP paper stresses the importance of a flexible and adaptable force but in discussing extended deterrence and declaratory policy integrates U.S. nuclear capabilities and conventional capabilities. The paper focuses less on employable nuclear options and takes a wider lens, focusing on reinforcing the credibility of assurance and U.S. deterrent threats

12. Blechman and Rumbaugh, “Appendix C.”

13. Ibid.

14. Murdock, *Project Atom*.

15. Colby, “Appendix D.”

with the “full range of U.S. capabilities . . . the fielding of advanced weapons systems (offense and defense, nuclear and conventional) that manifest American preeminence in military technology, and the maintenance of a nuclear force of the first rank.”¹⁶ If deterrence were to fail, a range of nuclear yields and employable options are prescribed for situations in which the United States would need to control escalation and terminate conflict, but are not discussed as part of a broader declaratory policy in the way both the CNAS and CSIS papers discuss them.

The relationship between extended deterrence and assurance is as nuanced in the NIPP argument above as it is in each of the strategies; perception plays a leading role. The CSIS and CNAS strategies focus on the extent to which extended deterrence and assurance drive U.S. nuclear force posture and policy. Forward-deployed U.S. nuclear weapons are front and center in these two strategies, both acknowledging the significant role forward-deployed weapons already play in assurance and extended deterrence. The CSIS paper posits, “U.S. extended deterrence commitments will be significantly less credible (both to potential adversaries and our allies) in 2025–2050 than they are today unless that commitment is provided by U.S. nuclear weapons based on the territory of the ally whose security is threatened by a nuclear-armed regional adversary.”¹⁷ The CSIS and CNAS strategies for extended deterrence and assurance make the argument for nuclear burden sharing in a similar way. The CNAS paper adds that nuclear burden sharing of this nature would not only “enable more direct participation by allies in the deterrent posture” but would also mitigate “pressures toward proliferation” in various regions of the world.¹⁸

The Stimson Center paper argues that even though nuclear guarantees are an important component of allied security, allies doubt them more than they doubt U.S. conventional commitments because nuclear guarantees pose a greater risk to the U.S. homeland. Because of this doubt, “no level of force deployment, whether conventional or nuclear, can guarantee allies’ confidence in American security commitments.”¹⁹ By acknowledging that the United States will only use nuclear weapons in the event of a nuclear attack, the Stimson paper argues, the United States “would be helping to weaken perceptions of the importance of these weapons and to strengthen perceptions of the dangers they pose.”²⁰ In short, the Stimson team argues for an extended deterrence and assurance policy that relies on U.S. conventional dominance and the history of U.S. willingness to employ conventional capabilities, and minimizes the role of nuclear weapons in allied security commitments.

Extended deterrence and assurance commitments will endure into the 2025–2050 time frame and will shape U.S. nuclear policy and force structure. Whichever strategy is adopted, the components of the nuclear arsenal will be shaped to carry it out and will look and operate quite differently.

16. Payne and Scheber, “Appendix E.”

17. Murdock, *Project Atom*.

18. Colby, “Appendix D.”

19. Blechman and Rumbaugh, “Appendix C.”

20. *Ibid.*

U.S. Nuclear Force Structure and Posture: Attributes and Capabilities

All four papers underscore the importance of the triad, recognizing the need for a U.S. force structure that is survivable, reliable, and responsive. However, how each team defines “responsive” varies and the differences outlined in each of the proposed strategies above are reflected in the force structures designed to carry out those strategies.

For the CSIS and CNAS papers, the similarities continue. In order for the United States to execute the strategy outlined by the CSIS paper, the nuclear force must be modern, reliable, capable, and responsive. This requires commonsense improvements to the force, such as updated NC2 and an affordable modernization program. The largest change is a direct result of providing more employable options: a revitalized nuclear mission in the DoD. For the department to be seen as willing and able to use more employable weapons, they must demonstrate that willingness first to themselves through training and exercises. Not only will this enable the strategy to be successful, but it will strengthen resolve at home and assurance among U.S. allies. The strategy outlined by the CNAS paper requires much of the same: operational effectiveness (reliability and survivability), capability for limited conflict (discrimination and escalation control), effect on adversary decisionmaking (coercion), assurance, signaling, and long-term viability (cost-efficiency and resilience).²¹

In terms of force structure, both teams highlighted the need for variable yield weapons available on multiple platforms. The CSIS paper identified the lack of variety in the U.S. arsenal as the “United States has one system, the B61 bomb, in its inventory, while Russia retains the full range of its battlefield nuclear weapons and is modernizing them.”²² The CNAS paper proposed equipping “Trident II D5s with primary only warheads and emplacing variable yield warhead on the new long-range standoff missile (LRSO).”²³ Both papers call for exploring updates in the delivery systems of the triad as well. Life extensions and updates to the ICBM force are standard and to be sustained for as long as is feasible.

The air leg of the triad has options. Both papers explore modernizing the fleet to include the penetrating long-range strike bomber, the standoff bombers (B-52 and B-2), and procuring “sufficient numbers of F-35 aircraft in a dual-capable mode to provide for theater deterrence and assurance purposes”²⁴ and “provide visible manifestations of U.S. extended deterrence and allied burden-sharing.”²⁵ While the CSIS paper admits that the CNAS force structure is probably too ambitious financially, both are quite similar in their range and capabilities.

21. Colby, “Appendix D.”

22. Murdock, *Project Atom*.

23. Colby, “Appendix D.”

24. Ibid.

25. Murdock, *Project Atom*.

Through outlining the various yield options for the arsenal, both papers expose opportunity but also highlight the amount of work to be done in order to execute the strategies they propose. In maintaining the triad, retaining the existing weapons in the arsenal, and building on those foundations, both papers reinforce the success of a triad thus far; the need for an arsenal that reflects the future security environment; and the political difficulties involved in dramatically changing the arsenal in one direction or the other, despite what the strategy calls for.

The NIPP force structure and posture does not differ greatly from the CSIS or CNAS force structures and postures but organizes both in such a way that the focus remains on adaptability and resilience, rather than addressing key specifics within the strategy and the future security environment. In order to adapt to the “potentially shifting strategic requirements of the contemporary, highly dynamic threat environment,”²⁶ the force proposed by the NIPP paper must be able to provide the following things: flexibility, survivability, intercontinental range, forward deployment, prompt response, variable payload, assorted weapons yields, high delivery accuracy, and a robust and secure NC2. This force, like the others, focuses on updating and modifying the weapons in the current force but finds resilience in its ability to adapt without developing and producing new capabilities.

The “flexibility-related enhancements” proposed include producing low-yield, primary-only warhead options for the ICBMs and SLBMs, modernizing a nuclear EPW weapon, and retaining and enhancing U.S. forward-deployment options. Forward-deployment improvements, like the modernization plans for dual-capable aircraft and the B61-12 life-extension program, would allow for emergency deployments to areas where the United States does not yet forward deploy nuclear capabilities, such as the Middle East and Northeast Asia. The NIPP paper also keeps the option open for producing additional *Ohio*-class replacement SSBNs (approximately 16–18 instead of the planned 12).²⁷ Finally, any designs for weapons for the 2025–2050 time frame “should not constrain payload weight and volume to only that needed for the current inventory of highly optimized warheads.”²⁸ Overall, the NIPP force does not differ much from the CSIS and CNAS forces but it looks at the future security environment through a different lens and takes a shorter term and more realistic timeline and budget into account.

Where the previous three forces expanded and updated, the Stimson Center force maintained at minimum and reduced where possible. While still retaining a triad, the Stimson force reduced to “1,000 deployed nuclear warheads (or to the size of the largest nuclear arsenal in the world, whichever is smaller).”²⁹ The ICBMs provide a significant deterrent value for the Stimson strategy and are therefore modernized but reduced to 300 from 400. In the bomber fleet, B-2s remain the “mainstay” and are equipped with new nuclear-capable cruise missiles. B-52s will be maintained and the LRS-B next-generation

26. Payne and Scheber, “Appendix E.”

27. *Ibid.*

28. *Ibid.*

29. Blechman and Rumbaugh, “Appendix C.”

bomber should be nuclear capable but not equipped as such unless “serious doubts are raised about the continuing capabilities of the B-2s and B-52s.”³⁰

It is in the submarine fleet and the tactical nuclear weapons arsenal that one finds the biggest change in the Stimson force. They plan for only 10 *Ohio*-class replacements, arguing that a fleet reduced to this size would then match the overall reductions of the force and hedge against overinvesting. In terms of the tactical nuclear weapons, the Stimson force will phase them out at the end of their lifetimes (mid-2020s), citing “no operational or strategic advantage as compared to either strategic nuclear forces or conventional forces, while generating additional costs for modernization and maintenance.”³¹ This means the life-extension plans for the tactical B61 and any development of a dual-capable F-35 are also scrapped. Reductions of this size not only reduce the reliance on and role of nuclear weapons in the Stimson strategy but free up funds to be allocated to maintaining U.S. conventional superiority.

Final Thoughts

While there are many similarities among the force postures and structures proposed here, the differences show the complexity of the challenges facing the U.S. nuclear arsenal as it phases into a new security environment with an, as yet, unknown strategy. If nothing else, these comparisons show the dangers associated with entering a future security environment without a coherent strategy and without a force structure that can support it. The United States cannot afford to enter the 2025–2050 time frame with an insufficient nuclear strategy and an incapacitated, unreliable nuclear force.

30. Ibid.

31. Ibid.

Appendix G. Characteristics of a Future Nuclear Force: Smaller, Lower, Newer, More Diverse, and More Integrated

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The Project Atom study considers how U.S. nuclear forces should be structured for the 2025–2050 time frame if they were unencumbered by current policy or statutory restraints. The following is an intellectual exercise to articulate some possible new characteristics and capabilities of such a “blue-sky” force. This exercise is a timely one. Just two years from now, in 2017, a new administration will begin a new review of the U.S. nuclear posture, the fourth since the end of the Cold War.

For years, commentators have recognized that we have entered into a new strategic era, what some call a “second nuclear age.” Others number it third, fourth, even sixth.² Whatever the count, the near nuclear future will probably be characterized by different rules, more actors, wider distribution of disruptive technologies, less predictability, and the need to respond to limited nuclear use.

Although serious internal reviews of nuclear guidance continue to reaffirm the need for flexible capabilities, public debates about nuclear strategy and force posture have been beset by inertia and doubts. A kind of post–Cold War euphoria arguably contributed to not only constricted infrastructure and a relatively static force structure but also more

1. For thoughts and comments provided on various drafts of this essay, I would like to thank Sam Brannen, John Harvey, Ron Lehman, Brian Lessenberry, Andrew Metrick, Frank Miller, Sarah Minot, Clark Murdock, Brad Roberts, David Trachtenberg, Drew Walter, Angela Weaver, and others. I would also like to extend special thanks to Clark Murdock for the invitation to contribute to Project Atom and to submit this essay. Responsibility for the content is my own.

2. Keith Payne, *Deterrence in the Second Nuclear Age* (Lexington: University of Kentucky Press, 1996); Paul Bracken, *Fire in the East: The Rise of Asian Military Power and the Second Nuclear Age* (New York: Harper Collins, 1999); Thomas Donnelly and David Trachtenberg, *Toward a New “New Look”: U.S. Nuclear Strategy and Forces for the Third Atomic Age* (Washington, DC: American Enterprise Institute, March 2010). In a forthcoming paper, Ronald Lehman suggests six ages: nuclear monopoly, nuclear superiority, bilateral balance, military superiority, strategic complexity, and peer resurgence.

atrophied thinking about deterrence.³ The average weapon in today's stockpile is 28 years old and getting older every day. Delivery systems have suffered a multidecade procurement holiday. While events in the past several years suggest a basis for improvement, modernization and recapitalization have proven remarkably elusive.

The future nuclear force will share many characteristics of today's force, but in other respects it may need to change. In the face of the likely future strategic environment, a nuclear force that is basically a smaller version of that of today could make deterring nuclear war relatively harder and nuclear use more likely. Inflexibility can weaken credibility and create perceptions of self-deterrence, in the minds of both allies and potential adversaries alike. Failure to adapt to a changing world can mean a relative weakening of deterrence.

In short, different capabilities may be needed to defend against and decisively defeat threats in the next nuclear age. The analysis below sketches out features and possible modifications to the future nuclear force and enterprise designed to adapt to technological and geopolitical trends already under way. Some of these features are new, others are not. As depicted here, the future nuclear force would assume an increasingly bifurcated character, on the one hand preserving a credible strategic deterrent of global nuclear war, and on the other hand a diverse spectrum of discriminate and distributed capabilities for escalation control, escalation dominance, and rapid war termination in regional contingencies if deterrence fails.⁴ These features include:

- Nuclear employment strategy that preserves both traditional strategic deterrence and the need to defeat and defend against emerging threats
- Diverse force structure based with a triad of delivery vehicles as its foundation, dual-capable aircraft (DCAs), and additional delivery systems
- Nuclear stockpile with a smaller technical hedge
- Weapons with variable yields and effects, of both high and lower yields, capable of diverse means of delivery
- Greater diversity of medium- and intermediate-range missile delivery systems
- Nuclear earth penetrator to hold at risk hardened and deeply buried targets
- More distributed basing flexibility
- Greater diversity at sea, including sea-launched cruise missiles (SLCMs) and F-35Cs

3. Therese Delpech, *Nuclear Deterrence in the 21st Century* (Santa Monica, CA: RAND, 2012), 11; Jeffrey A. Larsen and Kerry M. Kartchner, eds., *On Limited Nuclear War in the 21st Century* (Stanford, CA: Stanford Security Studies, 2014).

4. With the Soviet Union, escalation dominance was harder, but it may deserve another look for future and smaller threats. Kerry M. Kartchner and Michael S. Gerson, "Escalation to Limited Nuclear War in the 21st Century," in *On Limited Nuclear War in the 21st Century*, ed. Larsen and Kartchner, 165–66.

- Resilience to emerging threats from counterspace, cyber attack, and electronic warfare
- Greater integration of nuclear forces with precision strike; intelligence, surveillance, and reconnaissance (ISR); conventional prompt strike; and missile defenses
- Robust nuclear command, control, and communication (NC3) systems that degrade gracefully under stressing environments
- Responsive infrastructure that regularly refreshed the stockpile and incorporated appropriate new technologies
- Freedom for the national laboratories to develop capabilities formerly in the stockpile, as well as to research new designs for lower cost, more security, greater safety, more reliability, new capabilities, lower yields, and other effects

These features describe a future nuclear force characterized by *smaller* numbers of weapons, *lower* and variable yields, *newer* and more refreshed weapons, a *more diverse* set of delivery systems, *more distributed* deployment, and *more integration* with nonnuclear capabilities. Sustaining deterrence and adapting the future nuclear force presupposes, however, that senior political and military leadership continue to believe in nuclear deterrence and act to truly “improve” and “strengthen” deterrence, rather than merely preserving current capabilities.⁵

Toward the Next NPR

Attempting to sketch out a force structure for 2025–2050 requires numerous assumptions and caveats. Thirty-five years is a considerable amount of time. By way of illustration, some 35 years ago, precision guidance and stealth technologies were beginning to appear, NATO decided to deploy Pershing II and ground-launched cruise missiles (GLCMs), and policymakers were debating the neutron bomb. Another 35 years earlier, one arrives at the first use of nuclear weapons in 1945.

The crystal balls in the 1950s did not gaze any further into the future than do those of today, yet the force planners of that time too were tasked with developing a force structure that would be in place for decades. Rather than having the architecture laid out in advance, procurement decisions had to hedge against considerable uncertainty. In 35 years, a century or more will have transpired since the days of the V-1, the Manhattan Project, the B-29, and the *Nautilus*. It is a remarkable statement of continuity that missiles, submarines, and bombers are still widely assumed to play important deterrence roles in 2050.

Two things are certain: The force of 2050 will not be the force of 2015, even if it retains a similar force structure; and decisions made in the next few years will shape that future force. Most of today’s delivery systems and weapons will have reached the end of their

5. U.S. Department of Defense (DoD), *Nuclear Posture Review Report* (Washington, DC: DoD, April 2010), xi.

already-extended service lives by or around 2025. Some weapons will be life extended, others are planned to be withdrawn, and still other designs could be added back into the stockpile. The last *Ohio*-class SSBN will be phased out by 2041, and the *Ohio*-replacement class will operate until the 2080s. First appearing in 1970, the Minuteman III ICBM complex will likely require replacement or upgrades in the 2030s. The B-52 may still be around in 2050, but the United States has not relied on it for a penetrating role in decades. The modest B-2 fleet will be reduced to a standoff platform from which to launch increasingly long-range penetrating cruise missiles. The Advanced Cruise Missile (ACM) was begun to replace the 1981-era air-launched cruise missile (ALCM), but the ALCM is now life extended until 2030. The nuclear infrastructure will hopefully also have been recapitalized by 2030. Some of today's infrastructure dates to the 1940s, including parts of the uranium facility in Tennessee.

Modernization of the nuclear enterprise has been a long time coming. Both anticipating and responding to geopolitical changes, the 2001 Nuclear Posture Review (NPR) emphasized the need to move beyond Cold War thinking and transform our force structure accordingly. While retaining the continued commitment to diverse delivery systems, the report emphasized the need for these to be supplemented with defenses, nonnuclear strike, and a responsive infrastructure to reinvigorate the nuclear enterprise. This enlarged view of what it would take to sustain nuclear deterrence was described as a kind of “new triad.” Moving well beyond the 1994 review, the 2001 NPR characterized the developing changes and laid out recommendations for nuclear transformation—but they were never implemented. Unfortunately, these goals were beset by heated opposition, resulting in the substantial delays or cancellation of recapitalization and modernization programs, as witnessed with the reliable replacement warhead and the robust nuclear earth penetrator.

In his 2009 Prague speech, President Obama reiterated the goal of moving beyond Cold War thinking by further reducing the role of nuclear weapons in U.S. national security strategy, but also committed to retaining a safe, secure, and effective arsenal to deter any adversary. Although the 2010 NPR did not retain the “new triad” vocabulary, there remained remarkable continuity in terms of diagnosing the problems facing the nuclear enterprise. Building on the bipartisan recommendations of the Strategic Posture Commission and other reports, the 2010 NPR laid out a path for the modernization of the stockpile, delivery systems, and the aging infrastructure of the nuclear enterprise, although stopping short of recommending new capabilities.⁶ The New START agreement proved to be a further catalyst for the implementation of modernization efforts, and in November 2010 an

6. U.S. Department of Energy (DoE) and U.S. DoD, *National Security and Nuclear Weapons in the 21st Century* (Washington, DC: DoE and DoD, September 2008), <http://www.defense.gov/news/nuclearweaponspolicy.pdf>; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Report of the Secretary of Defense Task Force on DoD Nuclear Weapons Management: Phase II: Review of the DoD Nuclear Mission* (Washington, DC: DoD, December 2008), <http://www.defense.gov/pubs/pdfs/PhaseIIReportFinal.pdf>; National Nuclear Security Administration, *FY 2011 Stockpile Stewardship and Management Plan Summary* (Washington, DC: DoE, May 2010), <http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/stockpile-stewardship-mangement-plan-summary-fy2011.pdf>.

updated plan included a 10-year plan and funding commitment to provide a sustainable deterrent and nuclear enterprise.⁷ The trend toward integrating the nuclear mission with nonnuclear capabilities also continued, as both missile defenses and conventional strike were seen as means to support deterrence.⁸

Future Strategic Environment

In the coming decades, the strategic environment is likely to become more complicated, more dynamic, more unpredictable, and more nuclear.⁹ Adversaries are likely to view nuclear weapons as effective means to counter conventional military advantages and possibly coerce the United States or others into backing down.¹⁰ Indeed, the nuclear taboo and the stated U.S. preference for a reduced role of nuclear weapons could be exploited by lowering the nuclear threshold. “Escalate to de-escalate” tactics might be used by Russia, but also by North Korea and perhaps China. Pakistan has similar ideas regarding India. Both American conventional superiority and concern about further proliferation provide significant motivations for states to acquire and potentially brandish nuclear weapons.

The United States is likely to maintain significant conventional advantages, but some will disappear. To offset particular military superiorities, adversaries and other smaller nuclear-armed states will likely continue to pursue high-payoff capabilities including precision strike and other means of anti-access and area denial.¹¹ Adversaries will likely place increased importance on a wide variety of capable delivery systems, including cruise and ballistic missiles that are mobile, low profile, maneuverable, and survivable. Basing concepts will likely evolve to include rail or other mobile systems, hardening and underground basing, sea basing, and other unmanned systems. Adversaries may also use kinetic and nonkinetic weapons to defeat space-based assets relevant to the U.S. nuclear mission. Advances in anti-stealth and in adversaries’ own air and missile defenses will challenge the penetration of U.S. delivery systems. Increased adversary precision-guided strike systems and the proliferation of unmanned systems may further threaten forward bases, naval forces, allies, and the U.S. homeland. The maintenance of stealth and the penetration of air defenses may become increasingly challenging.

7. “November Update to the National Defense Authorization Act of FY 2010: Section 1251 Report: New START Treaty Framework and Nuclear Force Structure Plans,” Los Alamos Study Group, November 2010, http://www.lasg.org/budget/Sect1251_update_17Nov2010.pdf.

8. DoD, *Nuclear Posture Review Report* (2010), vi; and DoD, *Ballistic Missile Defense Review Report* (Washington, DC: DoD, February 2010), http://www.defense.gov/bmdr/docs/BMDR%20as%20of%2026JAN10%200630_for%20web.pdf.

9. Including South Africa and excluding former Soviet states and Iran, 10 nuclear powers have emerged over the past 70 years. Additional nuclear powers may be expected to appear before 2050.

10. Similar arguments have been made by Brad Roberts. See Brad Roberts, *The Case for U.S. Nuclear Weapons in the 21st Century* (Stanford, CA: Stanford University Press, forthcoming).

11. National Intelligence Council (NIC), *Global Trends 2030: Alternative Worlds* (Washington, DC: NIC, 2012), 69, http://www.dni.gov/files/documents/GlobalTrends_2030.pdf.

Just as the precision guidance revolution has migrated to potential adversaries, so too increased intelligence, surveillance, and reconnaissance is likely to be reflected back. The transparency of U.S. nuclear systems may therefore increase, making deception and survivability harder. This transparency may include the seas, assisted by advanced computing power with the imagery of overhead satellites, exotic new sensors, unmanned aerial systems, and swarms of unmanned underwater vehicles.

The future arms control and proliferation environment may also be quite different. Russia's pattern of treaty noncompliance has now become acute. China, Pakistan, and other nuclear states have not agreed to any arms control agreements limiting their nuclear forces or even providing transparency. Current regimes from the late Cold War could even break down or come under increasing strain, such as the Intermediate-Range Nuclear Forces (INF) Treaty, the Missile Technology Control Regime, the Conventional Forces in Europe Treaty, the Nuclear Nonproliferation Treaty, and even numerical limits and verification regimes of strategic nuclear treaties. The New START agreement will be up for extension in 2021, six years from now. Given recent actions by Russia, renewing its limits and its verification regime might not be extended. A nondeployed geopolitical hedge and upload capability will remain important to manage these kinds of risk.

Other new technologies will come to affect deterrence in ways that were less plausible in the Cold War, including electronic warfare, directed energy, means to detect and counter cruise missiles and reentry vehicles, and unmanned platforms. Increased cyber threats will pose substantial challenges to NC3, to nuclear weapons themselves, and to delivery systems. All this could create challenges and renewed importance of cyber defense, cyber resiliency, and trustworthy supply chains. Targeted cyber attacks could increase the importance of redundancy both in terms of weapon types and delivery systems.

Lower-level extended deterrence and assurance missions will likely increase in salience and difficulty. Attempts to assure allies and stem further proliferation may require new extended deterrence commitments to both existing and even new allies—which could increase, rather than decrease, the need for credible and forward-based nonstrategic nuclear forces.

Of course, some of these challenges could go away entirely. Still other unpredicted problems are yet to emerge. Not all of these trends and possibilities will materialize, but the realization of even some would challenge the credibility and flexibility of the 2015 force structure.

Limited Nuclear Threats

One potential feature of the future environment worth special attention is the threat of limited nuclear war, coercion, and escalation posed by proliferation and the prospect of deterrence failure. Despite significant recognition of these problems in numerous posture

reviews and statements of declaratory policy since the 1990s, the United States may still not be well equipped to handle the problem of limited nuclear use.

The history of U.S. nuclear strategy is in some way a history of efforts to provide limited and credible nuclear options against military targets. Despite labels of massive retaliation and mutual assured destruction—and epithets about “war fighting”—every president since Eisenhower has pursued such options. The Kennedy administration spoke of “flexible response,” others emphasized “war termination” and “countervailing” or “prevailing” strategies. Despite considerable geopolitical change and evolving force structure, there has been remarkable continuity in terms of pursuing limited nuclear options.

With nuclear and nonnuclear weapons alike, the movement from larger to smaller warhead yields was both driven by and contingent upon technological and weaponry advances especially in precision guidance and reliability. All things being equal, reliably producing a given effect on a given target requires more redundancy and higher-yield weapons in proportion to limited intelligence and the inaccuracy and unreliability of delivery systems. The revolutions of precision strike and ISR begun in the 1970s brought forth the conventional follow-on-forces attack plans and precision-guided munitions later displayed in Desert Storm and Bosnia. Unlike air and missile defenses of the 1960s and 1970s that used nuclear warheads to compensate for inaccuracy and uncertainty, missile defense efforts since the 1980s have largely focused on hit to kill, requiring exponentially greater tracking and discrimination capabilities. Continuing to incorporate technological improvements like these could well provide new capabilities to further strengthen nuclear deterrence.

In retrospect, the decade following the collapse of the Soviet Union represented a kind of lost opportunity to revisit and expand nuclear flexibility.¹² Following the presidential nuclear initiatives (PNIs) and the moratorium on nuclear testing, the U.S. strategic force structure was largely frozen in place—at lower numbers, with less delivery system diversity, and dramatically fewer low-yield weapons. The introduction of the B61-11 earth penetrator was one of a few important actions to adapt the nuclear force to these new challenges, but its future sustainment is now in doubt. The 1994 NPR likewise did little to stimulate innovation, and instead reaffirmed that the United States would not create new capabilities. Admittedly, such caution was motivated by concerns that new capabilities could upset arms control reductions with Russia and stoke rather than suppress wider proliferation.

A glimpse at the newer challenges was seen in 1996, when Secretary of Defense Perry openly mentioned the preemptive use of nuclear weapons to prevent the operation of a Libyan chemical weapons facility. Advances in American conventional superiority have

12. A study commissioned by STRATCOM expressed concerns about the inability to adequately address and deter regional nuclear contingencies, and suggested possible measures such as lower-yield weapons and arming expeditionary forces with portable weapons. Thomas C. Reed and Michael O. Wheeler, “The Role of Nuclear Weapons in the New World Order,” declassified report to the commander in chief of Strategic Command, December 1991, 28.

arguably complicated the problem. In 1997, Secretary of Defense William Cohen noted that a “paradox of the new strategic environment is that American military superiority actually increases the threat . . . by creating incentives for adversaries to challenge us asymmetrically.”¹³ Future threats are probably not best understood as “lesser included cases” of the deterrence of Russia or the Soviet Union. Nuclear strategy and nuclear force structure tailored to these challenges should likewise not be understood as “lesser included forces” for strategic deterrence.¹⁴

Nuclear Strategy

The principal function of U.S. nuclear weapons continues to be the deterrence of nuclear attack against the United States and its allies. Additional functions include the deterrence of major aggression, assuring allies, providing an extended deterrent, dissuading further proliferation among allies and adversaries alike, and, should deterrence fail, the ability to defend against the attack, limit damage, control escalation, and defeat an adversary.

Deterrence involves the threat of something terrible, and nuclear deterrence means the threat of nuclear use. Effective deterrence depends upon capability and force structure to deliver the threat, the communication of one’s intentions, and the perception and belief that these threats are credible.

New strategies and capabilities by our adversaries in some ways conspicuously parallel the “flexible response” and “first-use” plans that NATO embraced to more effectively counter the local conventional superiority of the Soviet Union. The proliferation of precision-strike and mobile missiles would further threaten allies and American power projection. When integrated with nuclear forces, regional adversaries would acquire greater escalation leverage relative to the United States.

As reflected in past nuclear posture reviews, future nuclear strategy will need to continue to not only deter massive nuclear attack but also stress cases of small nuclear use or coercion. The more likely threats may include “onesies and twosies”—very small nuclear threats, demonstration shots, nonlethal electromagnetic pulse attacks, or limited employment against U.S. or allied forces. Herman Kahn spoke of “barely nuclear war,” rung 15 of his 44-rung escalation ladder, which included nuclear use by accident or to achieve modest political purposes. The means to deter and defeat these threats is not necessarily a lesser included case of that required to deter major nuclear attack.

The 2014 Quadrennial Defense Review (QDR) detects this trend, noting that a “loss of depth across the force could reduce our ability to intimidate opponents from escalating conflict.” In the face of this, the QDR declares that U.S. nuclear forces “support our ability to

13. Office of the Secretary of Defense, *Proliferation: Threat and Response* (Washington, DC: DoD, November 1997), iii, http://www.dod.mil/pubs/foi/operation_and_plans/NuclearChemicalBiologicalMatters/904.pdf.

14. David Ochmanek and Lowell H. Schwartz, *The Challenge of Nuclear-Armed Regional Adversaries* (Santa Monica, CA: RAND, 2008), iii, http://www.rand.org/content/dam/rand/pubs/monographs/2008/RAND_MG671.pdf.

project power by communicating to potential nuclear-armed adversaries that they cannot escalate their way out of failed conventional aggression.”¹⁵ The problem of escalation is likewise highlighted in the 2013 revision to nuclear employment guidance: “The US will maintain a credible nuclear deterrent capable of convincing any potential adversary that the adverse consequences of attacking the US or our Allies and partners far outweigh any potential benefit they may seek to gain from such an attack.”¹⁶

These statements identify a real problem that has yet to be fully solved. Continued emphasis on the reduced role of nuclear weapons could cause adversaries and allies to misjudge the seriousness of U.S. intent and capability to respond in kind. Specifically, they may believe that the nuclear taboo and the historical precedent of nonuse would cause a U.S. president to be self-deterred from responding to nuclear use in kind, and perhaps even to back down.

Extended deterrence commitments are also likely to come under increasing strain with regional tensions between nuclear adversaries and nonnuclear allies. While a failure of deterrence might increase the nuclear taboo, it could also communicate the fragility of deterrence and doubts about relying on extended deterrent commitments from the United States. The credibility of America’s extended deterrent promises would suffer, which in turn would spur its allies and partners to acquire nuclear capabilities of their own and scuttle core assumptions of the Nuclear Nonproliferation Treaty and other nonproliferation regimes.

To continue to reassure allies and partners that they do not require their own nuclear deterrent, nuclear force structure changes will be needed. Indeed, the role of nuclear weapons in the U.S. national security strategy may need to increase. Supplemented by conventional and defensive systems, more diverse nuclear forces would be helpful to address potential gaps in U.S. capability, assure its allies and strengthen extended deterrence, dissuade its allies from acquiring nuclear weapons, and provide additional capabilities to defend and defeat lower-level adversaries such as North Korea and perhaps China in the event deterrence should fail. Even a blue-sky nuclear force, however, will not likely alter the relationship of strategic vulnerability with Russia, which continues dramatic advances for its nuclear weapons and delivery systems. Their survivability and therefore Russia’s second-strike potential to hold at risk U.S. forces and other targets will also likely remain for the foreseeable future.

15. DoD, *Quadrennial Defense Review 2014* (Washington, DC: DoD, 2014), 64, 13, http://www.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf.

16. DoD, “Report on Nuclear Employment Strategy of the United States Specified in Section 491 of 10 U.S.C.,” June 2013, 4, http://www.defense.gov/pubs/ReporttoCongressonUSNuclearEmploymentStrategy_Section491.pdf.

Possible Characteristics of a Future Nuclear Force

Several potential gaps in the current U.S. force arise from the post-Cold War contraction of delivery system diversity and reliance on nonstrategic nuclear weapons. There has been significant constriction or consolidation in not only the overall number of weapons deployed but also the types and effects of both weapons and their delivery systems. The “3+2” modernization plan currently being pursued—three warheads for missile delivery and two air-delivered bombs—is a logical extension and further consolidation of the current triad and deployed weapons without the addition of new capabilities. In the near term, this modernization path should continue, but it may need to be expanded.

The following is a list or menu of possible modifications to the future nuclear force. Not every option will prove necessary within each category. Nevertheless, to maximize flexibility and credibility for the future, the U.S. nuclear force would benefit from increased characteristics of a *smaller* but *newer* responsive stockpile, *lower* and variable yields and special effect weapons, a more *diversified* set of delivery systems, greater *distribution* and forward deployment, and greater *integration* with nonnuclear capabilities.

SMALLER STOCKPILE

One undeniable trend of the past several decades has been to a smaller stockpile. In 2009, the number of weapons in the U.S. nuclear stockpile stood at 5,113 weapons, and in 2013 stood at 4,804, a 6 percent reduction in four years. This number also represents an 85 percent reduction since 1967, and a 78 percent reduction since the fall of the Berlin Wall. The number of nonstrategic nuclear weapons declined by 90 percent since 1991.¹⁷ The stockpile will continue to reduce in size without any new or positive decision for reductions. Some number of weapons are removed from the stockpile each year and destroyed, for example, to test safety and surety. Absent substantial reductions by not only Russia but other nuclear powers, however, this path is not sustainable.

The implementation of a responsive infrastructure will both enable shorter-term technical reductions and arrest the longer-term risk with a smaller stockpile. Warhead interoperability among platforms could permit further reductions, but at the potential risk of decreased technical diversity. The B61-12 life-extension program alone is expected to result in a 50 percent reduction in the number of gravity bombs, an 80 percent reduction in the amount of special nuclear material in those bombs, and the removal of the B83-1 megaton-capable weapon.¹⁸

17. U.S. Department of State, “Transparency in the U.S. Nuclear Weapons Stockpile,” fact sheet, April 29, 2014.

18. Hearing before the Strategic Forces Subcommittee, Committee on Armed Services, U.S. Senate (witness statement by members of the Nuclear Weapons Council Frank Kendall, Cecil D. Haney, Frank Klotz, Brian McKeon, and Michael Elliott, March 4, 2015).

The size of the U.S. strategic stockpile should not be permitted to fall beneath rough parity with Russia, however, retaining the “second-to-none” criteria, but more attention should be given to the nonstrategic imbalance. The United States should continue to assess Russia’s compliance with the PNIs and INF, and with the size and missions of Russia’s likely nonstrategic force—the significance of which will become increasingly important with further reductions of strategic weapons.

The size of the stockpile is not itself a major impediment to strategic stability, however, nor is it the metric for deterrence. The stockpile should be sized to how its composition and diversity matches the goals of nuclear strategy, not to meet a particular number of weapons. The 2010 NPR notes that stockpile reductions beneath New START levels could be taken only if they “strengthen deterrence.” *Strengthening* deterrence and strategic stability is not the same thing as modest and acceptable weakening of deterrence capabilities.

Although reductions in the stockpile should not be pursued for their own sake, the current and steady downward trajectory in the number of weapons is nevertheless a fact. While future events could surely arrest this trend, and while a responsive infrastructure and deeper Russian reductions could reduce the needed technical and geopolitical hedges, this trajectory is likely to continue for the immediate future.

LOWER YIELDS

Another remarkable trend has been the reduction of weapon yields within the U.S. stockpile. From a peak of 20,491 megatons, the gross stockpile yield dropped by 88 percent to 2,375 megatons in 1994, with a calculated average yield of 216 kilotons across 10,979 stockpile weapons. Supposing that the average yield remained the same, the calculated yield of the stockpile in 2013 would have been 1,038 megatons (probably lower), a 95 percent reduction.¹⁹ Increasing accuracy would permit continued reductions of yield for some weapons and therefore continued reductions in both the gross yield of the stockpile and the average weapon yield. If modern delivery systems allow a subkiloton warhead to reliably accomplish comparable effects that was once possible only with 10 kilotons, such substitutions could communicate the seriousness with which the United States treats the nuclear mission.

As compared with only a few decades ago, the United States and many other nations now have significantly higher expectations for applying the international law of armed conflict. Commitment to these principles for the nuclear mission was highlighted in the U.S. 2013 nuclear employment guidance, that “all plans must be consistent with the fundamental principles of the Law of Armed Conflict. Accordingly, plans will, for example, apply the principles of distinction and proportionality.”²⁰ The law of war does not necessarily preclude nuclear employment, but it would seem to point in the direction of more discriminate delivery systems and weapon yields that are lower and more variable.

19. DoE Office of Science and Technical Information, “Nuclear Weapons Stockpile Data Table,” <https://www.osti.gov/opennet/forms.jsp?formurl=document/rdd-3/rdd-3i.html#ZZ80>.

20. DoD, “Report on Nuclear Employment Strategy,” 8.

Lower-yield and more precise weapons are more compliant with discrimination principles and are more consistent with the larger trends of today's precision targeting capabilities. The modifications currently under way for the new B61-12 tailkit, for example, include Joint Direct Attack Munition (JDAM)-like precision guidance instead of parachute delivery, and proportionately reduce the yield necessary to deliver the same effect. Besides not incorporating the earth-penetration ability (and the absence of a life-extension program for the B61-11), it would be unfortunate if the B61-12 provided less yield flexibility than currently available among B61 variants.

It is frequently said that creating lower-yield weapons or otherwise creating new capabilities to deliver them credibly will somehow make nuclear use more likely, but the opposite may be the case. One significant way to provide greater flexibility and credibility would be with the exploration of weapons with yields lower than those currently deployed or planned on the B61-12, capable of being delivered by a variety of delivery systems. The United States currently deploys variable-yield W80 weapons on ALCMs; yields comparable or lower than those planned for the B61-12 should be considered for the W80-4. Lower- and variable-yield weapons should also be available for mating to a wide variety of delivery systems, including each leg of the triad, DCAs, and cruise missiles.

The United States should also explore ways to sustain and improve its nuclear earth-penetration capability ability to hold at risk hardened and buried targets. The conventional Massive Ordnance Penetrator (MOP) is, however, insufficient to hold some targets at risk. The need for a new penetrator will become more pressing when the B61-11 approaches the end of its service life, but a more capable earth penetrator may be explored sooner. Alternatively, an improved version of the MOP's shell could be fitted with a nuclear warhead. Larger-yield weapons such as the W88 or the higher yields of the B83 may continue to play an important role for HDBTs.

Low-yield weapons will probably not, however, become the backbone of the future strategic deterrent. Even if all targets could be held at risk with precision-guided conventional warheads, high-yield weapons may still play an important role as a hedge and to ensure that the threat of major nuclear war remains truly terrible.

NEWER WARHEADS

Any serious discussion of the future nuclear posture will again have to wrestle with the question of newness. Following previous statutory restrictions, the 2010 NPR expressed that the United States will not develop new nuclear warheads, will use only nuclear components based on previously tested designs for life-extension programs, and that the United States will not support new military missions or provide for new military capabilities. These restrictions might be interpreted either as an addition to the capabilities currently deployed, or as an addition to the designs and capabilities from within the historical stockpile. The latter interpretation permits more flexibility.

The diversity of legacy warheads and capabilities represents a perhaps underappreciated pool from which the United States can draw to reshape a future force, consistent with strategic need and contemporary expectations for safety, surety, reliability, and effectiveness—possibly without the need for testing. Weapon designs in the current and past stockpiles, as well as others tested but never deployed, could perhaps be useful in the future.

While technological advances long ago rendered nuclear artillery, atomic demolitions, and other historical weapons an obsolete capability, a wider set of missions and effects may help strengthen deterrence. It is simply too soon to know, for instance, if the force of 2050 would benefit from enhanced radiation, low-radiation, or electromagnetic pulse weapons. The test for whether a particular capability is needed should be driven by strategy and technical possibility, and not by whether the design is currently in the active stockpile or whether it existed in 1992.

For the near term, policymakers should first consider allowing and charging the national laboratories to further investigate the range of the historical stockpile systems by affirming that Cold War legacy systems are not “new.” The nuclear infrastructure must be exercised to maintain the set of skills to produce new capabilities. To this end, the national laboratories should be encouraged to explore the greater potential of these past, “non-new” designs.

For the truly longer term, sustainable deterrence may require a degree of flexibility beyond leveraging historical U.S. nuclear designs. Drawing on past capabilities and designs, even if not currently deployed or active, might be an intermediate step toward some future time frame and would help sustain the necessary intellectual infrastructure in the national labs. In the coming years, the state of verification technologies and patterns of arms control treaty compliance may further clarify the merits of ratifying the comprehensive test ban.

None of this is possible, however, without revitalizing the nuclear weapons infrastructure. Despite some progress, its implementation remains still far from certain. The uranium and plutonium facilities that, as of 2010, were supposed to be implemented in 2018, have now been pushed out to 2027 or later. The pit and subassembly production goals stated in 2010 have likewise since been lowered. Continued progress on the path to modernize the U.S. nuclear infrastructure remains essential to a sustainable nuclear deterrent.

DELIVERY SYSTEM DIVERSITY

Commentators frequently talk about “the triad” as a venerable legacy of the Cold War, but the extent of past diversity is often underappreciated. The triad itself was not designed or built as a system. The synergies of the structure were discovered only after the individual pieces had been developed individually, as products of both interservice rivalry and a general willingness to experiment in the pursuit of diversity. The robustness and

imagination of strategic thought, and the diversity of research and development, permitted the remarkable technological evolutions today taken for granted.

Indeed, today's nuclear forces are a small subset of that produced in the past golden age of diversity. Cold War nuclear forces included the ICBMs, SLBMs, bombers, and dual-capable aircraft (the quadrad we still retain)—but also included ground-based cruise missiles, sea and air platforms, nuclear air defense missiles, depth charges, nuclear missile defenses, cruise missiles, artillery, medium and intermediate range missiles, and demolitions.²¹ Atomic artillery and demolitions, for instance, are extinct species that will probably never need to be resurrected, but the existence of this larger field speaks to diversity beyond today's triad and the currently deployed weapons.

Many Cold War delivery systems had what we today call “multimission” flexibility. Sea-based fleet defense missiles might also serve as an antiship missile, and land-based surface-to-air missiles (SAMs) might have a secondary surface-to-surface role. Warheads were likewise sometimes modified and repurposed across missions and platforms.

One recent example of the contracting post-Cold War force is with the end of a sea-launched cruise missile capability. The nuclear Tomahawk land-attack missile (TLAM-N) has long been the extended deterrence weapon for the Asia Pacific. The decision to retire TLAM-N was reportedly based in part on safety and cost concerns, but restoring some similar sea-based capability may prove desirable in the longer term. Russia, for example, has recently increased its sea-launched cruise missile (SLCM) deployments, including submarines reportedly operating off the east coast of the United States.

The development of the Long-Range Standoff (LRSO) cruise missile provides an opportunity to diversify its basing to include launching from DCAs, a naval version based on surface or subsurface ships, and even ground launch. The credibility of air-delivered weapons could be impaired, however, if the future W80-4 does not provide as diverse a range of options as the B61.

To enable greater delivery system diversity, the following options should be begun, continued, or explored:

- LRSO development should support both conventional and nuclear missions.
- Nuclear-capable LRSOs should be capable of being launched from various domains and platforms. Like Tomahawk and other missiles, LRSOs should be built with variants, such as for delivery by bombers and dual-capable F-35s (LRSO as ALCM), from ships (LRSO as SLCM, to replace TLAM-N), and potentially ground launched if the INF Treaty goes away (LRSO as GLCM). A “Short-Range Standoff (SRSO)” variant should also be considered.

21. Thomas B. Cochran et al., *Nuclear Weapons Databook: Vol. I: U.S. Nuclear Forces and Capabilities* (Cambridge, MA: Ballinger/Natural Resources Defense Council, 1984), 7–11.

- Ability to forward deploy nuclear weapons in the Asia Pacific, such as Guam, Japan, Hawaii, and South Korea, including from F35Cs on aircraft carriers.
- The future ICBM should retain upload MIRV capability and should incorporate increased accuracy to permit lower-yield weapons.
- Lower-yield primary-only packages could be introduced on SLBMs and ICBMs.
- Intermediate-range ballistic or cruise missiles might be acquired by adopting innovative multission transferability to existing nonnuclear delivery systems. The motors and airframes for JASSM-ER, AMRAAM, SM-6, LRASM, and even SM-3 IIA, for example, might conceivably be converted to carry different payloads, as might other solid rocket motors currently available. These missiles could potentially be launched from land, sea, or air, including from the navy's Vertical Launch System.
- The solid-rocket motor and larger missile industrial base should be kept active, to permit new types of cruise and ballistic missile delivery systems, hypersonic cruise missiles, other boost-glide vehicles, and for responsive space-launch capabilities.
- Work on conventional prompt strike and missile defenses can be applied to nuclear systems, to create hybrid ballistic/cruise trajectories capable of maneuvering and penetrating adversary air and missile defenses.

MORE DISTRIBUTED AND FORWARD

Given the future technological capabilities of adversaries, higher concentrations of deployed weapons will likely incur greater risk in terms of survivability and resilience. To respond to this problem, the triad should be preserved but supplemented with the addition of smaller nuclear-capable ballistic and cruise missiles capable of distributed deployment at sea, air, and land. The navy's recent "distributed lethality" concept suggests a wide variety of offensive and defensive missiles distributed over a wider number of ships to distribute both risk and striking power.²² Related trends could encourage a similar distribution of nuclear weapons.

Under New START, the United States will deploy 55–70 percent of its nuclear force on SSBNs, assuming bombers are not uploaded. In the event of significant ASW advances, SSBNs may lose some of their unique survivability, and thus require a rebalance to other means of delivery. Since ASW targets not the missiles but the SSBN, increased distribution or dispersion would be desirable in the number of SSBNs at sea and in their operational concepts to maximize deception, dispersion, and evasion. The number of tubes per submarine may be relatively lessened while the number of SSBNs at sea at any given time would become relatively more important.

22. Vice Admiral Thomas Rowden, Rear Admiral Peter Gumataotao, and Rear Admiral Peter Fanta, "Distributed Lethality," *Proceedings* 141, no. 1 (January 2015).

The forward deployment of nuclear forces continues to serve a special role for nuclear coupling with those allies under the U.S. nuclear umbrella. The United States should retain and periodically demonstrate the capability to forward deploy nuclear weapons to the Asia Pacific, Europe, and the Middle East, both on land and at sea. The forward deployment of B61 nuclear weapons in Europe should be continued, consistent with agreement of NATO and the host countries. Consistent with the 2010 NATO Strategic Concept, joint military exercises implicating the nuclear mission should be held with NATO and non-NATO allies, with U.S. and non-U.S. dual-capable aircraft. In response to INF violations, the United States should look at other possible deployments, such as rotational bomber deployments, ALCM/LRSO deployment, and additional temporary forward-weapon storage facilities or mobile surge capacity.

MORE INTEGRATED

Still another trend that the future nuclear force should continue is the greater integration of nuclear deterrence with conventional strike options and missile defenses, a point apparently embraced by both the 2001 and 2010 NPRs and their subsequent employment guidance documents of 2002 and 2013. In a scenario of limited nuclear employment to defeat North Korea, for example, the majority of targets would probably be destroyed by non-nuclear means.²³

Conventional prompt strike, boost-glide vehicles, and new cruise missiles should be explored for improved conventional deterrence, including an increased emphasis in non-nuclear strike capabilities to destroy targets prior to launch. Unmanned missile-based strike capabilities should be of various ranges, basing options, and types of warheads (including hypersonic and maneuverable glide vehicles).

Nonnuclear missile strike capabilities should be developed for deployment on ICBMs, SLBMs, and guided missile surface ships and submarines. Some means should be found to compensate for the missile tubes lost with the SSGN retirements by 2028, such as Virginia payload modules, towed payload modules, or other unmanned underwater vehicles.

Nuclear-armed ICBMs could be converted to conventional prompt global strike (CPGS) systems or left in silos unarmed. For the benefit of increased survivability, these could be interspersed to enhance the ICBM force as a missile sink, by creating uncertainty at a lower number of deployed systems. To be sure, colocation of conventional and nuclear launchers is alleged to present difficulty for crisis instability if, for example, a conventional strike at a regional actor was misinterpreted as an attack on Russia. To help avoid misperception, separate packs of conventionally launched ICBMs, such as older Minuteman III, could be used for conventional strike.

The credibility of nuclear forces will require integration with nonnuclear strike systems across the various combatant commands. The operational integration of conventional

23. See for example, Bruce W. Bennett, "On U.S. Preparedness for Limited Nuclear War," in *On Limited Nuclear War in the 21st Century*, ed. Larsen and Kartchner, 225–27.

and nuclear “combined arms” should be further exercised, including greater planning for nonnuclear weapons operating in a nuclear environment.

Regional and homeland defenses for ballistic and cruise missile threats should continue to evolve in numbers and quality, both for the United States and for our allies and partners. These defenses will continue to grow in importance for damage limitation, maximizing decision time, for intra-war deterrence, and for reducing the likelihood of penetration by small attacks.

The trend of continued advances in conventional weaponry and its integration in the nuclear mission could help further reduce the relative role of nuclear weapons. Even in the unlikely event that technological advances were able to hold at risk every conceivable target with nonnuclear means, however, nuclear weapons will still likely remain essential to deterring attack and to hedging against future threats. Nuclear weapons will not become impotent and obsolete anytime soon.

The Near Term

During the Bush administration, proposals for modernization were stalled, and both a robust nuclear earth penetrator and a reliable replacement warhead were defeated. During the Obama administration, by contrast, the modernization of the nuclear enterprise has begun and a serious path laid out for the future nuclear force should be sustained. Continuing that progress represents the most important near-term priority for the nuclear enterprise, and without it future enhancements to the future force will not be possible.

The above analysis laid out a number of possibilities for the future force of 2025–2050, but these possibilities should not detract from the priorities of the coming decade. The most significant near-term priorities remain the recapitalization for delivery systems, weapons, and infrastructure, which should be continued without further delays or contraction, including:

- Uranium and plutonium facilities, with capabilities specified comparable to the 2010 Stockpile Stewardship and Management Plan (SSMP) report and on the timelines currently agreed upon by Congress and the administration.
- At least 12 *Ohio*-replacement SSBNs should be produced with no fewer than 16 missile tubes per ship, and these should begin operation by 2031, with the ability to produce more if needed to meet deterrence requirements in the 2040s and beyond.
- Under New START (scheduled to last until 2021, possibly 2026), up to 70 percent of the U.S. nuclear deployed force will be on submarines. These tubes might include substitutions of cruise missile launch rather than SLBMs while retaining upload potential.

- Development of the replacement ICBM should have substantial C3 improvements, an examination of road-mobile and other basing modes, and should retain upload capacity.
- The B61-12 Life Extension Plan (LEP) should be completed, to produce a precision-guided, capable of lower yields and a various means of delivery.
- LRSB purchased in sufficient quantities (80–100) to suppress cost, supporting both conventional and nuclear missions.
- LRSO produced on time without further delays, with exploration of multiple basing modes.
- Retain B-52Hs and B-2As as standoff bombers and continue plans for dual-capable F-35s.
- Pursue hypersonic maneuvering delivery vehicles, including for INF-range missiles.
- Study the prospects for a nuclear earth-penetration capability to counter hardened and deeply buried targets, either by life extending or replacing the B61-11.
- Use modern management practices and competition to bring down the cost and reduce delivery times for components of the nuclear arsenal.

The post–Cold War deferred investment and recapitalization has resulted in numerous significant bills coming due for multiple strategic weapon systems within the next few decades. Several high-profile events have also called into doubt the most fundamental basis for deterrence: leadership and high-level belief in the nuclear mission. In late 2014, outgoing secretary of defense Chuck Hagel affirmed that the “nuclear deterrent plays a critical role in assuring U.S. national security, and it is DoD’s highest priority mission.”²⁴ The extent to which this will be continued and implemented remains to be seen.

Conclusion

The Strategic Posture Commission noted in 2009 that the abolition of nuclear weapons is unlikely to occur absent a fundamental transformation of the world political order.²⁵ Whether or not one would wish for such a political transformation, and regardless of what weapons supplant nuclear weapons, this aspiration is unlikely to be realized anytime soon. Nuclear deterrence needs to be sustained for the indefinite future, and the force required to do so will differ from that of today.

24. Secretary of Defense Chuck Hagel, “Message to the Force on Our Nuclear Enterprise,” Washington, DC, November 14, 2014.

25. William J. Perry and James R. Schlesinger, *America’s Strategic Posture: Final Report of the Congressional Commission on the Strategic Posture of the United States* (Washington, DC: U.S. Institute of Peace, 2009), 17.

The strategic environment of 2025–2050 is likely to become more complicated, more unpredictable, and more nuclear. The current U.S. nuclear force may not, however, be well suited to the challenge. In the short term, the path of modernization and recapitalization of existing forces and capabilities must be continued without further delays. For the longer term, however, more significant changes may be necessary to strengthen credibility and flexibility.

To better meet these challenges, the future nuclear enterprise and nuclear force would benefit from a responsive infrastructure and liberated national labs, a smaller but newer stockpile, lower and variable yields, a more diversified set of delivery systems, greater distribution and forward deployment, and further integration with nonnuclear capabilities. Both the 2017 nuclear posture review and several near-term procurement decisions will provide opportunities to review and potentially advance some of these capabilities.

Appendix H. Template and Framing Assumptions for Think Tank Team Papers

Purpose

- Identify issues and questions to be addressed by each of the think tank teams.
 - Ensure answers are comparable within a common framework.
- Establish “framing assumptions (FAs)”—trends, likely developments, generic descriptions—that establish the boundary conditions for think tank team analysis.
 - Teams are free to depart from the framing assumption, but should explicitly identify when and how they are departing.
- FAs will also be included in the separate CSIS papers on the 2030+ security environment, 2025–2050 technological possibilities for nuclear weapons, and adversary nuclear strategies for coping with the United States and its superior conventional capabilities.

Some Initial Comments

- The 2030+¹ “Likely Future” is a projection of current trends and likely developments that takes the current security environment as its departure point and projects how it evolves *in the absence* of “wild cards,” discontinuities, “black swans,” and other game-changing events that would significantly change the nature of the 2030+ security environment.
 - Working-group participants were divided on how static or dynamic the current security environment and how different the 2030+ Likely Future will be from today’s world. Participants were also divided on how much strategic uncertainty

1. The time frame for the Likely Future has been changed from 2025–2050 to 2030 and beyond or 2030+. 2030+ is far enough into the future that a new nuclear capability could be developed and fielded, but not so far in the future (as many felt was the case with 2050) that it was difficult to forecast a Likely Future.

there was about the future security environment and, presumably, how much of their nuclear strategy would be driven by the need to hedge for uncertainty.

- There is no expectation that the think tank team will reach agreement on these issues, although each team should state explicitly their assumptions on uncertainty, both strategic and tactical.
- Once the alternative futures (such as world of 16–18 nuclear powers rather than 9–11² projected in the Likely Future) have been identified, the think tank teams would address how their recommended strategy and nuclear posture (for the Likely Future) would vary (if at all) for the alternative futures.
 - The teams may identify additional futures (and their associated nuclear strategy and posture) but must address the set of futures (“Likely” plus three more) identified in the CSIS paper on the 2030+ security environment.
- FA #1: Assume approximately the current level of resources (about \$30 billion per year in constant 2013 dollars, comprising approximately 4 percent of the total defense budget) over the 2015–2050 time frame to modernize and sustain the nuclear arsenal and nuclear command and control (NC3), plus the infrastructure that supports it.³
 - This is a relatively constant level of effort across the 35-year time period, but assumes that it will vary from year to year (particularly in the early 2030s when several modernization programs overlap).

The Role of the United States and its 2030+ National Security Strategy

- FA #2: As the world’s strongest (although its margins are decreasing) military power, still with many economic strengths, the United States will continue its post–World War II role as a provider of global stability and principal architect of the international order.
- Administrations, of course, have varied considerably in how broadly they have defined this role and how effectively they have played it, but none have abandoned an activist, outwardly focused foreign policy for an inwardly focused “Fortress America” isolationism.

2. Nine current nuclear powers, plus Iran (should it acquire nuclear weapons) and Saudi Arabia (should it acquire nuclear weapons). While Project Atom participants were divided on prospects for Teheran’s joining the nuclear club and even more divided on whether Riyadh would follow suit, there was little pushback to the CSIS study teams’ assumption that a world of 10 or 11 nuclear powers would be more complex and uncertain than the current world, but far different from one with 18 nuclear powers.

3. Although the fiscal environment out to FY 2030+ is likely to cause continued downward pressure on the defense budget top line, the relatively small percentage of the defense budget devoted to nuclear modernization suggests that budget pressure alone will not necessitate cutbacks in U.S. nuclear forces. Sustaining a program that is 4 percent of the defense budget is considerably easier than a program two or three times as large.

Strategic Weapons

- FA #3: Unlike the Cold War, when “strategic deterrence” usually referred to “nuclear deterrence,” nuclear weapons in the twenty-first century are one of several weapons that can have strategic effects on a crisis or conflict. The FAs about the relationship between nuclear weapons and other “strategic weapons” are as follows:
 - BMDs will continue to improve with greater reliability in defending against regional small-scale missile attacks but with little utility against nuclear arsenals the size of Russia’s and China’s.
 - While border security capabilities will also continue to improve, irregular means of delivering a nuclear weapons cannot be entirely eliminated.
 - Unmanned systems, and advances in intelligence, surveillance, and reconnaissance (including enhanced, cheap sensors and ability to process massive data) could degrade the survivability of submarines.
 - By 2050, the capacity for destruction and disruption of chemical and biological weapons and offensive cyber weapons will be widely appreciated, which will increase the perceived need to deter and defend chemical, biological, and cyber attacks (although not necessarily with nuclear weapons).
 - The vulnerability of space-based assets will grow while the cost of access to space for all will decrease, but nuclear weapons will not have been deployed in space and space-based lasers will remain impractical.
 - Improving CPGS capabilities will increase concern among some (if not all) nuclear-armed powers about the risk of nonnuclear attacks on their nuclear weapons, which (when combined with more effective BMD) negate their assured second-strike capability against the United States.

Nuclear Strategy

- Identify principal role/function of U.S. nuclear weapons in support of U.S. national security strategy in this future time frame. What is their relative value to American security?
 - Deter whom from doing what?
 - Role of extended deterrence and assurance?
 - War termination?
 - Retaliation?
 - Preventing further nuclear proliferation?
- Describe the general nature of the declaratory and employment policy that supports recommended strategy for nuclear weapons.

Nuclear Posture

- FA #4: Assume that a healthy nuclear complex supports the recommended nuclear posture.
 - Weapons do not need to be retained in the stockpile as a technological hedge.
- FA #5: assume that the current U.S. policy against introducing new nuclear weapons or new nuclear capabilities has been dropped.
 - Although current policy goals (such as the long-term pursuit of a world without nuclear weapons) and constraints (such as the introduction of new nuclear capabilities) have been lifted as part of this study's zero-based approach to nuclear strategy and posture, think tank teams are free to embrace them as part of their recommended approach.
- FA #6: The paper is agnostic on whether nuclear testing has been resumed but assumes (a) that the United States would not be the first major nuclear power to resume testing, and (b) a future U.S. president would be unlikely to resume testing solely for the purpose of testing a new weapons design.
 - Identify key capability attributes/characteristics:
 - Such as survivable, flexible, secure, reliable, etc.
 - Relationship to other key strategic technologies, be they cyber, electronic warfare, conventional global strike, etc.
 - Weapons:
 - Key capability characteristics (e.g., variable yield)
 - Desirable weapons effects (low collateral, EMP, ERW, etc.)
 - Stockpile (approximate size, deployed/nondeployed ratio, strategic/nonstrategic composition, etc.)
 - Other?
 - Delivery systems:
 - Types: SLBMs, ICBMs (fixed and mobile), bombers, tactical fighters, unmanned air and maritime systems, cruise missiles, etc.
 - Approximate numbers of each type
 - How many types of delivery systems

Appendix I. Technological Possibilities for Nuclear Weapons in 2025–2050

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I. Key Findings

- a. *Special nuclear materials.* While technology will be available in this time frame that could encourage and enforce nonproliferation, special nuclear material is likely to be easier to produce than it is today, and efforts to begin military programs more difficult to detect or regulate.
- b. *Warhead design.* No major advances are expected during this time frame; however, all nuclear powers will modernize their existing nuclear warheads, and Russia and China may pursue new warhead designs optimized for EMP or “clean” low-yield warheads.
- c. *Delivery systems.* More actors are likely to have more capable delivery systems (particularly ballistic and cruise missiles), which they will deploy in familiar ways (e.g., land mobile) and new ways (e.g., unmanned systems technology).
- d. *Convergent offensive technologies.* Developments in space, cyberspace, autonomy, and chemical and biological weapons will make more complex the considerations of deterrence and strategic stability.
- e. *Convergent defensive technologies.* Defenses will continue to improve in this time period, with potential for a change in the affordability and effectiveness of limited missile defense, and potential to hold at risk an adversaries’ deterrent through increasingly capable ISR.

1. The author relied primarily on background interviews with leading experts with significant scientific and technical expertise. A literature review confirmed an absence of specific writing on this topic. Instead, the existing literature is fragmented among discussion of future nuclear use with superficial understanding of underlying technology trends, nuclear nonproliferation-related considerations, missile defense and ballistic and cruise missile discussion, and general technology futures work absent consideration of nuclear weapons application. This draft version reflects comments received from fellow Project Atom scholars during the 9 June 2014, meeting.

II. Special Nuclear Materials

- a. Overall: While technology will be available in this time frame that could encourage and enforce nonproliferation, special nuclear material is likely to be easier to produce than it is today, and efforts to begin military programs more difficult to detect or regulate.
- b. Enrichment could be easier to achieve and more difficult to detect.
 - i. Additive manufacturing² has notable potential to increase access to specialty equipment for enrichment while decreasing likelihood of detection.
 1. Additive manufacturing brings processes that previously required specialized industrial capacity and facilities and scales them down significantly to functioning production lines that could fit in a small facility and at significantly reduced cost (in particular, magnitudes less sunk infrastructure cost).
 2. Specialty equipment/parts already can be transmitted virtually by supplier networks.
 - a. For example, centrifuge tubes can be fabricated from e-mailed schematics using a special output device that layers metal alloys according to the digital plans in three dimensions.
 - ii. Existing methods of uranium enrichment (U-235 via gaseous diffusion or gas centrifuge) will continue to be incrementally improved.
 - iii. Isotopic separation of uranium based on photoexcitation principles (SILEX) could be feasible at weapons-complex scale.³
 1. The process has commercial backing (e.g., GE Hitachi has applied for a U.S. plant license).
 2. Laser enrichment plants are smaller and therefore could be more difficult to detect than existing enrichment facilities.⁴
- c. During this time frame, technologies could also reinforce the nonproliferation regime.
 - i. Modular and thorium reactors could make it more difficult to covertly redirect civilian-use nuclear material.

2. “Additive manufacturing” is the preferred term for “three-dimensional printing.” Traditional metal work can be considered “subtractive manufacturing” because it begins with larger pieces of materials that are shaped, or reduced, to a final part, which in turn is often mated with other parts. Additive manufacturing fashions allow new design complexity and precision. It is different from other information technology-driven precision methodologies, such as computer-numerical-control (CNC) machining, which are subtractive. It is most different because it is significantly cheaper to acquire and operate and it is capable of more complex and potentially much stronger designs.

3. U.S. Nuclear Regulatory Commission, “Uranium Enrichment,” <http://www.nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html>.

4. William J. Broad, “Laser Advances in Nuclear Fuel Stir Terror Fear,” *New York Times*, August 20, 2011, <http://www.nytimes.com/2011/08/21/science/earth/21laser.html?pagewanted=all&r=0>.

- ii. Improved fissile material detection technologies (better, more numerous, more affordable sensors deployed in novel ways) could make it more difficult to smuggle nuclear material.
- d. Reprocessing will continue to pose a latent risk for diversion to military programs and breakout.⁵
 - i. Public pressure globally is increasing to pursue a “closed” nuclear fuel cycle, given continued public concerns with disposal of nuclear waste generated by lightwater reactors.
 - ii. Most significant risk remains plutonium-uranium extraction (PUREX) that yields pure, weapons-grade Pu-239.
 - iii. U.S. government position maintains that pyroprocessing carries increasing proliferation concern (it is a technique of great interest today in South Korea).⁶
- e. Demand for nuclear power and the construction of new plants will grow fastest in Asia during this time period.⁷
- f. The development of a pure fusion weapon is a breakout wild card (nearly impossible to detect, uses only tritium and deuterium).

III. Warhead Design

- a. Overall: No major advances are expected during this time frame; however, all nuclear powers will modernize their existing nuclear warheads, and Russia and China may pursue new warhead designs optimized for EMP or “clean” low-yield warheads.⁸
 - i. The U.S. nuclear enterprise remains in a late-to-need posture (10–20 year cycle development time), while newer complexes are more agile in meeting emerging operational needs.
- b. Three available technologies could enable more complex and reliable warheads fielded by other states.
 - i. Additive manufacturing (described in great detail in the previous section) could enable new warhead designs and the fabrication of complex designs at magnitudes of lower costs than current production methods reliant on industrial age (vs. information technology age) approaches to manufacturing.

5. World Nuclear Association, “Processing of Used Nuclear Fuel,” September 2013, <http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Fuel-Recycling/Processing-of-Used-Nuclear-Fuel/>.

6. See Daniel Horner, “Pyroprocessing Is Reprocessing,” *Arms Control Wonk*, April 2011, https://www.armscontrol.org/act/2011_04/Pyroprocessing; and Sarah Weiner, “Reaching an Agreement on South Korean Pyroprocessing,” CSIS, September 18, 2012, <http://csis.org/blog/reaching-agreement-south-korean-pyroprocessing>.

7. Regarding growth of nuclear energy in East Asia, see World Nuclear Association, “Plans for New Nuclear Reactors Worldwide,” March 2013, <http://www.world-nuclear.org/info/current-and-future-generation/plans-for-new-reactors-worldwide/>.

8. For an excellent examination of Russian and Chinese consideration of new weapons designs, see Paul I. Bernstein, “The Emerging Nuclear Landscape” in *On Limited Nuclear War In the 21st Century*, ed. Jeffrey A. Larsen and Kerry M. Kartchner (Stanford, CA: Stanford Security Studies, 2014), 109–17.

- ii. Reactive materials, nanomaterials, and the miniaturization of mechanical devices could have unique applications to nuclear weapons, among other attributes making them more survivable, lighter in weight, and smaller in size.
- iii. Computer modeling and simulation, long harnessed by the United States, in response to the Comprehensive Test Ban Treaty, is widely available and will continue to advance.⁹
 - 1. Highly reliable modeling and simulation could encourage a range of new, untested weapons designs, or unforeseen breakthroughs.
 - 2. Significantly cheaper supercomputing and processing power are available as the commercial market continues to drive down cost, though the limitations of Moore's law will be reached around 2020.¹⁰
 - 3. Quantum computing may emerge sometime in the late 2020s, and it is not possible to predict what follow-on breakthroughs such a system could enable.
- c. Low-yield and "clean" nuclear weapons are emphasized in Russian and Chinese nuclear doctrine and are likely to produce new weapons designs.
 - i. Development of low-yield weapons or EMP-optimized weapons, designed to be more precise and usable near or inside the user's own territory (think inside Chinese "first and second island chains") already may be under way.
 - ii. These weapons could be designed to be mated to more precise delivery systems (see next section).
- d. Focus on rendering territory uninhabitable in the reasonably limited geography of the Middle East could encourage new nuclear states in that region to focus on development of a neutron bomb.

IV. Delivery Systems

- a. Overall: More actors are likely to have more capable delivery systems (particularly ballistic and cruise missiles), which they will deploy in familiar ways (e.g., land mobile) and new ways (e.g., unmanned systems technology).
- b. Current estimates show that this time frame will be heir to significant short, intermediate, and intercontinental ballistic missile proliferation.¹¹
 - i. The "average" ballistic missile could be more capable due to:
 - 1. Availability of precision navigation and timing technology (guidance systems; even commercially available);

9. The United States remains at a marked advantage in the use of this technology because of the existing scientific information it has from previous tests.

10. Joel Hruska, "Intel's Former Chief Architect: Moore's Law Will Be Dead Within a Decade," ExtremeTech, August 30, 2013, <http://www.extremetech.com/computing/165331-intels-former-chief-architect-moores-law-will-be-dead-within-a-decade>.

11. U.S. National Air and Space Intelligence Center, "Ballistic and Cruise Missile Threat," 2013, <http://www.afisr.af.mil/shared/media/document/AFD-130710-054.pdf>.

2. More sophisticated countermeasures to confuse missile defense targeting (especially if China or Russia share technology).
- ii. Greatest change from today: ICBMs to be possessed by more states (e.g., North Korea, Iran).
 1. It is notable that past predictions of ballistic missile proliferation have been overstated; for instance, the Commission to Assess the Ballistic Missile Threat to the United States (“Rumsfeld Commission”) predicted in 1998 that North Korea and Iran would have an ICBM that could strike the continental United States within five years of a decision to pursue the technology.¹²
- c. Cruise missiles are likely to proliferate during this time frame.
 - i. Cruise missiles are attractive as a means to defeat missile defense.
 - ii. Cruise missiles can fly below radar, hide using key terrain features.
 - iii. Cruise missiles could be used potentially as a deniable/irregular delivery vehicle (e.g., Russia’s “Club K” launcher disguised as containerized shipping).
- d. Precision-guidance technology is spreading rapidly in the conventional domains and is likely to be used in new nuclear weapons delivery vehicles.
 - i. Precision-guided technology could significantly change targeting practices and increase belief in ability to use nuclear weapons with greater discrimination, particularly when mated with a low-yield, lower-radiation (“clean”) warhead.
- e. Road-mobile missiles are likely to remain a difficult targeting challenge, and therefore will remain central to the nuclear posture of many states.
 - i. China and North Korea have paired road-mobile missiles with the use of vast tunnel networks, further complicating the targeting problem.
- f. Penetrating tactical fighter aircraft and bomber-delivered weapons could be at greater risk due to the proliferation of anti-access defensive weapons systems, and the growth of these high-end defensive systems will discourage most countries from pursuing fifth- and sixth-generation penetrating strike.
 - i. The United States will likely field its follow-on long-range strike penetrating bomber by this time frame; the future of Russia’s new PAK-DA heavy bomber is less certain.
 - ii. Hypersonic standoff nuclear munitions could be a more attractive alternative to penetrating bombers and fighters.
- g. Boost-glide rockets are currently considered in the context of conventional strike, but could have utility to defeat missile defenses and “open the door” for nuclear weapons.
 - i. This technology is likely to be fielded only by China, Russia, and the United States in this time frame.

12. “Executive Summary of the Report of the Commission to Assess the Ballistic Missile Threat to the United States,” July 15, 1998, <http://www.fas.org/irp/threat/bm-threat.htm>.

- h. Countries likely will continue to view the sea as a secure domain for a second-strike deterrent, though vulnerabilities—or at least rapid offense-defense competition—may grow in this time frame.
 - i. The United States, the United Kingdom, Russia, France, and Israel will maintain nuclear submarine-launched ballistic or cruise missiles. China and India will also field SLBMs well before this time frame.
 - ii. These and other nuclear powers—in particular, Pakistan—will also turn to surface vessels (regular or irregular) to carry nuclear-armed cruise missiles.
 - iii. A significant wild card exists in the potential of new anti-submarine warfare (ASW)/tag-track-locate capabilities that may become available as well as the ability to use unmanned systems to increase the security of existing surface and subsurface maritime platforms (e.g., rapidly countering ASW advances in an offense-defense race; see final paper section).
- i. Air and maritime unmanned systems could be used as delivery systems.¹³
 - i. There will be a general increase in the use of military robotics; other countries are likely to use these as delivery systems, substituting in part for the expense of manned aircraft and naval vessels capable of surviving an anti-access environment.
 - ii. Particularly as the commercial sector increases development and production of unmanned systems, there is increased risk that this could be a delivery system for nonstate actors, or a “deniable” system for states to use.
 - iii. Advances in autonomy and sensors could create increasingly difficult to predict or guard against delivery vehicles (more on autonomy in the section below).
- j. Nuclear weapons are increasingly likely to be “mixed and matched” with the increasing conventional capabilities of other states, and it will therefore be more difficult to ascertain what is a nuclear-specific delivery system.

V. Convergent Offensive Technologies

- a. Overall: Developments in space, cyberspace, autonomy, and next-generation biological and chemical weapons will make more complex the considerations of deterrence and strategic stability.
- b. Any strategic-level consideration of nuclear weapons will need to include space and cyberspace (nuclear C2).
 - i. An offense-defense race, especially related to space-based robotics and resiliency/redundancy, will continue to escalate as the number of space-faring nations increases and commercial space launch grows.

13. Arguably the use of unmanned systems has been with us throughout the nuclear age through the use of ballistic and cruise missiles, and unmanned systems are just the latest development in that trend line.

1. The cost of space lift will decrease dramatically during this time frame, perhaps to as little as \$200 per kilogram to launch into low-Earth orbit (LEO).¹⁴
 2. Miniaturization and the development of nanosatellites will also change the cost to operate in space and will afford greater redundancy and rapid replacement of lost space-based systems.
 3. These space-based assets will, however, remain vulnerable to a range of adversary approaches such as spoofing, dazzling, jamming, and kinetic kill.
- ii. Offensive cyber and other electronic warfare capabilities will be a large area of investment over the next two decades, potentially creating a highly contested and unstable military environment and holding at greater risk assured C2.
- c. The ease of cyber exfiltration of intellectual property could pose a disproportionate threat to those nations “ahead” in any element of technology, and holding out the possibility that any unique advances may rapidly proliferate to multiple nations.
 - d. Autonomy is likely to be widespread in multiple weapons systems by this time, and some countries may choose to integrate it into nuclear C2 to increase surety of retaliation (think USSR’s “Perimeter”¹⁵ but enabled by significantly more sophisticated technology).
 - i. The use of autonomy is already widespread in air and missile defense systems; that it would transition to offensive decisionmaking because it offers decisive advantage is possible.
 - e. Next-generation chemical and biological weapons are likely to be increasingly lethal and indistinguishable from each other.
 - i. An inherently dual-use field, the life sciences are experiencing a sustained period of innovation, particularly leveraging information sciences and the advent of “synthetic” biology.
 - ii. Biology and chemistry are increasingly intertwined in the academic and commercial worlds, and that is likely happening in military development as well.

VI. Convergent Defensive Technologies

- a. Overall: Defenses will continue to improve in this time period, with significant potential for a change in the affordability of limited missile defense, and potential to hold at risk an adversaries’ deterrent through increasingly capable ISR.

14. “Nanosats Are Go!,” *Economist Technology Quarterly*, June 7, 2014, 18–20, <http://www.economist.com/news/technology-quarterly/21603240-small-satellites-taking-advantage-smartphones-and-other-consumer-technologies>.

15. David E. Hoffman, *The Dead Hand: The Untold Story of the Cold War Arms Race and Its Dangerous Legacy* (New York: Doubleday 2009), 143–54.

- b. Cyberspace and the electromagnetic spectrum are increasingly vulnerable and relied on, and the need to defend them will drive solutions such as quantum-based encryption.
 - i. The development of quantum encryption during this time period could rapidly decrease this vulnerability and represent a decisive advantage.
- c. Radars and other sensors of all types (air breathing and space based) will also continue to improve in accuracy and could begin to allow greater “tag, track, locate” of others’ weapons (including land mobile).
 - i. Software to integrate all sensor data, autonomously conducting processing, exploitation, and dissemination, will be a key area of advantage/innovation.
- d. Related to the above point, missile defense technology will continue to improve, driving toward lower cost and greater reliability in point defense against a limited threat, but not useful against an arsenal the size of Russia’s or China’s.¹⁶
 - i. Two technologies will lower the cost and offense-defense imbalance of missile defense, though will have limited application.
 - 1. Electromagnetic rail gun will be available for point defense, especially of naval platforms.
 - 2. Directed energy will be a fielded capability in this time frame.
 - a. In particular, electric lasers will be available for point missile defense.
 - b. Electric laser advances could also allow fielding aboard long-loiter unmanned aerial systems for area defense.
 - ii. Chinese and Russian MIRVs will continue to evolve in sophistication and constitute an extremely difficult challenge for any missile defenses.
 - iii. The chance of a space-based “Strategic Defense Initiative (SDI)-like” capability remains highly unlikely during this time period because of cost and inherent vulnerability.
- e. Unmanned systems could significantly enhance detection capabilities (long loiter, far cheaper to operate in large numbers), in both the air and maritime domains.
 - i. As noted in the earlier section, this could pose a particular threat to a sea-based deterrent, but could also simply represent a rapid offense-defense competition that restores the status quo ante.

16. For an excellent discussion of this topic that informs some of the findings here, see comments by James N. Miller and Dean Wilkening, “What’s Next? Missile Defense in 2030,” Atlantic Council, May 28, 2014, <http://www.atlanticcouncil.org/events/past-events/what-s-next-missile-defense-in-2030>.

Appendix J. Adversary Nuclear Strategies: 2030+

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Overall Assumptions

- FA #1: Russian and Chinese nuclear strategy and posture will remain focused on the United States as a primary strategic competitor; they will continue to hedge against each other as the second greatest threat.
- FA #2: The United Kingdom, France, Israel, and India will not plan against the United States as a nuclear adversary.
- FA #3: North Korea will continue to view the United States as its foremost nuclear adversary, growing its ability to hold at risk allies and U.S. forces and interests in the region, and to reach the continental United States (CONUS) with a small number of nuclear weapons (ICBMs).
- FA #4: Should it acquire nuclear weapons, Iran will plan against the United States and Israel as nuclear adversaries, focusing on targets in the Middle East, but it is unclear whether it will field capabilities to reach CONUS.
- FA #5: Pakistan and Saudi Arabia (should it acquire nuclear weapons) will, through nuclear strategy and posture, seek to deter the United States or any outside power from seizing its nuclear weapons.
- FA #6: Pakistan, India, North Korea, Iran, and Saudi Arabia (should either acquire nuclear weapons) pose a “loose-nukes” threat because of potential internal instability. Pakistan and North Korea pose an additional risk that factions within the state could wittingly transfer nuclear weapons to a nonstate/terrorist group.

Russia

- Russia’s conventional military capabilities and defense industrial base will decline relative to other top-tier militaries throughout this time period, increasing Russian

reliance on the role of nuclear weapons (a strategic trend already well under way), particularly related to territorial defense, and securing its interests in local conflicts in its “near abroad.”

- Related to its overall military and defense-industrial decline and the effect on its sea-based (SSBNs and traditional counter-ASW capabilities) and airborne deterrent (reduced numbers and capability of fighters and bombers), land-mobile missiles will be increasingly central to Russian strategy and posture.
- Affecting strategic stability, Russia will retain focus on next-generation agents in its chemical and biological weapons programs.
- Degradation or failed modernization of Russian space-based early warning and nuclear C2 may prompt further changes to strategy and doctrine.
- Russian nuclear doctrine will emphasize options for escalation control, including “escalating to deescalate” and the use of nuclear weapons on or near its territory against adversaries engaging in conventional warfare.
 - In support of this doctrine, Russia may substitute warheads in its strategic arsenal to include newly developed lower-yield “cleaner” warheads mated to precision-guided delivery systems.
 - Recognizing the importance of net-centric warfare to U.S. and increasingly Chinese conventional dominance, Russia will also likely develop EMP-optimized warheads.
- Russia will maintain its current levels of strategic nuclear weapons according to the New START Treaty, and will maintain its stockpile of nonstrategic weapons at roughly current levels.
- Russia will continue to focus on technological and operational approaches to defeat emerging U.S. missile defense capabilities (a continuing neuralgic for the Russians).
- Russia will retain a large force structure of nonstrategic nuclear weapons and will continue to forward deploy nonstrategic nuclear weapons along its borders, particularly with the Baltic States (including in Kaliningrad Oblast¹) and along its eastern border with China.
- Russia will continue development of next-generation agents in its chemical and biological weapons programs.

1. For confirmation of the presence of tactical nuclear weapons in Kaliningrad, see “Russia Confirms Tactical Missile Deployment on NATO borders,” *RIA Novosti*, December 16, 2013, http://en.ria.ru/military_news/20131216/185614387/Russia-Confirms-Tactical-Missile-Deployment-on-NATO-Borders.html.

China

- China will likely continue to express a public no-first-use policy, but its private doctrine is likely to maintain options for nuclear first use in the event of certain “redline-crossing” actions in regional conflict.
- China will continue to avoid transparency regarding its nuclear strategy and posture, and it will continue denial and deception operations (information and physical).
- Overall Chinese nuclear force structure is likely to grow, with investment in capabilities to ensure survivability of nuclear weapons and C2 in an environment of improved missile defenses, electronic warfare (including cyber operations), and in the conditions of ongoing nuclear war.
- The significant expected development in Chinese conventional capabilities—in particular affecting the People’s Liberation Army Navy (PLAN) and People’s Liberation Air Force (PLAF)—and the growing sophistication of its defense industrial base will allow it to continue to grow the relative strength of the naval leg of its nuclear arsenal, and to invest in an air-delivered leg if it so chooses.
 - Related, China will continue to field more capable hypersonic cruise missiles that it could arm with nuclear warheads.
- Chinese military doctrine will continue to focus on attacking and disrupting the enemy’s electronic information systems across domains (air, space, land, maritime, and cyberspace), including options to use nuclear weapons optimized to create an electromagnetic pulse and attack and disable electronic hardware.

North Korea

- The Kim Jong-un regime or a like faction will maintain power, continuing to emphasize nuclear weapons as a guarantee of survival.
- North Korea will maintain a small arsenal of nuclear weapons, including achieving sufficient miniaturization for a nuclear warhead capable of mounting on a nuclear weapon.
 - Gaining intelligence on North Korean employment doctrine and capabilities will remain extremely difficult.
- North Korea will field the KN-08 ICBM capable of reaching the United States by this time frame, though these will be few in number and of questionable precision and reliability, perhaps possible to mitigate through missile defense.
- North Korea will increase the number and capabilities of its SRBMs and medium-range ballistic missiles (MRBMs; particularly the Musadan-1 and derivatives), including those capable of delivering a nuclear payload.

- North Korea will continue to pursue irregular means of nuclear weapons delivery and may consider provision of nuclear weapons to a nonstate/terrorist group for proxy use or generally against U.S. or allied interests.

Pakistan

- Pakistan will pose a significant “loose-nukes” and nonstate transfer threat because of the continued fragility of the state, the relative insecurity of its nuclear arsenal and special nuclear materials, and the broad presence of Islamist extremist groups with anti-Western political agendas specifically targeting the United States and its allies, and the deep links of these groups to the military and intelligence services.
 - The same is true for North Korea, India, and would be true for Saudi Arabia and Iran (should they acquire nuclear weapons), but to varying and lesser degrees than Pakistan.
- Pakistan’s nuclear strategy will remain focused on Indian aggression, but it will continue to use its nuclear program as a tool of international influence (including in its relations with possible next-wave proliferators such as Saudi Arabia).
- As Pakistan falls further behind Indian technological and conventional capabilities, it will continue to evolve its nuclear strategy and posture to emphasize decentralization of C2 and the use of a wide range of what it may view as secure second-strike delivery vehicles, including irregular naval platforms, unmanned aerial systems, and special forces capable of penetrating Indian borders.
- Pakistan will maintain wariness that the United States and others may attempt to seize control of its nuclear weapons in a crisis, and that may drive further efforts to decentralize or obfuscate storage of nuclear weapons.
 - This makes Pakistan a “gray-area adversary” because it is postured to deter any effort to seize or eliminate its nuclear weapons, even though those concerns are prefaced not on aggression toward it but to address the realistic potential that its weapons will fall into nonstate actors’ hands.

Iran (Should It Acquire Nuclear Weapons)

- Iran will remain an Islamic Republic with the supreme leader continuing to serve as the country’s ultimate authority on nuclear policy.
- Iran’s nuclear strategy would focus primarily on its rivalry with Israel and Saudi Arabia and, to a lesser degree, other Gulf Cooperation Council (GCC) countries.
- Iran would seek to use its nuclear weapons to deter U.S. military actions in the region and reduce overall U.S. political influence in the Middle East, including by coercing states that would seek to cooperate with the United States.

- Iran would acquire a small arsenal of nuclear warheads, including achieving sufficient miniaturization to mount a nuclear warhead on its SRBMs and MRBMs.
- Iran’s ability to field an ICBM capable of reaching CONUS is uncertain, but could draw from North Korean or other third-party capabilities in this time frame.
 - Iran, along with other adversaries across this time frame, could also seek an “irregularly” delivered nuclear weapon, such as firing a cruise missile from a surface ship (potentially even a merchant ship, as in the Russian “Club K” concept for containerized shipping cruise missile system).

Saudi Arabia (Should It Acquire Nuclear Weapons)

- The government of Saudi Arabia will remain a monarchy with the king continuing to serve as the country’s ultimate authority on nuclear policy.
- Saudi Arabia would only reveal or acquire a small arsenal of nuclear warheads, potentially obtained from Pakistan, including achieving sufficient capabilities to mount a nuclear warhead on SRBMs and MRBMs, if it concludes that Iran has a nuclear capability or is close to achieving one.
- Saudi Arabia’s nuclear strategy would focus primarily on its direct rivalry with Iran (and in the context of its guardianship of the Holy Sites) and, to a lesser degree, regional terrorist organizations that threaten regime security, and a distant third, to deter Israeli or other regional state aggression.
- Saudi Arabia’s nuclear strategy and trajectory could develop akin to Pakistan, acquiring nuclear weapons to primarily serve as a deterrent against a regional adversary. With significant cooperation, the Saudi and Pakistani nuclear and missile programs could become inextricably linked regarding infrastructure and technological capabilities.

Appendix K. 2030+ Security Environment: The “Likely Future” and Several Alternative Worlds

Purpose

Establish a common understanding (among the think tank teams) of the future security environment to ensure that all, including the CSIS team, are planning to the *same* future, which includes both strategic uncertainty (about which future actually happens) and uncertainty within each future.

- Why 2030 and beyond (2030)? Far enough into the future to develop and field new military (including nuclear) capabilities if desired. Best point estimate: 2035 nuclear posture.
- Not a comprehensive statement of the future security environment, but focuses on those factors likely to affect 2030+ U.S. nuclear strategy and posture.

Concepts and Terminology

The 2030+ “Likely Future” is a projection of current trends and likely developments that takes the current security environment as its departure point and projects how it evolves *in the absence* of discontinuities, game-changers, wild cards, “black swans,” and other events that would significantly change the nature of the 2025–2050 security environment.

- The think tank teams will formulate their nuclear strategies and design their nuclear postures for this scenario.

The 2030+ Alternative Worlds consist of additional 2030+ scenarios (one with two variants) that may warrant significant changes to the strategy/posture recommended for the Likely Future.

- Think tank teams should identify in general terms how their strategy/posture would be changed (if at all) for each Alternative World but need not describe it in the same detail as provided for their strategy/posture formulated for the Likely Future.

2030+ Likely Future: General Characteristics and Implications for Nuclear Strategy/Posture

GREAT POWER COMPETITION

- The United States still retains significant advantages in several dimensions of national power (e.g., conventional military strength, global network of allies and friends, cultural leadership, per capita income) in comparison to China and Russia, but its overall margin continues to decline versus its near-peer competitors.
 - China, however, is overtaking the United States on several dimensions of economic power (e.g., size of the economy, dominance of some regional trade systems, development assistance) and achieving parity in key military areas (e.g., cyber, psychological warfare, anti-access/aerial denial).
 - Although in long-term economic and demographic decline, Russia continues to “punch above its weight,” in part because of its energy resources, aggressive strategic culture, and its nuclear superiority versus China.
 - Although still major powers within their respective regions, Europe and Japan continue to recede from the global scene.
- Nuclear balance
 - Russia continues to rely on its nuclear forces to sustain its status as a great power and pursues a nuclear-centric security strategy, including coercive diplomacy employing nuclear threats.
 - Investment in nuclear capabilities will remain a top priority, as Russia seeks to maintain (and perhaps improve) its superiority versus China and maintain (and perhaps improve) its rough parity with the United States.
 - Although much less reliant than Russia on nuclear weapons in its security strategy, China will continue to modernize its nuclear forces to ensure a survivable assured destruction capability versus its great power rivals and to maintain its lead over major nuclear powers (e.g., India and Pakistan).
 - While adamantly insistent that it adheres to its no-first-use policy and minimum deterrence principles, China cloaks its actual intentions, strategy and employment policy (which may be only partially formulated).

THE 2030+ NUCLEAR CLUB

- Either 9 members (same as today), 10 members (should Iran acquire nuclear weapons), or 11 members (should Saudi Arabia follow suit).
 - FA #7: There is significant uncertainty about whether current efforts to prevent Iran from acquiring nuclear weapons will be successful. If Iran does join the nuclear club, the incentives for Saudi Arabia to follow suit would be very strong.

While a Middle East with two or three (vs. one) nuclear powers would be considerably more complex and dangerous, the nature of the global system of nuclear powers is assumed to be substantially the same as it is today.

- However, if the addition of two new nuclear powers triggers a “nuclear cascade,” the result would be, as described below, an Alternative World of 18 Nuclear Powers, which would be very different than a Likely World of 9 or 11 nuclear powers.

KEY REGIONS

- Northeast Asia
 - A rising and increasingly confident China is growing more assertive about restoring (after a “century of humiliation”) its role as regional hegemon and securing its “indisputable” territorial claims to 90 percent of the South China Sea.
 - Increased risk of conflict between China and several U.S. allies (Japan, Republic of Korea [ROK], and Philippines) and friends (Vietnam and Malaysia).
 - China is growing its ability to counter U.S. power projection into the region through A2/AD forces and enhancing its ability to project power in the region. At the same time, China is enhancing its ability (particularly in the cyber domain and nuclear realm) to impose costs on the U.S. homeland. However, China will continue to have an interest in preserving stable economic relations with the United States and the region.
 - North Korea is the newest and most unpredictable member of the nuclear club and seems highly unlikely, since it guarantees regime survival, to give up its nuclear deterrent.
 - Will have developed a nuclear-tipped ballistic missile capable of reaching CONUS.
 - The DPRK’s growing nuclear capabilities will embolden its propensity to take provocative conventional actions against the ROK and to defy the United States (and China to a lesser extent).
 - North Korea’s nuclear-enabled bellicosity will test the credibility of U.S. extended-deterrence assurances to Japan and South Korea and will fuel the desire of some in each capital to “go nuclear.”
 - Japanese and Korean calculations on this issue will also be influenced by their perceptions of China and the U.S.-China dynamic.
- South Asia
 - The unstable dynamic between India and Pakistan may carry the highest risk of nuclear employment by a state given Pakistan’s provision of sanctuary (and some

level of backing) for significant terrorist attacks on India and its reliance on nuclear weapons to deter conventional attacks from India.

- Instability inside Pakistan poses a “loose-nukes” threat and could allow a nonstate actor to gain control of a nuclear weapon.
- China also plays a role in this regional dynamic but it is an uneven triangle between the three nuclear-armed powers:
 - China features prominently in India’s strategy, while India is mostly an afterthought to China.
 - China has enabled Pakistan’s entry into the nuclear club but seems to be distancing from its unreliable partner.
 - While the “nuclear shadow” might have inhibited India’s and Pakistan’s risk-taking propensities, there may be less strategic stability (however defined) in this region than any other.
- Middle East
 - The tensions, conflicts and strains (Arab-Israeli, Sunni-Shia, democracy-authoritarian, etc.) show no sign of receding and are unlikely to dissipate significantly by 2035, although (hopefully) they will be less destabilizing.
 - Israel’s undeclared nuclear status has backstopped Israel’s conventional superiority in deterring a major conventional attack.
 - Without prejudging the eventual outcome of the current 5+1 (and U.S.-Iran) negotiations over Iran’s nuclear program, what would be the impact of Iran’s “going nuclear,” however defined (nuclear-capable vs. nuclear tested, declared vs. undeclared, etc.)?
 - FA #8: The incentives for Saudi Arabia, as the leader of the Persian Gulf’s Sunni community, to quickly follow suit would be very strong.
 - FA #9: Neither of the two new nuclear powers are “undeterrable,” although their strategic cultures are distinctively different from other nuclear powers (including each other).
 - However, the regional dynamics with three nuclear powers (instead of one) would be more complex with a greater risk of miscalculation and unintended escalation.
 - U.S. influence in a Middle East with three nuclear powers would be more limited than it is today.
 - Europe
 - FA #10: Russia’s recent belligerence (fueled by resentment, nationalism, and anti-Americanism) is not a passing phenomenon and will roil European security politics until 2030+.

- While mutual deterrence based on the threat of assured destruction will continue to work at the global level, Russia will continue to nibble away at the edges of Europe (yesterday in Georgia and Moldavia, today in Ukraine) to test the resolve of Europe and the United States.
 - While the presence or absence of U.S. forward-deployed nuclear weapons in Europe is an indicator (perhaps significant) of the state of the Transatlantic Alliance, it has little impact on Russia’s strategic calculus.
- FA #11: European solidarity and willingness “to bear any price” will continue to deteriorate, as the United States discovers (in fits and starts) what price it will bear and where it will draw the line against Russia’s creeping expansionism.
- Violent Islamic Extremism¹
 - In calling on al Qaeda members to seek weapons of mass destruction, Osama bin Laden stated that it was the “sacred duty of Muslims” to “kill, fight, create traps and destroy” Americans and drive them out of Saudi Arabia and the Gulf.
 - Nuclear weapons, of course, are not the only weapons that have catastrophic effects. Radiological weapons, chemical weapons, biological weapons, innovative uses of conventional weapons (see 9/11) and (in the future) new weapons that combine nonnuclear weapons to deadly effects.
 - FA #12: Violent Islamic Extremists, who can generate and employ suicide bombers for purely tactical purposes, pose significant deterrence challenges. The United States can more easily defend, disrupt, or kill them. Perhaps the best deterrence strategy is focused on their facilitation network (e.g., financial backers, trainers), which can be attacked nodally.
 - The successful employment of a nuclear weapon by a terrorist group against the United States—perhaps even a series of nonnuclear catastrophic terrorist attacks—could lower the threshold for U.S. nuclear use (in part because of domestic political pressure), but this would occur in AW #2 (Post-Nuclear Use), Variant 2 (Useable Nukes), not the Likely Future.

2030+ Alternative Worlds (AWs)

- AW #1: 18 Nuclear Powers
 - Precipitating events: Loss of credibility of U.S. extended-deterrence assurances and Iran’s joining of the nuclear club triggers a cascade of proliferation.
 - One scenario: United States, Russia, Middle East (Israel, Iran, Saudi Arabia, Turkey, and Egypt); Northeast Asia (China, DPRK, Japan, and ROK), South Asia

1. While other nonstate actors (ranging from non-Islamic terrorists to international drug cartels) pose significant security challenges to the United States, only this one *potentially* has relevance at the nuclear level.

(India and Pakistan), Europe (United Kingdom, France, and Poland), Latin America (Brazil), and Africa (South Africa).

- AW #2: Postnuclear Use
 - Precipitating events: Nuclear weapons are used in a regional conflict or in an act of terrorism.
 - Variant 1: Taboo Strengthened
 - Humanitarian consequences of nuclear incident shocks the world and reinforces the nuclear taboo.
 - Variant 2: Useable Nukes
 - Nuclear weapons evolve into “just another weapon” (see end of World War II and early years of the Cold War) because of the successful employment of a nuclear weapon by a regional nuclear power (e.g., early use by North Korea in a demonstration mode during a U.S.-DPRK crisis forces the United States to back off).
 - Less likely scenario: An act of nuclear terrorism or a series of nuclear-like terrorist attacks against the American homeland causes the United States, fueled by domestic political outrage, to lower the nuclear threshold.
- AW #3: Momentum Grows for Global Zero
 - Precipitating events: The transformation of the international system assumed necessary for the elimination of nuclear weapons actually happens.
 - Very positive political developments (Russia, China, Middle East, etc.) make nuclear weapons less relevant to security needs and reinforces drive to eliminate them, in part to deny access to them by nondeterrable nonstate actors.

About the Authors

Clark Murdock is senior adviser for the Defense and National Security Group at CSIS and director of the Project on Nuclear Issues (PONI). Joining CSIS in January 2001, Murdock has completed studies on a wide range of defense and national security issues, including strategic planning, defense policy and governance, and U.S. nuclear weapons strategy and policy. He directed the four-phase study on Defense Department reform, *Beyond Goldwater-Nichols: USG and Defense Reform for a New Strategic Era*, which released reports in 2004, 2005, 2006, and 2008. Murdock is currently leading an ongoing “track 2” dialogue on nuclear policy issues—the Trilateral Nuclear Dialogues involving the United States, United Kingdom, and France. He has also recently completed studies on methodological approaches to building force-planning constructs and on nuclear posture implications of U.S. extended deterrence and assurance. He is the principal author of *Planning for a Deep Defense Drawdown* (CSIS, 2012), *The Department of Defense and the Nuclear Mission in the 21st Century* (CSIS, 2008), and coauthored *Nuclear Weapons in 21st Century U.S. National Security* (AAAS, 2008).

Before joining CSIS, Murdock taught military strategy, the national security process, and military innovation at the National War College. Prior to that, from 1995 to 2000, he served in the Office of the Air Force Chief of Staff, where, as deputy special assistant to the chief for long-range planning, he helped develop a strategic vision for the 2020 air force. Then, as deputy director for strategic planning, he institutionalized the air force’s strategic planning process and spearheaded the development of new planning products. Before joining the Air Force Chief of Staff’s Office, he was special assistant to the undersecretary of the air force, providing analytic support to the secretary and undersecretary on broad issues of concern, including the future of air power and air force missions. Before joining the air force, Murdock served in the Department of Defense, where he headed the Policy Planning Staff in the Office of the Undersecretary of Defense for Policy and held responsibility for mid- to long-range analysis and planning on strategy and defense policy issues. Prior to joining the Department of Defense, he served for several years on the House Armed Services Committee as a professional staff member and as a senior policy adviser to then-chairman Les Aspin. Murdock’s experience in defense planning and policy also includes service on the National Security Council as senior director for Africa affairs and in multiple roles in the Central Intelligence Agency. Before turning to government service, Murdock taught for 10 years at the State University of New York at Buffalo. He is an honors graduate of Swarthmore College and holds a PhD in political science from the University of Wisconsin at Madison.

Samuel J. Brannen is senior manager in A.T. Kearney's Global Business Policy Council, a strategic advisory service. He joined the firm in December 2014. Brannen was previously a senior fellow in the International Security Program at the Center for Strategic and International Studies (CSIS), where he focused on U.S. defense and security strategy and policy. He also held various positions at CSIS from 2002 to 2009, including as fellow and deputy director of the International Security Program and as assistant director of the Global Strategy Institute. From 2006 to 2007 and again from 2009 to 2013, Brannen served in the Office of the Secretary of Defense including as special assistant to the principal deputy undersecretary of defense for policy; country director for Turkey; special assistant to the deputy undersecretary of defense for strategy, plans, and forces during the process and drafting of the 2010 Quadrennial Defense Review; and as a strategist focused on defense implications of long-range trends. Brannen holds a BA in political science from Trinity University (San Antonio, TX) and an MA in international affairs from the George Washington University. He is a term member of the Council on Foreign Relations and has been awarded the Office of the Secretary of Defense Medal for Exceptional Public Service four times and has also received the Department of State Superior Service Award and Secretary of Defense Award for Excellence.

Thomas Karako is a senior fellow with the International Security Program and the Project on Nuclear Issues at the Center for Strategic and International Studies (CSIS). His research focuses on national security, U.S. nuclear forces, missile defense, and public law. He is also an assistant professor of political science and director of the Center for the Study of American Democracy at Kenyon College. For 2010–2011, he was selected to be an American Political Science Association Congressional Fellow, during which time he worked with the professional staff of the House Armed Services Committee on U.S. strategic forces policy, nonproliferation, and NATO. Karako received his PhD in politics and policy from Claremont Graduate University and his BA from the University of Dallas. He previously taught national security policy, American government, and constitutional law at Claremont McKenna College and California State University, San Bernardino.

Angela Weaver is program coordinator and research assistant for the Defense and National Security Group at CSIS. Her work focuses on a wide range of defense and national security issues, including strategic planning, defense policy and governance, and U.S. nuclear weapons strategy and policy. She has written extensively on nuclear issues and strategy as well as on defense spending trends and the defense budget drawdown. She received a bachelor's degree in history from Wake Forest University, where she focused on international affairs, defense and national security policy, and interstate conflict.

Elbridge Colby is the Robert M. Gates Fellow at the Center for a New American Security (CNAS), where he focuses on strategic, deterrence, nuclear weapons, conventional force, intelligence, and related issues. In 2012 he served as the deputy head for national security personnel on the Mitt Romney pretransition effort and also worked on several of the campaign's security policy teams. From 2010 to 2013, he was a principal analyst and division lead for global strategic affairs at CNA. Before that, he served for over five years in the U.S.

government, including as policy adviser to the secretary of defense's representative for the new Strategic Arms Reduction Treaty, as an expert adviser to the Congressional Strategic Posture Commission, as a staff member on the President's Commission on the Intelligence Capabilities of the U.S. Regarding WMD, with the Coalition Provisional Authority in Iraq, and with the State Department. Colby also serves or has served as a consultant to a variety of U.S. government entities on a range of defense and intelligence matters. In 2014 he served as a staff member for the National Defense Panel.

Colby is a frequent commentator and author on defense and foreign policy issues. He has coedited *Strategic Stability: Contending Interpretations* (2013) and *Nuclear Weapons and U.S.-China Relations: A Way Forward* (2013) and has authored book chapters in a number of edited collections. He also publishes regularly on defense and foreign policy issues in a variety of venues such as the *New York Times*, *Wall Street Journal*, *Politico*, *National Interest*, *Foreign Policy*, *War on the Rocks*, and *Orbis*. He speaks frequently to government, expert, university, and broader public audiences in the United States, Europe, and Asia, and is a regular participant in track 2 discussions. He is a recipient of the Exceptional Public Service Award from the Office of the Secretary of Defense and of the Superior and Meritorious Honor Awards from the Department of State. A term member of the Council on Foreign Relations, a member of the International Institute of Strategic Studies, and cochairman of the Advisory Committee of the Hamilton Society, Colby is a graduate of Harvard College and Yale Law School.

Keith B. Payne is professor and head of the Graduate Department of Defense and Strategic Studies at Missouri State University (Washington Campus). He is also president and co-founder in 1981 of the National Institute for Public Policy, a nonprofit research center located in Fairfax, Virginia. Payne served in the Department of Defense as deputy assistant secretary of defense for forces policy. In this position, he was the head of the U.S. delegation in numerous allied consultations and in "Working Group Two" negotiations on ballistic missile defense cooperation with the Russian Federation. In 2005 he was awarded the Vicennial Medal for his many years of graduate teaching at Georgetown University.

Payne is chairman of the U.S. Strategic Command's Senior Advisory Group, Strategy and Policy Panel; editor-in-chief of *Comparative Strategy*; and cochair of the U.S. Nuclear Strategy Forum. He served on the bipartisan Congressional Commission on the Strategic Posture of the United States, the Secretary of State's International Security Advisory Board, the Department of Defense's Deterrence Concepts Advisory Group, and on numerous other governmental and private panels and commissions. He has lectured on defense and foreign policy issues at numerous colleges and universities in North America, Europe, and Asia. He is the author, coauthor, or editor of over 150 published articles and 18 books and monographs. His most recent book, coauthored with the late Dr. James Schlesinger, is *Minimum Deterrence: Examining the Evidence* (Routledge, 2015). Payne received an AB (honors) in political science from the University of California at Berkeley in 1976; studied in Heidelberg, Germany; and in 1981 received a PhD (with distinction) in international relations from the University of Southern California.

Thomas Scheber is vice president of the National Institute for Public Policy. Before joining National Institute in October 2006, he was director of strike policy and integration in the Office of the Secretary of Defense. At National Institute, he specializes in deterrence strategies, extended deterrence and assurance of allies, and analyses of strategic force issues. In 2008 and 2009 he supported the Congressional Commission on the Strategic Force Posture of the United States. He served as a member and chairman of the Deterrent Force Posture Expert Working Group for the Commission.

From September 2000 to September 2006, Scheber served in the Office of the Secretary of Defense (OSD) for Policy. He played a central role in the conduct of the 2001 DoD Nuclear Posture Review. While at OSD, Scheber was a member of the U.S. delegation to the U.S.-Russia Consultative Group on Strategic Security (Offensive Transparency Subgroup) from 2002 through 2005. From 1989 to 2000, Scheber was a member of the professional staff at the Los Alamos National Laboratory and served as director of the Military Applications Group and project leader for weapon studies. He is a former naval officer and aviator.

Barry Blechman cofounded the Stimson Center in Washington, D.C. and was chairman of its board from 1989 to 2007. He also founded DFI International Inc., a research consultancy, in 1984, and served as its chief executive officer until 2007. Blechman has more than 50 years of distinguished service in national security, in both the public and private sectors. He is an expert on political and military policies, military strategy, and defense budgets and industries. He has worked in the Departments of State and Defense and at the Office of Management and Budget. At various times during his career, he has been associated with the Brookings Institution, the Carnegie Endowment for International Peace, the Center for Naval Analyses, and the Center for Strategic and International Studies. Among other boards and commissions, Blechman served on the Commission to Assess the Ballistic Missile Threat to the United States (1998–1999), the Defense Policy Board (2002–2006), and the Department of State Advisory Committee on Transformational Diplomacy (2005–2008).

Blechman holds a PhD in international relations from Georgetown University, has taught at several universities, and has written extensively on national security issues. In 2012 and 2013 he chaired the Defense Advisory Committee for the Peterson Foundation; the committee's reports, published by Stimson, are titled *A New US Defense Strategy for a New Era* (2012) and *Strategic Agility: Strong National Defense for Today's Global and Fiscal Realities* (2013).

Russell Rumbaugh, at the time this report was prepared, was a senior associate at the Stimson Center, director of the Center's budgeting for foreign affairs and defense programs, and a widely recognized expert on the institutions, processes, and budgets of U.S. national security. He also serves as an adjunct professor at the University of Maryland School of Public Policy.

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