



NATIONAL INSTITUTE FOR PUBLIC POLICY

A NEW NUCLEAR REVIEW FOR A NEW AGE



Dr. Keith B. Payne
Study Director

Dr. John S. Foster, Jr.
Chairman, Senior Review Group

Dr. Kathleen Bailey
Gen Kevin Chilton, USAF (ret)
Mr. Elbridge Colby
Mr. Matthew Costlow
Dr. J.D. Crouch II
Ms. Michaela Dodge
Amb. Eric Edelman
Mr. Fritz Ermarth
Dr. Gary L. Geipel
Dr. Colin S. Gray
Mr. Kurt Guthe
Dr. John Harvey
Ms. Rebeccah Heinrichs
Amb. Robert Joseph
Dr. Thomas Karako

Gen C. Robert Kehler, USAF (ret)
Dr. Susan Koch
Dr. Matthew Kroenig
Senator Jon Kyl
Dr. Steven Lambakis
ADM Richard Mies, USN (ret)
Hon. Franklin C. Miller
Senator Charles Robb
Dr. Bradley Roberts
Mr. Guy Roberts
Mr. Thomas Scheber
Dr. Mark Schneider
Dr. William Schneider
Gen Larry Welch, USAF (ret)

A New Nuclear Review for a New Age

April 2017

© National Institute Press, 2017

For additional information about this publication or other publications by the National Institute Press, contact: Editor, National Institute Press, 9302 Lee Highway, Suite 750 • Fairfax, VA 22031 • (703) 293-9181 • www.nipp.org.

© National Institute Press, 2017

A New Nuclear Review for a New Age

Table of Contents

Participants	
Preface	
Section I. Executive Summary	1
Section II. Security Environment.....	19
Section III. Purposes for US Nuclear Capabilities	41
Section IV. Adaptability and Required Characteristics: US Nuclear Forces and Posture	59
Section V. Considering Nuclear Force Size: How Much is Enough?.....	69
Section VI. An Assessment of Present and Planned US Nuclear Forces	79
Section VII. Missile Defense: Critical Element of US and Allied Security	141
Section VIII. Adapting Western Policies and Capabilities for the NATO Region	157
Section IX. Adapting US Policies and Capabilities for Asian Security	175
Section X. The Affordability of Nuclear Deterrence	185
Section XI. Declaratory Policy	199
Section XII. Arms Control and US Goals in the New Threat Environment Context ...	207
Appendix A. Sources for Tables 1 through 4 (Section VI).....	A-1
Appendix B. Summaries of the 1994, 2001, and 2010 Nuclear Posture Reviews.....	B-1

This report is based on extensive research and entirely open sources. Each section is heavily referenced, as appropriate, and Appendix A includes full references for the detailed Tables 1 through 4 appearing in Section VI.

Participants

Dr. Keith B. Payne

**Study Director, Contributing Author and
Senior Reviewer**

Dr. John S. Foster, Jr.

Chairman, Senior Review Group

- **Dr. Kathleen Bailey, Senior Reviewer**, Senior Associate, National Institute for Public Policy; former Assistant Director of the Arms Control and Disarmament Agency; Deputy Assistant Secretary of State (Bureau of Intelligence and Research)
- **Gen Kevin Chilton, USAF (ret), Senior Reviewer**, former Commander, US Strategic Command; Commander, Air Force Space Command
- **Mr. Elbridge Colby, Contributing Author**, Robert M. Gates Senior Fellow, Center for a New American Security. He previously served in the Department of Defense and on the staffs of a number of government commissions on strategic, defense, and nuclear weapons issues
- **Mr. Matthew Costlow, Contributing Author**, Ph.D. student; Analyst, National Institute for Public Policy; graduate, Graduate Department of Defense and Strategic Studies, Missouri State University
- **Dr. J.D. Crouch II, Senior Reviewer**, served in the administration of President George W. Bush as Assistant to the President and Deputy National Security Advisor, US Ambassador to Romania, and Assistant Secretary of Defense for International Security Policy
- **Ms. Michaela Dodge, Contributing Author**, Ph.D. student; Senior Policy Analyst for Defense and Strategic Issues, The Heritage Foundation; graduate, Graduate Department of Defense and Strategic Studies, Missouri State University
- **Amb. Eric Edelman, Senior Reviewer**, Distinguished Fellow, Center for Strategic and Budgetary Assessments; former Under Secretary of Defense for Policy; US Ambassador to Turkey; US Ambassador to the Republic of Finland; Principal Deputy Assistant to the Vice President for National Security Affairs
- **Mr. Fritz Ermath, Senior Reviewer**, former Chairman of the National Intelligence Council and staff of the National Security Council during the Carter and Reagan Administrations
- **Dr. John S. Foster, Jr., Chairman, Senior Review Group**, former Director of Defense Research and Engineering, Department of Defense; Director of the Lawrence Livermore National Laboratory
- **Dr. Gary L. Geipel, Contributing Author**, Senior Associate, National Institute for Public Policy; former Director of Research, Hudson Institute

The Contributing Authors are responsible for their views as expressed in their respective contributions to this report; these views do not reflect the official policy or position of the National Institute for Public Policy, the Department of Defense, or any institution with which the contributing authors are affiliated.

Senior Reviewers provided their comments on drafts of this report and may not be in agreement with each of its points or precise wording.

- **Dr. Colin S. Gray, Senior Reviewer**, Professor Emeritus, Department of Politics and International Relations, University of Reading; European Director, National Institute for Public Policy
- **Mr. Kurt Guthe, Contributing Author**, Director of Strategic Studies, National Institute for Public Policy
- **Dr. John Harvey, Contributing Author and Senior Reviewer**, former Principal Deputy Assistant to the Secretary of Defense for Nuclear, Chemical and Biological Defense Programs
- **Ms. Rebeccah Heinrichs, Contributing Author**, National Security Fellow, specializing in missile defense and nuclear deterrence, Hudson Institute; former Military Legislative Assistant to Member of the House Armed Services Committee
- **Amb. Robert Joseph, Senior Reviewer**, Senior Scholar, National Institute for Public Policy; former Under Secretary of State for Arms Control and International Security; Special Assistant to the President and Senior Director for Proliferation Strategy, Counterproliferation and Homeland Defense, National Security Council
- **Dr. Thomas Karako, Contributing Author**, Senior Fellow, International Security Program, and Director, Missile Defense Project, Center for Strategic and International Studies; Assistant Professor, Kenyon College
- **Gen C. Robert Kehler, USAF (ret), Senior Reviewer**, former Commander, US Strategic Command; Commander, Air Force Space Command
- **Dr. Susan Koch, Contributing Author and Senior Reviewer**, former Senior Advisor to the Under Secretary of State for Arms Control and International Security; Director of Proliferation Strategy, National Security Council
- **Dr. Matthew Kroenig, Contributing Author**, Associate Professor of Government and Foreign Service, Georgetown University; Senior Fellow, Brent Scowcroft Center on International Security at the Atlantic Council; former Special Advisor in the Office of the Secretary of Defense
- **Senator Jon Kyl, Senior Reviewer**, former US Senator representing Arizona, Senate Minority Whip; Senior of Counsel, Covington & Burling; Visiting Scholar, American Enterprise Institute
- **Dr. Steven Lambakis, Senior Reviewer**, Director of Space Studies, National Institute for Public Policy; Managing Editor, *Comparative Strategy*
- **ADM Richard Mies, USN (ret), Senior Reviewer**, former Commander in Chief, US Strategic Command
- **Hon. Franklin C. Miller, Senior Reviewer**, Principal, Scowcroft Group; former Special Assistant to President George W. Bush; Senior Director for Defense Policy and Arms Control, National Security Council; former senior OSD/Policy official for over two decades

The Contributing Authors are responsible for their views as expressed in their respective contributions to this report; these views do not reflect the official policy or position of the National Institute for Public Policy, the Department of Defense, or any institution with which the contributing authors are affiliated.

Senior Reviewers provided their comments on drafts of this report and may not be in agreement with each of its points or precise wording.

- **Dr. Keith B. Payne, Study Director, Contributing Author and Senior Reviewer**, President, National Institute for Public Policy; Head, Graduate Department of Defense and Strategic Studies, Missouri State University; former Deputy Assistant Secretary of Defense
- **Senator Charles Robb, Senior Reviewer**, former Governor of Virginia; US Senator representing Virginia; Co-Chair, Commission on Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction
- **Dr. Bradley Roberts, Contributing Author and Senior Reviewer**, Director of the Center for Global Security Research at Lawrence Livermore National Laboratory; former Deputy Assistant Secretary of Defense for Nuclear and Missile Defense Policy
- **Mr. Guy Roberts, Contributing Author**, former Deputy Assistant Secretary General for Weapons of Mass Destruction Policy and Director for Nuclear Policy, NATO
- **Mr. Thomas Scheber, Contributing Author**, Vice President, National Institute for Public Policy; former Director of Strike Policy and Integration, Office of the Secretary of Defense
- **Dr. Mark Schneider, Contributing Author**, Senior Analyst, National Institute for Public Policy; former Principal Director for Forces Policy, Office of the Secretary of Defense
- **Dr. William Schneider, Senior Reviewer**, Senior Fellow, Hudson Institute and Member, Defense Science Board; former Chairman of the Defense Science Board, and Under Secretary of State
- **Gen Larry Welch, USAF (ret), Senior Reviewer**, Trustee Emeritus and Senior Fellow, Institute for Defense Analyses; former President, Institute for Defense Analyses; Chief of Staff, US Air Force; Commander in Chief, Strategic Air Command

The Contributing Authors are responsible for their views as expressed in their respective contributions to this report; these views do not reflect the official policy or position of the National Institute for Public Policy, the Department of Defense, or any institution with which the contributing authors are affiliated.

Senior Reviewers provided their comments on drafts of this report and may not be in agreement with each of its points or precise wording.

Preface

This study, *A New Nuclear Review for a New Age*, was first conceived in mid-2015. It began with the expectation that the new presidential administration entering office in January 2017 would continue the now-established tradition of conducting a Nuclear Posture Review (NPR) early in the administration's tenure. And, indeed, one of President Donald Trump's first acts after entering office was to call for a new NPR. This forthcoming NPR will likely set the course for US nuclear policy for the next decade; consequently, its significance can hardly be overstated.

An entering principle of this study was that it include a broad spectrum of participants: senior retired military officers; individuals with well-recognized technical and policy expertise; noted academics; highly-regarded legislators; and, former senior officials from Republican and Democratic administrations with deep personal experience in one or more of the earlier NPRs. We were also pleased to invite several of the younger, next generation scholars in the field to participate. They undoubtedly will contribute to future NPRs.

Approximately six months were required to secure the needed funding for this effort, and so our work began in early-2016, with the goal of having a thoughtful and fully-referenced text completed by early 2017—in time to help inform the expected, new, 2017 NPR. We formed a Senior Review Group to provide guidance, suggestions and comments on each part of this study. As noted, many of the participants in this study have first-hand experience with the challenges that were involved in producing past NPRs and even earlier US nuclear reviews, and fully appreciate the value of helpful input by those with previous pertinent experience and other noted experts in the diverse subject areas included in an NPR.

The intention of the study is to identify and assess the metrics and corresponding force attributes that should be deemed important when considering the adequacy of nuclear policy to serve priority national goals given the threat environments in which those goals must be served. This involves identifying those priority national goals, the character of the threat environment, and the corresponding force attributes and other elements of nuclear policy, including declaratory and arms control policies, that can best support those national goals.

We would like to express our deep appreciation to the Sarah Scaife Foundation and Smith Richardson Foundation, and to the individuals who sponsored this study effort—and for their generosity in doing so. We also would like to thank the participating authors and senior reviewers, all of whom devoted considerable effort and attention to the task, and also Amy Joseph of the National Institute who produced the final text, and the many earlier drafts, with exceptional skill. The result of these efforts by many is a 222-page report with a convenient-to-read, 17-page executive summary. We are confident that these efforts provide a thoughtful basis for *A New Nuclear Review for a New Age*. It is respectfully dedicated to the goal of assisting those offices and individuals with the responsibility for producing the new 2017 NPR.

*Dr. Keith B. Payne
Study Director*

*Dr. John S. Foster, Jr.
Chair, Senior Review Group*

Section I. Executive Summary

One of President Donald Trump’s first actions after entering office was to direct Secretary of Defense James Mattis to “initiate a new Nuclear Posture Review to ensure that the United States nuclear deterrent is modern, robust, flexible, resilient, ready and appropriately tailored to deter 21st-century threats and reassure our allies.”¹ Secretary Mattis has since reportedly directed that the new Nuclear Posture Review (NPR) be completed in six months.² This new 2017 NPR will be the fourth in a series, following the 1994, 2001, and 2010 NPRs.

This report—entitled *A New Nuclear Review for a New Age*—examines major questions and issues for consideration in the new NPR.

The forthcoming NPR will supersede its immediate predecessor, completed in 2010 under the Administration of President Barack Obama. Previous NPRs were issued in 1994 and 2001 to guide nuclear policy under the Clinton and Bush Administrations, respectively. Since the 2010 NPR, the global security environment has changed significantly. Existing US nuclear weapons and delivery systems have aged while potential adversaries have modernized their arsenals. The attitudes and perceived options of US allies in many cases are different as well. Taken together, these and other changes highlight the high priority of the new NPR and the need for well-informed discussions leading to new guidance.

This report examines the international security environment, goals of nuclear policy, technology issues, funding questions, the precedents set by earlier NPRs, the relevance of nuclear declarations and arms control efforts, and other key inputs, and offers recommendations for consideration in the forthcoming NPR.

This Executive Summary is organized according to the chapters in this report.

Security Environment

The world as seen from the United States looks very different today—and much more threatening—than it did at the time of the last NPR in 2010. Therefore, a new review of US nuclear policy and requirements must begin with a realistic assessment of the security environment and the challenges it poses.

The four countries whose leaderships and doctrines continue to be of greatest importance to US nuclear policy are the Russian Federation, the People’s Republic of China (PRC), the Democratic People’s Republic of Korea (DPRK), and the Islamic Republic of Iran. In addition, the potential terrorist-style actions of belligerent non-state actors continue to be of major concern. Each is considered in turn.

Russia. Long-standing US hopes for more constructive relations with Russia—which date to the collapse of the Soviet Union in 1991 and informed all three previous NPRs—have been dashed

in recent years. President Vladimir Putin's regime in Moscow appears to be driven by the goal of re-establishing Russian hegemony in the former "Soviet space." In 2008, Russia invaded Georgia and since has effectively absorbed parts of Georgian territory. Russia's illegal 2014 occupation and subsequent annexation of Crimea, along with its ongoing military involvement in Eastern Ukraine, constitute fundamental challenges to the post-Cold War European peace. More recently, Russia intervened in the Syrian civil war in support of Syrian President Bashar al-Assad, and reportedly was aware in advance of Assad's deadly April 2017 use of chemical weapons against Syrian civilians. President Putin has stoked imperial nationalism at home, probably to draw attention away from domestic challenges and generate ongoing popular support for his regime's expansionist agenda.

Putin and his small inner circle—poised to continue controlling Russian defense and foreign policy for years to come—are inherently anti-Western and have named the United States and the North Atlantic Treaty Organization (NATO) as priority threats. Potential flashpoints between Russia and NATO span Eastern Europe and certainly include the Baltic states as well as the Middle East.

Russian leaders now appear to consider their country's nuclear capability as an enabler of expansionist regional actions. Developments in Russian doctrine elevate the potential role of nuclear weapons. Most ominously, reports indicate that Russia has developed an "escalate-to-win" approach that includes threats of nuclear first use and apparent planning for nuclear first use in regional conflicts—to demonstrate the extreme risks of Western resistance to Russian geopolitical gains.

Russia has put highest priority on modernizing strategic and non-strategic nuclear capabilities for the past decade—announcing more than 20 programs to develop and deploy new strategic nuclear systems or modernize Soviet legacy systems. These include multiple systems for every leg of the Russian nuclear triad as well as two possible systems extending beyond the triad: a hypersonic glide vehicle and a nuclear-armed and powered undersea delivery vehicle. These Russian developments pose unprecedented challenges to Western deterrence and assurance goals.

China. The Chinese Communist Party (CCP) under the leadership since 2012 of President Xi Jinping, asserts central control of Chinese national security and foreign policy. In recent years, while remaining an important US economic partner, China has redoubled its efforts to achieve hegemony in Asia and, correspondingly, continued its military buildup, including nuclear. China has made claims to nearly the entire South China Sea, in violation of international law and tribunal rulings—and even has disputed Japanese sovereignty over the island of Okinawa, where US military personnel remain stationed.

The precise size and nature of China's nuclear arsenal—like its nuclear doctrine—remain opaque. China certainly controls at least several hundred nuclear weapons—both strategic and theatre missiles—and is committed to nuclear modernization, including a new ballistic-missile submarine and a new generation of strategic bombers.

Official Chinese declaratory policy includes a no-first-use nuclear policy emphasizing the ability to survive a nuclear attack and respond with unacceptable damage on an enemy. However, there are considerable doubts about the reality of this expressed Chinese commitment to no first use; many analysts tend to believe that China's actual policies are more flexible.

North Korea. Post-Cold War hopes that the DPRK would collapse peacefully or slowly reform have not been realized. North Korea defies UN resolutions and international sanctions openly, with provocative military behavior and threatening rhetoric, including nuclear threats. North Korea's continued development of nuclear weapons and long-range ballistic missiles—linked to its overarching goals of regime preservation and unifying the Korean peninsula under its control—place the regime in fundamental opposition to US and allied interests in the Pacific.

Under the solidified leadership of Kim Jong Un—the third in his family to control the country—North Korea's nuclear forces appear to be increasing both in quantity and quality. The DPRK has tested a nuclear device five times in recent years and, while open estimates vary, the country may have enough fissile material to produce 50-100 weapons by 2020. It also remains committed to developing long-range missiles capable of reaching US territory.

Officially, North Korea claims that its nuclear capability is meant for defensive or retaliatory purposes, but its explicit nuclear threats appear to reflect hostile intent, and little is known with certainty about how the DPRK's leaders might employ nuclear weapons. Certainly the regime continues to leverage its nuclear program for coercive diplomacy and to bolster its international standing.

Iran. Since the 2010 NPR, Iran has expanded its disruptive actions in the Middle East, including provocations against the United States, and continues to support terrorist organizations as well as the Assad regime in Syria. Iran's theocratic regime—centered since 1989 on Supreme Leader Ali Khamenei—remains in firm control.

Despite the Joint Comprehensive Plan of Action (JCPOA), Iran retains the potential to become a nuclear power in relatively short order. The JCPOA does not limit potential nuclear delivery vehicles such as missiles, and Iran reportedly continues to invest heavily in their development. Its recent satellite launches suggest that long-range missile development remains part of these efforts as well. Technology sharing between North Korea and Iran also is of great concern.

Non-state actors. Open-source reports indicate that terrorist groups so far have been unsuccessful in obtaining a nuclear weapon or the materials needed to assemble one. Should this change, however, the threat to the United States and its allies could be immense and immediate—and so this possibility must remain a high priority in US nuclear thinking.

Summary conclusion. The expectation of a more benign nuclear threat environment embedded in previous nuclear reviews—an environment in which nuclear weapons and nuclear deterrence were expected to play ever-diminishing roles—has faded from view and should *not* serve as a planning assumption for the new NPR.

Purposes of US Nuclear Capabilities

The general purposes of US nuclear capabilities—and therefore the goals of nuclear policies—have been remarkably consistent over time and certainly since the first NPR in 1994. Three purposes are of particular importance: the *deterrence* of enemies, the *assurance* of allies, and *defense or damage limitation* in the event of war. In addition, nuclear *nonproliferation* has taken

on increasing prominence and indeed was identified as a top priority in the 2010 NPR. It is important to understand the ongoing salience of each of these purposes.

Deterrence. Defined by the US Department of Defense (DoD) as “the prevention of action by the existence of a credible threat of unacceptable counteraction and/or belief that the cost of action outweighs the perceived benefits,” deterrence has been a central purpose of US nuclear policy and capabilities. Going back to the 1948-49 Berlin crises and the 1962 Cuban Missile Crisis, considerable evidence exists that nuclear deterrence helps uniquely to prevent war or the escalation of conflict between countries. And even with regard to non-state actors, deterrence can help to dissuade adversary countries from providing technical or material assistance to dangerous groups.

In a highly-dynamic threat environment, to the extent possible, US deterrence policies must also be highly adaptable: capable of being “tailored” to the various requirements posed by a shifting spectrum of opponents and contingencies. Such adaptability, in turn, rests on the availability of a flexible nuclear-force posture that provides US presidents with a range of deterrent options that not only deter, but also could help limit damage to civilian populations and society in the event deterrence fails.

Assurance. While the primary audience for US deterrence messages are adversaries, nuclear assurance addresses itself to allies and partners—by creating or reinforcing confidence among them regarding the US ability and will to help preserve their security against external threats. The United States extends nuclear assurance commitments to more than 30 countries, particularly in Europe and Northeast Asia, where US nuclear policy provides confidence to allies that their security does not require their development of independent nuclear arsenals.

As with deterrence, assurance depends not only on the credibility of the US commitment but also on the flexibility of available options. While some allies may have doubts that the United States would risk all-out strategic nuclear war involving the American homeland to defend their territory, sub-strategic US nuclear and non-nuclear capabilities deployed in their vicinity can help provide important assurance effect.

Damage limitation. In the event that deterrence fails, damage limitation continues to be a US policy priority reinforced by nuclear capabilities. Numerous official policy documents in the past have identified damage limitation as a priority US goal, and the Obama Administration’s 2013 *Report on Nuclear Employment Strategy of the United States* implicitly identifies it as such.

A potential means of limiting damage is so-called “intra-war deterrence,” in which the priority goal during an ongoing conflict is to reestablish deterrence and thereby minimize escalation and damage to US and allied military, political, and societal assets. While reestablishing deterrence following initial conflict can never be considered a certain outcome, it is most likely to be achieved if the United States has a range of limited nuclear and non-nuclear options at its disposal that can provide a response scaled to any level of attack. Active defenses, such as ballistic missile and air defenses, also may contribute to the goal of damage limitation.

Nonproliferation. Nonproliferation—preventing the adoption of nuclear weapons by additional countries or a numerical increase in the number of nuclear weapons—remains a vital goal. Proponents of using further US nuclear reductions and limitations to promote nonproliferation

argue that US nuclear-force reductions contribute to decisions of other countries to forego nuclear weapons or to more seriously pursue nonproliferation. Yet, there is little to no evidence that supports this widely-claimed linkage; there is, however, considerable evidence (discussed later in this report) indicating that credible US nuclear capabilities contribute to the assurance of allies and thus to the goal of nonproliferation.

Summary conclusion. The 2010 NPR explicitly elevated nonproliferation “for the first time” to the highest priority of US nuclear policy, among other priorities, including deterrence and assurance.³ It also identified a reduction in the roles and number of nuclear weapons as a means to promote its priority nonproliferation goal. Senior DoD officials identified “preventing nuclear proliferation and nuclear terrorism,” and “reducing the role of nuclear weapons in US strategy” as the top US strategic objectives, and stated explicitly that the Department of Defense assessed “deterrence requirements against these metrics.”⁴ Correspondingly, then-Secretary of State Hillary Clinton said, “As part of the NPR, the Nuclear Posture Review, we are grappling with key questions... Will our deterrence posture help the United States encourage others to reduce their arsenals and advance our nonproliferation agenda? [And] How can we provide reassurance to our allies in a manner that reinforces our nonproliferation objectives?”⁵

There is now something of a consensus in Washington regarding the deterioration of the security environment since 2010, and senior DoD officials accordingly have identified US nuclear deterrence as the Department’s “highest priority mission.”⁶ The 2017 NPR should explicitly reestablish deterrence and assurance—coupled with preparations for damage limitation in the event of deterrence failure—as the priority goals for US nuclear policy. Nonproliferation remains important, but the emphasis on it as the priority goal “atop” US nuclear policy, and the corresponding prioritization accorded to the continuing reduction of US nuclear forces, should not be sustained. The realities of the contemporary threat environment and the corresponding prioritization of credible deterrence, assurance, and damage limitation goals are key factors for consideration in the new Nuclear Posture Review mandated by the Trump Administration.⁷ This alone is no small difference from the dominant post-Cold War nuclear policy narrative which has sought largely to limit and reduce US nuclear capabilities on a continuing and progressive basis.

Defining Adaptability

The current security environment, the purposes of US nuclear capabilities in response to that environment, and the reality of lengthy acquisition cycles for new weapons systems, combine to make *adaptability* an essential metric for US planning and nuclear capabilities supporting deterrence, assurance, and damage limitation.

Adaptability, as understood in this report, encompasses *flexibility* to adjust to different adversaries, contingencies, and employment plans, as well as *resilience*, which allows national leaders to adjust the force posture in response to adverse military, political, or technological changes.

In practice, several nuclear-force posture attributes reinforce flexibility and resilience. These include survivability (the ability of nuclear forces to withstand or escape attack); suitable range; ability to forward deploy (closer to adversaries and allies alike); prompt response capability; variable payloads (e.g., the ability of ballistic missiles and bombers to carry different types and numbers of weapons); assorted weapon yields; and high delivery accuracy.

In addition, several other factors enhance the resilience of the US nuclear force posture. The diversity and readiness of the existing force structure is a key factor, for example, including its “triad” of land-based, sea-based, and airborne delivery systems. The ability to adjust the size and alert levels of the deployed force—by bringing weapons out of stockpile if necessary, for example—is important as well. And, the potential to modify existing capabilities through straightforward hardware changes also can enhance adaptability.

Summary conclusion. Adaptability in general should be made a guiding metric for the evaluation of US nuclear policy, planning, and force structure; its preservation and enhancement in these elements should be a primary theme in the 2017 NPR.

Considering US Nuclear Force Size: How Much Is Enough?

The size of a future US nuclear force is likely to be a key consideration in the forthcoming NPR. The specification of “how much is enough” in terms of nuclear force numbers has been an enduring question addressed in previous NPRs. A “minimalist” school of thought has long argued for no more than the force size necessary for a retaliatory threat to an opponent’s society, in response to an attack by that opponent. Such a threat is said to be adequate for US deterrence requirements while demanding a relatively small number of US nuclear weapons—typically ranging from a few dozen weapons to hundreds.

This report identifies a number of reasons to reject the minimalist approach to answering the question of US nuclear force sizing:

1. Declaring a low specific number of weapons as adequate for US deterrence needs because it meets the requirements to threaten an opponent’s society reflects a basic misconception of deterrence. No one can know the “minimal” number of nuclear weapons necessary to deter credibly; and even if known, the number likely would change on a continuous basis due to shifts in force structure, weapons technology, the opponent’s worldview, the stakes of the conflict, context, and numerous other factors. This is the reason deterrence strategies must be sufficiently flexible to be “tailored” to specific contexts, not predicated on a static minimalist concept.
2. A minimal number of weapons may not be sufficiently large and diverse to discourage first-strike strategies and planning by a determined opponent. The consensus of Democratic and Republican administrations for 50 years has been to maintain a diverse and, in some ways, overlapping triad of strategic nuclear forces to ensure the survivability of US forces, as is necessary for deterrence, and thus to discourage opponents from considering first-strike strategies, and to preserve credible deterrence even in the face of an opponent pursuing such a strategy.
3. The minimalist focus on threats to civilians and other societal targets as the measure of effective US deterrence capabilities is widely considered immoral, a violation of international law, and likely to be viewed as an incredible US deterrent by some opponents.
4. A minimal force number oriented to threatening societal destruction would provide little flexibility to hold at risk other assets that an opponent’s leadership might value more than

- civilian centers—such as military or political control targets. Thus, such a minimal deterrent could be inadequate and an imprudent approach to deterrence and assurance.
5. A minimal force would provide a future US president the most miserable option if deterrence fails—that of responding against an opponent’s society with remaining forces—at the expense of other targeting options that could more likely help limit escalation of the conflict and avoid further counter-strikes from the opponent.
 6. A minimal nuclear force needed to threaten society likely would be seen as wholly insufficient for assurance by at least some allies under the US nuclear umbrella.

Summary conclusion. The US goal must be for nuclear deterrence and assurance to work as effectively as possible in all cases, and to limit escalation to the extent possible should deterrence fail. This demands the rejection of a minimalist approach. In the forthcoming NPR, recommendations regarding US nuclear force numbers should *not* aim for a hypothetical minimum derived from only the requirements for holding societal targets at risk, fixed budget numbers, or other static boundaries. The standards of adequacy for multiple nuclear policy goals in severe, diverse and shifting conditions can never realistically be considered fixed. Instead, numbers should be the product of a careful assessment of the dynamic security environment and US purposes within it.

Present and Planned US Nuclear Forces

The United States is in the initial stage of a planned nuclear-force modernization program. The program will encompass all elements of the force, require a budget of hundreds of billions of dollars over the next quarter century, and affect US capabilities for deterrence, assurance, and damage limitation for decades after its completion. This report outlines key components of present and planned US nuclear forces, and evaluates the changes expected from the modernization program against the metrics of adaptability described in the earlier section on that topic. (See the extensive supporting open references for this discussion in Appendix A). The report also considers aspects of technology development and the nuclear-weapons infrastructure that are in need of modernization.

For purposes of this Executive Summary, the potential impacts of key force changes are summarized with reference to the adaptability criteria:

Survivability. Force survivability is a matter both of escaping or withstanding attack (pre-launch survivability) and penetrating defenses that could impede an effective response (post-launch survivability). The force-modernization program, as reported, will not change the survivability level of US ballistic missile submarines (SSBNs) in port. Nor will it change the survivability of bombers and dual-capable aircraft (DCA) at air bases, or intercontinental ballistic missiles (ICBMs) in silos. The *Columbia*-class SSBN, however, is designed for greater *at-sea* survivability than its *Ohio*-class predecessor. The B-21 bomber, long-range standoff missile (LRSO), and F-35A DCA are all designed for greater post-launch survivability against advanced air defenses than their existing counterparts. And the planned ground-based strategic deterrent (GBSD) missiles are expected to be more survivable after launch than the existing Minuteman III.

Suitable range. Current submarine-launched ballistic missiles (SLBMs), ICBMs, and bombers have intercontinental ranges and—while the ranges of next-generation systems have not been revealed publicly—it is reasonable to expect that their ranges will be similarly intercontinental. In

the same way, the LRSO may be expected to have an intermediate range comparable to the current air-launched cruise missile (ALCM-B) and retired Advanced Cruise Missile. DCA typically have shorter ranges than bombers—and open-source estimates suggest the F-35A will be no exception—but can be forward deployed and refueled in flight to extend range.

Ability to forward deploy. Bombers and SSBNs are the forward-deployable legs of the US nuclear triad—and DCA can assume forward-deployment duties as well. Historically, both bombers and submarines have been sent abroad on visible “presence” missions to deter foes and assure friends. Other than possible concerns about their security in foreign locations or the revelation of their design elements, nothing would argue against the use of next-generation systems in similar ways. And, of course, the F-35A strike fighter should be entirely capable of assuming its predecessors’ forward-deployment roles.

Prompt response capability. Prompt response involves the ability to reach targets from long range in minutes rather than hours. As reported, this capability certainly will be sustained in next-generation ICBM and SLBM systems expected under the modernization program.

Variable payloads. Today, SLBMs and ICBMs are capable of carrying two types of reentry-vehicle warheads. Follow-on missiles envisioned in the modernization program could carry as many as three warhead types. The future bomber force, as reported, will continue to carry cruise missiles—LRSO missiles in place of ALCM-Bs—but there will be fewer types of gravity bombs as most variants of the B61 bomb are retired. The future bomber force also will retain significant “uploading” capacity—to take on additional warheads and bombs if conditions warrant.

Assorted weapon yields. This aspect of adaptability also will not change significantly, with future SLBMs and ICBMs reportedly still being armed with warheads of high (reportedly hundreds of kilotons or more) yield, while bombers reportedly will carry weapons of both high and low yields.

High delivery accuracy. Though improvements in the next generation seem likely, current SLBMs and ICBMs already boast accuracy reported to be within a few hundred feet of their intended targets. The modernization program is likely to impact the delivery accuracy of gravity bombs in a future force, since the follow-on B61-12 gravity weapon includes a guided tail-kit section designed to improve accuracy, as reported.

Technology development and rebuilding infrastructure. Beyond the replacement of aging weapons systems themselves—as planned in the modernization program—the United States also must grapple with the need to maintain and, in some cases, restart technology-development efforts surrounding our nuclear forces and to rebuild necessary infrastructure.

Examples of technologies in which the United States may face the choice between competing or losing key competencies to adversaries include anti-ballistic missile defenses, cruise-missile technology and hypersonic delivery vehicles, space-control capabilities, non-nuclear offensive technologies such as railguns and lasers, and command-and-control systems.

In addition, as US production of nuclear weapons in recent decades has ceased, the larger intellectual infrastructure needed to design, manufacture, and produce nuclear systems also has atrophied—creating what a growing number of observers believe are risky gaps between US capabilities and those of adversaries whose nuclear-technology programs continued apace. The

US nuclear-weapons stockpile today is the smallest since the Eisenhower Administration, and a comprehensive approach to sustaining overall nuclear readiness does not appear to exist. Addressing these areas of need will contribute to overall US flexibility and resilience.

The report also finds that accelerating replacement of the two critical US nuclear-material production facilities should be an urgent priority. The United States reportedly has not had a fully operational plutonium or uranium production complex since 1989.

Finally, US nuclear command, control, and communications (NC3) systems—including early-warning sensors, mobile and fixed command-and-control centers, and communications links between deployed nuclear forces and national leaders—remain in urgent need of modernization.

Summary conclusion. The existing US nuclear modernization program is critical to sustaining the adaptability of US nuclear forces needed to support the priority national goals of deterrence, assurance and damage limitation. The greatest virtue of the planned modernization program in this regard will be to preserve the flexibility and resilience inherent in the US nuclear triad for decades to come—as production lines reopen and new systems replace those whose practical lifespans are ending. The NPR also should consider possible changes to the current modernization program to achieve greater adaptability suitable for circumstances in which threats are emerging beyond what has been expected, more funding becomes available, new technological opportunities appear, or threat conditions dictate that US capabilities must be improved at a faster-than-planned pace.

Missile Defense

Ballistic Missile Defense (BMD) is widely recognized as a critical component of national and regional security, and has the potential to contribute significantly to deterrence, assurance, and damage limitation in a dynamic strategic environment.

Strategic missile defenses were severely restricted by treaty for 30 years on the assumption that they undermined “stable” mutual deterrence. However, missile threats facing the United States and its allies have been expanding for decades, and homeland and regional defenses now are accepted as essential contributors to security. Indeed, BMD can support all three priority purposes of US nuclear capabilities in general:

Deterrence. BMD can contribute to deterrence in several ways. First, it may provide the United States with very useful alternatives to offensive preemption or retaliation in crises. This was the case, for example, in the days prior to North Korea’s 2006 Taepodong-2 launch, when the deployment of a limited US homeland-defense system gave President Bush an alternative to a preemptive strike on the North Korean missile site (as was recommended by some at the time). Second, by helping to deny adversaries plausible limited nuclear first-use options against US allies and the US homeland, BMD can discourage even determined opponents from pursuing such dangerous strategies and deny their effectiveness in cases where opponents choose such strategies. Third, by relieving pressure to strike an adversary’s launchers preemptively in crises, effective BMD also can buy time for leaders to pursue diplomacy or non-nuclear means of averting or limiting escalation in an emerging nuclear crisis. Finally, point defense for critical military assets at home and abroad can enhance the survivability of US and Western deterrence forces that an

adversary otherwise might believe it could eliminate by preemptive attack—thereby strengthening deterrence and discouraging opponents from dangerous first-strike concepts.

Assurance. First, by reducing the potential costs of conflict with an ICBM-capable adversary, missile defense of the US homeland can improve the credibility of US security guarantees to allies by helping to counter an opponent's possible expectation that nuclear threats to the US homeland will work to decouple the United States from allies. Second, regional missile defenses help to reinforce assurance by providing local defensive capabilities while demonstrating the US security commitment. Finally, the cooperative process of developing and deploying missile defenses helps to build stronger alliance relationships and gives the United States a larger presence in, and commitment to, allies' security.

Damage limitation. Missile defenses can contribute to damage limitation by helping to discourage an adversary from escalating a conflict, and by providing a potentially meaningful degree of societal protection in many plausible conflict scenarios. BMD also can provide unique damage-limitation capabilities against the possibility of an accidental or unauthorized missile strike.

Finally, BMD can help provide a relatively near-term counter to the emerging North Korean missile threat—a defensive alternative to the option of a pre-emptive strike often discussed publicly. In addition, BMD may contribute to the goal of dissuading some adversaries from acquiring missile capabilities in the first place. For example, the prospect of strong US BMD against long-range ICBMs from Iran or North Korea could help discourage their continued investment of scarce resources in the development of such weapons.

Summary conclusion. Far from being an impediment to deterrence, BMD has emerged as a potentially crucial element in support of deterrence—particularly with regard to smaller and more unpredictable nuclear adversaries. BMD can also contribute uniquely to US assurance and damage-limitation goals. The larger report offers detailed recommendations for consideration in the forthcoming NPR to help improve the contributions of BMD to deterrence, assurance, and damage limitation. These include, for example: improving and expanding US capabilities for homeland defense, including defense against cruise missiles and potentially hypersonic missiles; expanding and accelerating SM-3 capabilities; the fielding of a space-based layer of sensors for persistent “birth-to-death” missile tracking and discrimination; providing operational capability to the Aegis Ashore Missile Defense Test Complex in Kauai, Hawaii; and, *inter alia*, continuing readiness efforts for a possible East Coast BMD site.

Implications for Security in the NATO Region

After the collapse of the Soviet Union, NATO reduced but by no means eliminated the role of nuclear weapons in its military strategy and deterrence posture. In light of the resurgent threat from Russia, particularly since 2014, nuclear policy and its contribution to deterrence and assurance once again are major topics within the alliance. Moscow's ongoing nuclear modernization programs and its emphasis on the nuclear first use or “escalate-to-win” option—effectively the threat or limited use of nuclear weapons to coerce NATO into backing down in a conventional conflict—create anxieties in NATO and a corresponding desire to strengthen deterrence and assurance. The forthcoming NPR and possible revisions of NATO's 2012 Deterrence and Defense Posture Review (DDPR) are opportunities for clarity and direction.

The renewed adversarial relationship with Russia and the apparent narrowing of Western non-nuclear military advantages mean that the United States and NATO need to reexamine and possibly revise their nuclear policy and posture. Key issues include: the future of US nuclear forces designated for NATO, especially the US B61 bomb and the DCA used to carry it; changes to the alliance's declaratory policy on the role of nuclear forces; involvement of additional NATO-member states in nuclear-sharing arrangements; and readiness levels and deployment locations throughout the alliance. The overarching deterrence goal in this regard is to deny Russia any plausible basis for perceiving exploitable political or military advantages that could lead Moscow to consider aggression or nuclear escalation against the West, even in crises.

This report includes the following recommendations for consideration:

1. In its forward-deployment decisions and declaratory policy, the United States and NATO must repeatedly make clear the indivisibility of the alliance and its nuclear policy: that an attack on one is an attack on all, and that any Russian nuclear escalation against the West would be the worst possible course for Russia under any circumstances.
2. The B61 life-extension bomb, the B61-12, reportedly will be the only US nuclear weapon based in Europe with precision accuracy and a low-yield option. Therefore, it should not be subject to further procurement delays, but instead should be advanced to the extent possible.
3. Availability of the nuclear-capable F-35A aircraft should be accelerated in order to provide NATO with the stealth technology to counter Russian air defenses and thereby enhance its deterrence credibility.
4. Nuclear burden sharing—especially in the deployment and support of DCA—should be widened in NATO, particularly including the former Warsaw Pact countries of Eastern Europe.
5. The United States should consider deploying sub-strategic missiles at sea in the NATO region or on NATO territory to increase the adaptability of its nuclear deterrent.
6. The United States and NATO should prioritize creation of an integrated air and missile defense system for the alliance, in order to help make a limited Russian nuclear attack unacceptably difficult and risky.

Summary conclusion. US nuclear forces deployed in Europe must continue to serve the dual purpose of underpinning deterrence—by posing the threat of incalculable costs in the mind of a potential aggressor—and assuring allies in the face of nuclear coercion. Adjustments to US and NATO capabilities and declaratory policy to meet these essential purposes and advance Western adaptability should now be considered.

Implications for Asian Security

Asia continues to constitute a highly-dynamic security environment. With regard to US nuclear policy and posture, four imperatives stand out.

A nuclear- and missile-armed North Korea must be countered. This is a considerable challenge since—during the plausible time horizon of the forthcoming NPR—the DPRK reportedly could emerge with a nuclear force of between 60-100 weapons, deployed on a mix of short- and

long-range delivery systems. Meanwhile, the country continues to be led by an eccentric, opaque and unpredictable dynastic regime.

US nuclear capabilities have long played a central role in the deterrence of North Korean aggression and the assurance of Asian allies, and will continue to do so. Forward-deployable strategic weapons in the US triad provide essential support for these goals—to signal US resolve to North Korea and to allies, and to help limit escalation in the event of conflict. Additional US nuclear capabilities—DCA hosted at Japanese and South Korean bases—may be important for deterrence of the DPRK. In addition, the United States should retain the ability to deploy nuclear-capable bombers in the region and demonstrate the capability for stand-off attack with stealthy delivery systems such as the LRSO. A low-yield nuclear weapon that could be delivered promptly against defended North Korean airspace also should be considered.

Finally, as discussed previously, US and allied missile defenses must help counter North Korean missile threats and defend against missile attack if deterrence fails.

Chinese expansion at the expense of US and allied interests must be deterred. China's assertiveness in declaring control of contested islands and a widening swath of ocean has occurred in recent years alongside the expansion and modernization of its nuclear force. While China remains the least transparent of the P-5 nuclear powers, its historical reliance on a small fleet of silo-based ICBMs clearly has given way to a mix of silo-based and mobile ICBMs and sea-based SLBMs, as well as a possible role for a nuclear bomber. This shift will give China more nuclear options, and more discriminate nuclear options to deter and coerce the United States and allies in its bid for regional hegemony.

China's growing assertiveness, expanding nuclear posture, and uncertainties about its future course may well create new nuclear requirements for the United States and the corresponding need to determine whether, when, and how to deploy additional capabilities. The United States must sustain capabilities with the requisite flexibility and resilience to deter China at many possible levels of escalation, and limit damage should deterrence fail.

The assurance of US allies in Asia remains of vital importance. Assurance is based on allied confidence that the regional deterrence strategies of the United States, Japan and South Korea are credible and supported by the necessary US and allied capabilities. Formal extended-deterrence dialogues begun by the United States in 2010 have had a positive impact in this regard and should be continued. The United States should consider going further to implement “NATO-like” nuclear consultation with Northeast Asian allies. The United States also should continue to press Japan and South Korea for trilateral cooperation, which would likely have a powerful effect signaling resolve against potential Chinese and DPRK aggression, and thus contribute to deterrence.

Consideration of rising nuclear dangers in South Asia remains important. Though the United States does not have an alliance-based role in deterring aggression between India and Pakistan, US interests are involved. The possibility of a Pakistani nuclear weapon falling into the hands of terrorists is a particular concern. Therefore, US policy should continue to encourage dialogues between India and Pakistan on nuclear issues, and to emphasize preparations for an emergency response to the loss of control of one or more Pakistani weapons.

Summary conclusion. As nuclear capabilities and military threats continue to grow in Asia, US nuclear forces will play a more important role in supporting key deterrence and assurance goals. Recommended here are considerations for strengthening the capabilities needed to support these goals and advance the adaptability of US forces and strategy.

Affordability of Nuclear Deterrence

The cost of US nuclear capabilities ultimately must be judged against the value they provide in support of US national goals—especially deterring war, assuring allies, and limiting damage if deterrence fails, particularly by preventing the escalation of conflict. In that light—and considering the likely consequences of a nuclear attack—the value of nuclear capabilities needed to support these goals may be judged as virtually infinite.

Infinite resources, however, are not available for any purpose, of course. And after decades of very limited investment in nuclear capabilities, today's estimated costs for the simultaneous modernization of the US nuclear triad appear especially daunting—reportedly ranging from roughly \$400 billion over the next 10 years to as much as \$1 trillion over the next three decades. Critics of such spending levels contend that nuclear forces are inappropriate to meet new 21st-century threats, should be minimized rather than upgraded to avoid wider global nuclear proliferation, and will lead to the starvation of needed investments in conventional forces.

In contrast, this report concludes that necessary investments in US nuclear-force modernization are, in fact, affordable and necessary; they should not rise beyond about five-seven percent of the US defense budget, even at the estimated peak of likely spending in the coming years—well within and even below historic US spending patterns for these forces and goals.

Moreover, critics of nuclear-investment costs greatly underestimate the unique value of nuclear forces in sustaining deterrence against the most dangerous threats and adversaries. US nuclear forces help deter existential nuclear threats to the homeland and to our allies. They provide a deterrent against the use of other types of weapons of mass destruction—including chemical and biological agents—against which the United States no longer possesses the ability to threaten comparable retaliation. They help cement US alliances by strengthening US security guarantees to allies and strategic partners. And, by deterring an opponent's escalation, they underpin the US goal of damage limitation in the event of conflict and the US freedom to use conventional forces effectively to protect American interests.

In the near term—in order to protect long-overdue investments in nuclear forces—this report recommends that Congress consider relief from the budgetary caps imposed (through so-called “sequestration”) by the Budget Control Act of 2011. If current budget law is not amended, the new administration should use executive authority to exempt spending on nuclear forces from the mandatory sequestration cuts.

Over the longer term—to build the kind of public and intra-governmental consensus necessary to sustain investments in needed US nuclear capabilities—the report recommends considering novel budgeting approaches. These could include the creation of a mandatory nuclear-insurance policy—amounting to a fixed portion of defense spending—or the establishment of a “strategic deterrence fund” to cover modernization needs over longer periods of time and thereby create efficiencies.

More fundamentally, the report recommends countering a widespread lack of understanding in key US constituencies about the importance of nuclear capabilities. Senior-level political and military leaders must make a consistent and systematic effort to educate the US Congress, the general public, and the uniformed military about the overwhelming value of nuclear forces to the country's priority security goals.

Summary conclusion. Funding the US nuclear force and modernization programs is both necessary and affordable. Failure to do so would increase the risk of intolerable consequences to the nation. Congress and the executive branch should assure steady investments, and US leaders should better inform Americans about the essential purposes and value of nuclear capabilities for credible deterrence, assurance and damage limitation.

Declaratory Policy

The primary purposes of declaratory policy are to signal US deterrence goals and expectations, including with regard to nuclear forces, and to help thereby deter foes and assure allies. Such statements form an essential component of US deterrence and assurance strategies, and their content and evolution should be considered as such in the forthcoming NPR.

Current US declaratory policy stems from the Obama Administration's response to a 2009 review undertaken by the bipartisan Strategic Posture Commission (the "Perry-Schlesinger Commission"). At that time, the United States reasserted traditional positive security guarantees: the commitment to come to the aid of allies under attack. It also reasserted traditional negative guarantees, with a modification, promising not to employ nuclear weapons against countries that are parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) "and in good standing with their nuclear nonproliferation obligations." The United States *rejected* declarations of "no first use" (the promise that the United States would employ nuclear weapons only in response to a nuclear attack) and "sole purpose" (the statement that the sole purpose of US nuclear capabilities is to deter nuclear attack). Instead of "no first use" or "sole purpose" declarations, the United States retained its traditional approaches of calculated ambiguity surrounding the employment of nuclear weapons and the application of nuclear deterrence to a spectrum of severe threats to the United States and allies.

This report concludes that the continued rejection of "no first use" and "sole purpose" declaratory policies is prudent. A no-first-use declaration would unsettle US allies and weaken deterrence by making conventional attack on an ally appear less risky. Correspondingly, it also would likely contribute to further nuclear proliferation incentives by undermining US assurance goals. A "sole-purpose" declaration would be extremely imprudent as long as significant biological, chemical, and large-scale conventional threats continue to exist as possible contingencies to be prevented via nuclear deterrence. The report also recommends retaining current US policies regarding nuclear-alert status and the option for "launch under attack."

The United States, however, should consider greater clarity and specificity regarding its declaratory nuclear policy in some cases. In the face of Russia's "escalate-to-win" concept and China's increasing military power and expansionism, more specific deterrent threats may be needed to strengthen deterrence and assurance. This would involve the United States and allies more clearly articulating a consensus on nuclear deterrence policy and options to prevent various

possible levels of escalation. Calculated ambiguity may remain, but deterrence at lower levels of possible escalation could be served by a variety of measures, including public signaling of NATO and allied cohesion and nuclear exercises.

The report also recommends that the United States clarify once again that it will maintain the capabilities needed to design, develop, produce, certify and, if necessary, deploy nuclear weapons in support of national deterrence and assurance goals. US intentions in this regard appear to have become uncertain in recent decades, potentially unsettling allies and leading adversaries to conclude that this is an advantageous area in which to challenge the United States.

Summary conclusion. Declaratory policy remains a vital component of nuclear deterrence and assurance goals. It should contribute to, not limit, US adaptability. Current US declaratory policy is appropriate to today's security environment and does not require significant overhaul. However, consideration should be given to greater specificity and manifest allied cohesion regarding deterrence signaling, and the clear demonstration of US intent to maintain its nuclear capabilities into the future.

Arms Control and US Goals in the New Threat Environment

Arms control is a long-standing element of nuclear policy and its content and usefulness in the current security environment must be considered. In general, Russia has not been a cooperative or trustworthy arms control partner for many years. Russia has rejected recent US arms control overtures in strong terms, and both Russia and China currently pursue aggressive, expansionist foreign policies—backed by growing nuclear arsenals—at the expense of US allies. These conditions do not make for a promising arms control environment and suggest that a key requirement of US arms control efforts in the coming years must be to strengthen US deterrence, assurance and damage-limitation capabilities by contributing to the adaptability of US nuclear capabilities, rather than seeking continued numerical nuclear force reductions in the pursuit of nonproliferation as the “top” nuclear policy objective. In addition, US allies and partners should be consulted closely on arms control efforts to reinforce the vital assurance goals of nuclear policy.

The report focuses heavily on the supposed linkage between continuing US nuclear reductions and the advancement of US nonproliferation goals. It does so because widespread belief that US nonproliferation goals demand continuing US nuclear reductions and limitations has had such a significant effect on US nuclear policy for many years. Contrary to this widespread belief, however, available evidence suggests strongly that the reduction of US nuclear capabilities and their limitation does not advance nonproliferation. Rather, it may in fact contribute to proliferation by motivating some allies under threat in the current environment (particularly in Asia) to consider acquiring their own independent nuclear deterrence capabilities. Instead of focusing the US arms control agenda on further US nuclear reductions for nonproliferation purposes, the United States should instead emphasize proven approaches to minimizing and countering proliferation, such as extending credible nuclear deterrence to allies, denying other countries the technology required to produce nuclear weapons, addressing the actual factors that motivate countries to pursue nuclear weapons in the first place, and pursuing a variety of defensive measures to protect against proliferation.

The report recommends consideration of a set of basic principles for the United States with regard to further arms control or limitation agreements, including:

1. Arms control should not be pursued for its own sake, and/or necessarily for the elimination of nuclear weapons, but rather to advance the traditional goals of arms control: reducing the probability of war, the consequences of war, and the cost of maintaining adequate defense capabilities. As such, a primary goal of US arms control policy now should be to advance the adaptability of US capabilities so as to strengthen their support for US deterrence, assurance and damage-limitation goals.
2. The US arms control agenda should not be bound by the 2013 US proposal for further reductions of up to one-third of US deployed strategic weapons.
3. If US-Russia nuclear arms control negotiations again become feasible, then non-strategic nuclear forces also must be included.
4. Effective verification and enforcement of agreements is essential, and the United States should not consider new arms control steps as long as Russia remains in stark non-compliance with existing agreements.
5. The United States should avoid re-establishing treaty limits on missile defense.

The report recommends that the United States continue adhering to the New START Treaty through its 2021 end date as long as Russia remains in compliance. If Russia does not comply with New START, then the United States should mitigate the consequences and strengthen US adaptability outside the treaty as necessary. The Trump Administration also should review the existing US position in support of the Comprehensive Test Ban Treaty (CTBT); the National Nuclear Security Administration (NNSA) should, for the sake of prudence, be directed to improve its readiness for testing—even if there is no immediate need to resume nuclear testing.

Finally, the report endorses the pursuit of feasible cooperative endeavors with both Russia and the PRC, and points to participation in the Global Initiative to Combat Nuclear Terrorism (GICNT) as an example of possible avenues for cooperation.

Summary conclusion. The United States must be clear-eyed about its own arms-control goals, the intentions and trustworthiness of its arms control interlocutors, and the essential requirement for verification and enforcement of all existing and prospective arms control endeavors. Simultaneously, the United States should consider using available arms control venues and cooperative possibilities to explore new options to reduce the probability of war, the destructiveness of war, and the cost of sustaining adequate deterrence, assurance and defense capabilities.

¹ Donald Trump, “Presidential Memorandum on Rebuilding the U.S. Armed Forces,” *WhiteHouse.gov*, January 27, 2017, available at <https://www.whitehouse.gov/the-press-office/2017/01/27/presidential-memorandum-rebuilding-us-armed-forces>.

² Rachael Karas, “Air Force nuclear chief: Mattis wants nuclear review completed within six months,” *Inside Defense*, March 29, 2017, available at <https://insidedefense.com/daily-news/air-force-nuclear-chief-mattis-wants-nuclear-review-completed-within-six-months>.

³ U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, DC: Department of Defense, April 2010), p. vi, available at https://www.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Report.pdf.

⁴ James Miller, Principal Deputy Under Secretary of Defense for Policy, as quoted in U.S. Congress, “The Current Status and Future Direction for U.S. Nuclear Weapons Policy and Posture,” 112th U.S. Congress, House Armed Services Committee, November 2, 2011, p. 62, available at https://fas.org/irp/congress/2011_hr/nw-posture.pdf.

⁵ Hillary Clinton, “Remarks at the United States Institute of Peace,” *State.gov*, October 21, 2009, available at <https://2009-2017.state.gov/secretary/20092013clinton/rm/2009a/10/130806.htm>.

⁶ Ashton Carter, “Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota,” *Defense.gov*, September 26, 2016, available at <https://www.defense.gov/News/Transcripts/Transcript-View/Article/956079/remarks-by-secretary-carter-to-troops-at-minot-air-force-base-north-dakota/>.

⁷ The White House, “Presidential Memorandum on Rebuilding the U.S. Armed Forces,” *WhiteHouse.gov*, January 27, 2017, available at <https://www.whitehouse.gov/the-press-office/2017/01/27/presidential-memorandum-rebuilding-us-armed-forces>.

Section II. Security Environment

Introduction

Any review of US nuclear policy and requirements must begin with a realistic assessment of the emerging security environment and the possible challenges it poses. This is the necessary foundation on which to craft US nuclear policy, goals, priorities, strategy, and capabilities. Without a realistic characterization of current and emerging threats, there can be no informed context for assessing the roles and requirements for US nuclear forces. Directing US nuclear policy on any other basis, such as the presumption of a future benign threat environment, would invite miscalculation based on optimistic speculation. As then-Commander of US Strategic Command (USSTRATCOM) Admiral Cecil Haney recently explained, "...we must have a comprehensive understanding of the strategic environment as perceived from an adversary's point of view. We must understand capability and intent so that we can deny enemy action, threaten the important areas the adversary values, and prevent misperceptions and actions from escalating. We must have a deep understanding of the adversary."¹ Therefore, a review of the security environment is an essential first step in determining US nuclear policy and related considerations such as arms control and declaratory policy.

The United States currently faces a dangerous and unpredictable security environment. As then-Director of National Intelligence (DNI) James Clapper recently stated, "unpredictable instability has become the 'new normal,' and this trend will continue for the foreseeable future."² The state of affairs internationally has changed rapidly and ominously since the publication of the most recent 2010 NPR. Potential adversaries' capabilities and actions now severely test the basic parameters of US post-Cold War nuclear policies as identified in the 1994, 2001 and 2010 NPRs. (See Appendix B for a point-by-point comparison of these past NPRs). US officials must now establish US priorities, strategy, requirements, and capabilities which are relevant to a very different threat environment than has been assumed for the past two decades, in addition to taking into consideration the possibility of surprising developments in a highly-dynamic threat environment.

Overview of the Threat Environment

The Cold War ended definitively with the dissolution of the Soviet Union in 1991. The United States found itself arguably with unmatched military capabilities. Soviet and then Russian leaders initiated domestic reforms and agreed to sweeping nuclear arms control commitments under the START and INF Treaties, and the Presidential Nuclear Initiatives of 1991 and 1992. US political and military leaders expected that Russia would become more of a partner and less of an adversary, and the three previous NPRs all reflected this basic expectation. As then-Commander of European Command General Philip Breedlove remarked recently, "We embarked on a policy of 'hugging the bear' with what we perceived was a former adversary turned strategic partner."³ US officials seemed generally optimistic that China could grow economically in a peaceful manner and perhaps US diplomatic efforts could influence North Korea and Iran in positive directions, or that North Korea would collapse peacefully.

However, since the end of the Cold War, and to a heightened degree after the most recent NPR was published in 2010, several prospective opponents have adopted increasingly hostile postures toward the United States and its allies, and have increased their nuclear capabilities and their reliance upon them.⁴ Russia has engaged in the use of military force to occupy territory and change borders in Europe for the first time since World War II. Then-US Secretary of Defense Ashton Carter stated that this dramatically new threat environment signals “a return to great power competition.”⁵

Indeed, Russian Defense Minister Gen. Sergei Shoigu recently observed that, “The rivalry for global leadership and resources is escalating. The leading nations do not share a vision of the world order... One has observed the growing role of military force as an instrument of pursuing national interests and the weakening of global security institutes.”⁶ This turn in the post-Cold War environment is reflected in numerous developments over the past decade.

Russia, for example, invaded Georgia in 2008 in a pre-planned attempt to destabilize the Georgian government and discourage pro-Western sentiment among its leaders. In 2014, Russian forces illegally occupied the Crimean peninsula, and Russian military forces are now directly aiding provincial rebel forces in Eastern Ukraine. China has made sweeping territorial claims in the South China Sea while building and militarizing islands in disputed sea areas in contravention of international laws and tribunal rulings.⁷ North Korea continues to initiate violent border confrontations with US ally South Korea, with the apparent ultimate goal of reuniting the Korean peninsula by force, if necessary. Iran continues to fund international terrorist groups, regularly provokes US and allied forces in the Middle East while striving for regional hegemony, and continues to develop long-range missile capabilities. Non-state actors such as core Al-Qaeda and ISIS destabilize and attack US targets, partners and allies, and reportedly aspire to weapons of mass destruction (WMD).

International nuclear developments since the publication of the 2010 NPR are considerable and troubling. Oft-expressed US views about the declining value and roles of nuclear weapons are *not* shared by other key states, a fact that has led to mismatched perceptions and unrealized expectations.

For example, Russia has elevated the role of nuclear weapons in its defense policy, is modernizing both its strategic and non-strategic nuclear forces, reportedly stages military exercises involving the first use of nuclear weapons, and openly discusses the potential first use of nuclear weapons in a local conflict as an acceptable way to “de-escalate” the conflict on terms favorable to Russia.⁸ As Admiral Haney recently stated, “These destabilizing actions are taking place at the same time Russia is declaring and recklessly expressing its willingness to escalate if required. By virtue of the size of its nuclear arsenal, Russia poses an existential threat to the United States.”⁹

China is modernizing its strategic nuclear forces as well, while pursuing a policy of opaqueness with regard to its nuclear posture. North Korea is actively testing its nuclear capabilities and ballistic missiles while remaining outside the Non-Proliferation Treaty (NPT). Iran, under the Joint Comprehensive Plan of Action (JCPOA), has agreed to limits on its nuclear programs, but may already be violating some of its provisions,¹⁰ and it is unknown how Iran will proceed following its

tenure. Finally, as noted, non-state actors, such as ISIS, reportedly appear to be committed to obtaining WMDs, including nuclear.

While future threats are impossible to predict with precision, the trends in the current threat environment point away from the increasingly benign world earlier expected for the post-Cold War order. The US Joint Chiefs of Staff (JCS) recently reported that the emerging security environment, “can be described by simultaneous and connected challenges – *contested norms* and *persistent disorder*.¹¹ Then-Chairman of the JCS Gen. Martin Dempsey stated in the Foreword to *The National Military Strategy of the United States of America 2015* that, “Future conflicts will come more rapidly, last longer, and take place on a much more technically challenging battlefield. They will have increasing implications to the US homeland.”¹² This is the general contemporary threat environment that must inform a 2017 NPR.

The 1994, 2001, and 2010 NPRs posited a relatively benign nuclear environment; but, in recognition of the unpredictability of the international security environment and the possibility of dangerous developments, all three advocated some form of “hedging” against the possibility of a downturn. Former Under Secretary of Defense Walter B. Slocombe, a key architect of the 1994 NPR, wrote in 1992, “Nuclear weapons will retain their fundamental role because, even if the transformation of the USSR follows a relatively optimistic path, there will be for many years an overhanging possibility not merely of transient ups and downs in Russian progress, but of fundamental relapse, an event which would again require active nuclear deterrence for world stability and US security.”¹³ This prescient insight should inform a 2017 NPR as it identifies the requirements for US nuclear policy posed by the type of “relapse” that is now a reality and the ongoing challenges of a highly-dynamic threat environment.

This section focuses on the threats posed by Russia, China, North Korea, Iran, and non-state actors as *illustrative of the dynamic and unpredictable current threat environment*. Future threats are likely to emerge in surprising or sudden ways.

Russian Federation

Virtually all senior Obama Administration Defense Department officials and senior US military leaders stated that Russia is now the number one priority threat to the United States.¹⁴ In 2008, Russia executed its pre-planned invasion of Georgia and has since effectively absorbed parts of Georgian territory.¹⁵ Since 2014, Russia also has illegally annexed Crimea from Ukraine, intervened forcefully in the Syrian civil war on the side of Syrian President Bashar al-Assad, and reportedly was aware in advance of Assad’s most recent use of chemical weapons against Syrian civilians.¹⁶ Russian leaders have named the United States and NATO as the priority “threats,” and issued numerous explicit and implicit nuclear threats to the United States and its allies. Russian President Vladimir Putin has stoked feelings of Russian “imperial nationalism”—apparently as a means of both inspiring popular domestic support and distracting domestic attention away from increasingly difficult economic conditions.¹⁷ In addition, Moscow supports fringe political groups in Europe to “undermine the social cohesion of neighboring states” in an effort to increase its “soft power” and establish regional dominance.¹⁸ This newly-assertive and aggressive foreign policy is particularly worrisome to US NATO allies that border Russia. NATO Secretary General Jens Stoltenberg stated recently, “We have seen a more assertive Russia implementing a substantial military build-up over many years; tripling defense spending since

2000 in real terms; developing new military capabilities; exercising their forces and using military force against neighbors.”¹⁹

Leadership

Russian President Vladimir Putin has been a central figure in Russian political leadership for nearly two decades and currently does not appear to face any significant domestic opposition.²⁰ The national security decision-making process in Russia, according to then-Commander of US European Command Gen. Philip Breedlove, is controlled by not just one person, but “by a very small group” around Putin. In addition, Gen. Breedlove states that he and his advisors agreed that “we will probably be dealing with this one person and some resemblance of that same small group for some time to come in the future... We are unsure that we would be in a better place if Mr. Putin was not there.”²¹ Consequently, the hope that Russia’s current aggressive goals and hostility will pass with President Putin is likely to be optimistic.

Putin’s worldview is inherently anti-Western since, as former NATO Deputy Secretary General Alexander Vershbow explains, he is “convinced that the West was determined not only to weaken Russia but to topple his regime.”²² Vladimir Putin and Prime Minister Dmitri Medvedev, along with other Russian officials, appear willing to accept great risks and “meaningful” harm to their economy in order to implement an aggressive expansionist foreign policy.²³ With regard to Russia’s need for military re-armament, in 2012 Putin wrote in *Foreign Policy* magazine that, “In other words, we should not tempt anyone by allowing ourselves to be weak. We will, under no circumstances, surrender our strategic deterrent capability. Indeed, we will strengthen it.”²⁴

Nuclear Forces

Russian officials appear to consider Russia’s nuclear capabilities as the guarantee of global parity with the United States and as an enabler for assertive regional actions. Then-Secretary of Defense Ashton Carter remarked that, “the Russians are also very rapidly modernizing their own nuclear arsenal... I associate it with the dynamics of their own feelings that nuclear weapons are one of the only things that guarantee their status in the world.”²⁵ According to the Department of Defense’s *2017 Defense Posture Statement*, “Moscow’s nuclear saber-rattling raises questions about Russia’s leaders’ commitment to strategic stability, their respect for norms against the use of nuclear weapons, and whether they respect the profound caution that nuclear-age leaders showed with regard to brandishing nuclear weapons.”²⁶ Indeed, there are significant and troubling gaps between how the United States and Russia view their respective nuclear forces that must be taken into account by a 2017 NPR. The National Intelligence Council notes in its *Global Trends 2030* report that, “Nuclear ambitions in the US and Russia over the last 20 years have evolved in opposite directions. Reducing the role of nuclear weapons in US security strategy is a US objective, while Russia is pursuing new concepts and capabilities for expanding the role of nuclear weapons in its security strategy.”²⁷

Russia has placed highest priority on its military modernization programs, particularly including nuclear, for at least the past decade, and those investments are producing newly-deployed conventional and nuclear forces.²⁸ Despite the tumbling value of Russian currency, capital flight, and Western economic sanctions, Russian defense spending as a percentage of GDP has risen steadily since 2010 and stood at 5.42 percent in 2015.²⁹ The draft 2017 budget before the Russian Duma may lead to a reduction in military spending—possibly in a bid to increase funding

for social and domestic improvements before the election year and thus benefit President Putin's political party.³⁰ But, Victor Ozerov, Chair of the Russian Federation Council Defense Committee, said in April 2017, "We choose financing priorities: *this is primarily the nuclear weapons complex*, the purchase of advanced materials, as well as the fulfillment of social obligations to the servicemen."³¹

Russia's recent expanded military acquisition reflects the high priority Russian officials have placed on nuclear weapons. Russia has announced over 20 programs to develop and deploy new strategic nuclear systems or modernize legacy Soviet systems. These include multiple systems for every leg of the Russian triad, and two possible systems that are beyond the traditional triad, i.e., a hypersonic glide vehicle and a new nuclear-armed and powered undersea delivery vehicle (Status-6).³² According to Russian open sources, Russia's modern nuclear programs include a new heavy ICBM with the capacity to carry "no fewer than 15" nuclear warheads,³³ or, alternatively, multiple hypersonic glide vehicles,³⁴ new road-mobile ICBMs, a rail-mobile ICBM, new SSBNs and SLBMs, new and modernized strategic bombers, and nuclear-capable cruise missiles.³⁵

In addition, Russia recently has deployed ground-launched cruise missiles in violation of the INF Treaty.³⁶ And, the US government estimates that Russia retains "2,000 to 4,000" tactical nuclear weapons, many of which remain in service today.³⁷

Russian officials have categorically rejected US petitions for further nuclear arms control agreements or proposed wholly unacceptable preconditions for such talks.³⁸ Indeed, Russian officials have indicated for over a decade that Russia requires nuclear capabilities that can only be filled by missiles prohibited by the 1987 INF Treaty.³⁹ Gen. Breedlove's conclusion in 2017 regarding the difference between Russian and Western views of these capabilities is striking:

NATO policymakers and planners must recognize that their Russian counterparts view nuclear weapons as practical tools for gaining tactical advantage on the battlefield, escalation control, and for intimidation during conflict termination: Russian views on the utility of nuclear weapons are a sharp departure from most Western thinking and thus represent a potentially dangerous risk during a crisis. The more Russian decision-makers believe this gap in perceptions exists, the more tempted they could be to threaten the use of nuclear weapons during a crisis, or actually employ them to shock Western policymakers into compliance with Russian political objectives.⁴⁰

Correspondingly, senior Russian officials have stated that Russia is developing new types of nuclear weapons. In January 2005, then-Defense Minister Colonel General Sergei Ivanov declared, "We will develop, improve and deploy *new types* of nuclear weapons. We will make them more reliable and accurate."⁴¹ In September 2009, Colonel General Vladimir Verkhovtsev, then-chief of the Defense Ministry's 12th Main Directorate, Russia's nuclear weapons organization, said the newly developed and manufactured nuclear munitions will have "improved tactical and technical specifications..."⁴² The new and modernized delivery systems reportedly will carry everything from new precision low-yield and low-collateral damage nuclear warheads to thermonuclear weapons with ultra-high yield.⁴³ Correspondingly, according to the 2009 Strategic Posture Commission, Russia apparently has engaged in some form of low-yield nuclear tests.⁴⁴

Russia also recently launched a civil defense campaign in which reportedly 40 million Russian citizens took part. These drills included instructions in the event of nuclear war.⁴⁵ Moscow is developing and deploying air and missile defense systems which Russian defense officials reportedly expect will be able to intercept ballistic missiles of all ranges and enemy air units at greater distances and with greater precision than previous systems.⁴⁶ The Commander of Air Force Global Strike Command Robin Rand recently expressed unprecedented concern that the US ICBM force, “will have a difficult time surviving in the active A2/AD [anti-access, area denial environment]” of the future. Gen. Rand also stated, “The Minuteman III with each year becomes more and more obsolete, and I am concerned that if we don’t replace it, the enemy gets a vote and we will not be able to provide the capabilities that are needed with the current system.”⁴⁷

Finally, Russia appears to believe that asymmetric military capabilities are necessary requirements even extending to outer space. For example, then-DNI Clapper stated in his *World Wide Threat Assessment*, “Russia [sic] senior leadership probably views countering the US space advantage as a critical component of warfighting.” In fact, “The Russian Duma officially recommended in 2013 that Russia resume research and development of an airborne antisatellite missile to ‘be able to intercept absolutely everything that flies from space.’” Clapper also stated, “Russian defense officials acknowledge that they have deployed radar-imagery jammers and are developing laser weapons designed to blind US intelligence and ballistic missile defense satellites.”⁴⁸

Doctrine

Russian strategy appears to employ multiple instruments of power to shape events and circumstances in and around its borders, including placing significant social, economic, political and, in some cases, direct military pressure on its Western neighbors. Vladimir Putin frequently speaks of Russia as a “balance” to the United States and the NATO alliance for the purpose of advancing Russia’s position of power and influence in Eurasia, particularly including Central and Eastern Europe. Gen. Breedlove described the foundation of Russian foreign and defense policy as a fundamental rejection of the post-Cold War settlement and norms: “Russia does not accept and does not care for the way the rules were rewritten at that time when they were in a weakened position. And so Russia is not interested in breaking those rules. They’re interested in rewriting them. Their every effort these days are to be seen as equal on the world’s stage.”⁴⁹ Chairman of NATO’s Military Committee, General Petr Pavel, explained that, “...Russia respects power. Russia sees the liberal approach, democratic approach, discussion, compromise, as a weakness.”⁵⁰

With such differing approaches and goals in this new security environment, the US-Russia strategic relationship has become openly antagonistic and may continue to be so in coming years. There are numerous potential flashpoints given Russia’s goals. As one recent report observed with regard to the Baltic states, “Russia views their integration into the Western bloc as an encroachment on its traditional sphere of influence, which is troublesome considering Putin’s intent to restore Russia’s great power status.”⁵¹

Russian nuclear doctrine has undergone fundamental changes since the end of the 1990s, with an increasing salience for nuclear weapons. Open-source reports and testimony by US and NATO officials indicate that Russia has developed an “escalate-to-deescalate,” or more accurately,

“escalate to win” nuclear strategy that includes the possibility of nuclear first use in regional and local conflicts in order to terminate a conflict on terms favorable to Russia.⁵²

As the National Intelligence Council states in its January 2017 *Global Trends* report, “Russia will remain committed to nuclear weapons as a deterrent and as a counter to stronger conventional military forces, as well as its ticket to superpower status. Russian military doctrine purportedly includes the limited use of nuclear weapons in a situation where Russia’s vital interests are at stake to ‘deescalate’ a conflict by demonstrating that continued conventional conflict risks escalating the crisis to a large-scale nuclear exchange.”⁵³

This strategy appears not to be limited to the defense of existing Russian territory. It could support *de jure* or *de facto* territorial gains in Europe by deterring or countering any robust NATO response to Russian military aggression.⁵⁴ Reflective of Putin’s drive to restore Russia’s position, and the role of nuclear weapons in support of that drive, are the explicit nuclear threats made against NATO allies in Central Europe and the placement of nuclear-capable systems in Russia’s Western enclave of Kaliningrad. Jacek Durkalec, a scholar with a government-sponsored Polish “think tank,” concludes that “the expanded function of Russia’s nuclear arsenal… is not just for traditional deterrence, which is aimed at preserving the status quo; it is also to be used as a tool of intimidation and coercion, supporting territorial change.”⁵⁵ This conclusion captures the sharp difference between Russian and Western approaches to deterrence and the roles of nuclear capabilities. As then-Assistant Secretary of Defense Robert Scher recently testified, “Russia’s purported doctrine of nuclear escalation to deescalate a conventional conflict amounts to a reckless gamble for which the odds are incalculable and the outcome could prove catastrophic.”⁵⁶ Then-Secretary of Defense Ashton Carter also noted that, “it’s a sobering fact that the most likely use of nuclear weapons is not the massive nuclear exchange of the classic Cold War-type, but rather the unwise resort to smaller but still unprecedentedly terrible attacks, for example, by Russia or North Korea to try to coerce a conventionally superior opponent to back off or abandon an ally during a crisis.”⁵⁷

In addition, as Admiral Haney recently stated, “Russia’s nuclear doctrine and rhetoric, which appear to lower the threshold for the use of nuclear weapons, show the difference between Russian and US concepts of the use of force. They also bring to light concerns about Russia’s commitment to strategic stability.”⁵⁸ Indeed, Lt. Gen. David Hogg, then-US Military Representative to the NATO Military Committee, said recently, “There is a Russian document [that] states that they will escalate to de-escalate and will be the first to issue a nuclear strike.”⁵⁹ This strategy, combined with Russia’s aggressive expansionist goals, virtually ensures serious US-Russian friction, including the grave possibility of nuclear crises in Europe. This is a dramatically different threat environment than that anticipated in earlier NPRs.

People’s Republic of China

Chinese nuclear forces have grown slowly but steadily in the past two decades, and Chinese nuclear doctrine appears to have evolved with new goals for a shifting strategic environment. China officially follows the practice of deliberate opacity concerning its nuclear force size and composition. Thus, there is a degree of uncertainty in characterizing the threat China may pose to the United States and allies now and in the future. However, what is known about the direction and goals of Chinese expansionism and nuclear forces is troubling. China has made claims to nearly the entire South China Sea, in violation of multiple international laws and tribunal rulings,

as well as disputing Japanese sovereignty over the island of Okinawa, where US military personnel are currently stationed.⁶⁰ Chinese officials, while claiming to act under international law, in fact are pursuing policies in direct violation of international law and norms which they assert were established by the United States following the Cold War to preserve its own advantages.

Leadership

Chinese President Xi Jinping assumed power in 2012 after many years as a senior official in the Chinese Communist Party (CCP). Since 2012, “Chinese national security and foreign policy have become more centralized and focused” under President Xi.⁶¹ The US-China Economic and Security Review Commission (USCC) summarized this process, stating: “President Xi continues to position himself at the apex of the security and foreign policy decision-making apparatus in Beijing, and appears to be successfully advancing a foreign policy and security agenda that reinforces CCP rule and seeks to enable China to achieve great power status.”⁶²

Nuclear Forces

The Obama Administration estimated that China has several hundred nuclear weapons, but other estimates place the number much higher.⁶³ President Xi recently initiated a series of military reforms and reorganization efforts that included renaming the Second Artillery Corps, China’s military force in charge of most of its nuclear forces, the “People’s Liberation Army Rocket Force.” At a PLA Rocket Force military ceremony, President Xi stated the Rocket Force is a, “core force of strategic deterrence, a strategic buttress to the country’s position as a major power, and an important building block in upholding national security.”⁶⁴ As the US Department of Defense explains, this move “elevated” the PLA Rocket Force from an independent branch to a full service.⁶⁵ China’s ongoing nuclear modernization programs are an indication that Chinese officials consider strategic nuclear forces a top priority.

The Department of Defense recently summarized China’s strategic modernization plans, stating that China is “developing and testing several new classes and variants of offensive missiles, including a hypersonic glide vehicle; forming additional missile units; upgrading older missile systems; and developing methods to counter ballistic missile defenses.”⁶⁶ Among these “new classes and variants of offensive missiles” is the DF-41 road-mobile ICBM which is capable of carrying numerous MIRVs and the newer versions of JL-2 and/or JL-3 SLBMs, which will also reportedly be MIRVed.⁶⁷ China is developing a second new type of ballistic missile submarine, the Type 096.⁶⁸ China’s Air Force Commander Maj. Gen. Ma Xiaotian has recently said, “We are currently developing a new generation of strategic bombers, soon you will be able to see it.”⁶⁹ In addition, in the *2015 Annual Report to Congress on China*, DoD includes a discussion of China’s tests of a hypersonic glide vehicle and the possibility it could be outfitted to carry a nuclear warhead.⁷⁰

China is expanding its strategic nuclear forces; the question is the limit of that expansion. The extensive length of China’s “Underground Great Wall” (the Chinese say 5,000-km of deep tunnels), suggests that a larger force of nuclear-armed ICBMs may be planned.⁷¹

China has a large force of theater nuclear missiles and new missiles are reportedly under development. A 2013 report by the National Air and Space Intelligence Center lists 13 types of Chinese theater-range ballistic missiles either operational or under testing.⁷² Chinese nuclear-

capable missile systems reported in US government reports include the CSS-2, two older versions of the CSS-5 (DF-21), the new DF-21D anti-ship missile (ASBM), a 4,000-km range IRBM, and new cruise missiles.⁷³ All but the IRBM reportedly are deployed already. The Taiwanese Defense Ministry says that the DF-11 short-range missile is nuclear capable.⁷⁴ The short-range Chinese DF-15 is also reported to be nuclear capable.⁷⁵

The USCC summarized these modernization programs as part of a broader shift in Chinese strategic thinking saying: “China has come to view a flexible, survivable, and lethal offensive missile force as a force multiplier in achieving its strategic objectives.”⁷⁶ In addition, the Chinese focus on flexible missile forces has led to a well-developed anti-satellite/counterspace capability that Chinese officials believe may be useful to deny and disrupt US space capabilities.⁷⁷ These newly developed and deployed “second-strike” forces and asymmetric weapons appear to allow Chinese officials greater latitude in developing China’s evolving nuclear doctrine.

Doctrine

China has officially committed to a No-First-Use nuclear policy. Consequently, Chinese officials claim that China has structured its nuclear forces according to a “second-strike” policy—with the need only to be able to withstand a nuclear first strike and respond. According to DoD, however, there is “some ambiguity” regarding China’s “No-First-Use” pledge and the conditions in which it might apply.⁷⁸ Col. (ret.) Larry Wortzel, Co-Chairman of USCC, has emphasized that China’s no-first-use formulation is essentially meaningless.⁷⁹ And, the Japanese *Kyodo News Agency* reported that it obtained classified Chinese documents which say that China “will adjust the nuclear threat policy if a nuclear missile-possessing country carries out a series of air strikes.”⁸⁰

The Pentagon recently summarized the Chinese doctrine stating, “China’s nuclear weapons policy prioritizes maintaining a nuclear force able to survive an attack and to respond with sufficient strength to inflict unacceptable damage on an enemy. China insists the new generation of mobile missiles, with warheads consisting of multiple independently targeted reentry vehicles (MIRVs) and penetration aids, are intended to ensure the viability of China’s strategic deterrent in the face of continued advances in US and, to a lesser extent, Russian strategic ISR, precision strike, and missile defense capabilities.”⁸¹

DoD summarized the Chinese military leadership’s vision of overall strategy, stating:

In tandem with the modernization and reorganization of the PLA, Chinese leaders are increasingly leveraging tactics short of armed conflict to advance China’s interests. Their approach seeks to enhance China’s reach and power through activities calculated to fall below the threshold of provoking the United States, its allies and partners, or others in the Asia-Pacific region into open conflict. This is particularly evident in China’s pursuit of its territorial and maritime sovereignty claims in the South and East China Seas.⁸²

In short, China seeks to expand its power, influence, and territorial claims in East Asia and is threatening US allies and partners in the process. In addition, China’s growing nuclear capabilities and evolving doctrine appear to be essential elements of this assertive and increasingly aggressive Chinese foreign and defense policy. Once again, this is a different threat environment than that which pertained at the time of the earlier NPRs.

Democratic People's Republic of Korea

North Korea continues to defy UN resolutions and international sanctions openly with its provocative militaristic behavior and threatening rhetoric. The Department of Defense recently summarized the threat from North Korea to US interests stating: “North Korea’s willingness to undertake provocative and destabilizing behavior, including attacks on the Republic of Korea (ROK), its continued development of nuclear weapons and long-range ballistic missiles, and its proliferation of weapons in contravention of United Nations Security Council resolutions (UNSCRs) pose a serious threat to the United States, the region, and the world.”⁸³

North Korea’s defense policy foundations are found in the overarching national goals of regime preservation and the reunification of the peninsula under its control. As the Department of Defense notes in its 2015 *Military and Security Developments Involving the Democratic People’s Republic of Korea* report, “The overarching national security objectives … [are]: international recognition as a nuclear-armed state; maintenance of a viable deterrent capability; the simultaneous development of its economy and nuclear weapons program [i.e., the ‘byungjin’ line]; reinforcement of its military-first approach to domestic and foreign affairs [‘songun’]; tight control over communications, borders, movement, and trade; and reunification of Korea under North Korea’s control.”⁸⁴ Then-Secretary of Defense Ashton Carter pointed out that “North Korea’s nuclear and missile provocations underscore that a diverse and dynamic spectrum of nuclear threat still exists, so our deterrence must be credible and extended to our allies in the region.”⁸⁵

As pursued by North Korea, these goals are incompatible with US and allies’ goals and are the basis for seemingly irreconcilable differences. In recognition of North Korea’s intransigent stance, then-DNI Clapper recently stated that asking North Korea to engage in negotiations to give up its nuclear weapons is “probably a lost cause.”⁸⁶

Leadership

Careful analysis of North Korean behavior suggests that the regime places priority value on honoring the supposed dignity of the Kim leadership which, if violated, could lead to confrontation and crisis.⁸⁷ As the leader of North Korea, one of the most isolated states in the world, Kim Jong Un has adopted an increasingly aggressive foreign policy that identifies the United States and its allies South Korea and Japan as its principal adversaries. Kim Jong Un inherited power from his father Kim Jong Il, who inherited his power from his father Kim Il Sung. The Pentagon believes, “The strategic goal of the regime is to ensure Kim family rule in perpetuity.”⁸⁸ After a series of “purges” and executions of top party officials, it appears Kim Jong Un has solidified his rule of North Korea and most likely has broad decision-making powers that extend to all aspects of North Korean life: economic, social, political, and military. Kim Jong Un has prioritized a “military first approach, which views military strength as the best way to deter and defend against foreign aggression, [and] also bolsters the centrality of nuclear weapons to the regime’s survival.”⁸⁹

Nuclear Forces

North Korea’s nuclear forces appear to be increasing both in quantity and quality. A senior North Korean diplomat recently declared that North Korea “is not interested in any kind of dialogue” if the goal is “making us give up our nuclear program.”⁹⁰ Current open estimates vary, but North Korea may have enough fissile material for 13-21 nuclear weapons and may produce enough for

50-100 nuclear weapons by 2020.⁹¹ North Korea has tested a nuclear device five times, including twice in 2016, with progressively increasing estimated yields. While apparently there is no definitive evidence that North Korea is now capable of successfully deploying a missile-based delivery vehicle or re-entry vehicle, a 2013 Pentagon report to Congress stated, “DIA assesses with moderate confidence the North currently has nuclear weapons capable of delivery by ballistic missiles.”⁹²

Open-source estimates vary as to when North Korea could produce a viable ICBM-range delivery vehicle, but US defense officials are confident that, “North Korea is committed to developing a long-range, nuclear-armed missile that is capable of posing a direct threat to the United States.”⁹³ North Korea has recently tested both ICBM and SLBM delivery capabilities with varying degrees of success.

Doctrine

Very little is known with certainty about how North Korean leaders view their nuclear weapons and what strategy they may employ for deterrence purposes. One North Korean official, Lee Yong Pil, director of the Foreign Ministry’s Institute for American Studies, recently stated that it was North Korean policy to “go nuclear” if it perceived an immediate threat to the homeland, even without actual shots being fired to begin a conflict.⁹⁴ North Korea has simulated nuclear strikes on South Korean airfields in the past, reportedly believing, in part, those airfields will be staging areas for US nuclear weapons in a presumptive attack on North Korea.⁹⁵ In addition, North Korean officials claimed their recent ballistic missile tests were meant as practice for striking US military bases in the region.⁹⁶ These may be indicative of North Korean nuclear targeting doctrine. Official North Korean law states, “the nuclear weapons of the DPRK can only be used by a final order of the Supreme Commander of the Korean’s People’s Army (Kim Jong Un) to repel invasion or attack from a hostile nuclear weapons state and make retaliatory strikes.”⁹⁷ Stating the consensus view of the Intelligence Community, then-DNI James Clapper stated recently, “Although North Korea issues official statements that include its justification for building nuclear weapons and threats to use them as a defensive or retaliatory measure, we do not know the details of Pyongyang’s nuclear doctrine or employment concepts. We have long assessed that Pyongyang’s nuclear capabilities are intended for deterrence, international prestige, and coercive diplomacy.”⁹⁸

These developments stand in stark contrast with US hopes after the end of the Cold War that North Korea’s government would either collapse peacefully or slowly reform, and that there might be a diplomatic solution to North Korean nuclear capabilities. While seemingly always on the edge of collapse, the North Korean government has proven to be resilient while apparently retaining control over the country and sustaining its nuclear programs. Despite multiple diplomatic efforts over the past two decades, North Korea appears to have made the strategic decision to sustain these programs and to further develop them to threaten the United States and its allies.

Islamic Republic of Iran

Iran has expanded its disruptive and aggressive actions in the Middle East, including provocations against the United States, and continues to support terrorist organizations. Then-DNI James Clapper described Iran in the most recent *Worldwide Threat Assessment* report as presenting “an enduring threat to US national interests because of its support to regional terrorist and militant

groups and the Assad regime in Syria, as well as its development of advanced military capabilities.⁹⁹ Indeed, Iranian leaders have in the past openly discussed the destruction of Israel and the United States.¹⁰⁰

While Iran is not a known nuclear power, it retains the potential to become a nuclear power, and exhibits considerable hostility to the United States and its allies. The Intelligence Community assesses that Iran's intent is "to thwart US, Saudi, and Israeli influence, bolster its allies, and fight ISIL's expansion."¹⁰¹ Most of these purported Iranian interests conflict with US security goals in the region and may therefore cause conflict in the future. The Commander of US Central Command Gen. Joseph Votel recently stated, "I am concerned about continued malign activities across the region," and that there has been an "uptick" in threatening Iranian behavior since the signing of the JCPOA.¹⁰²

Leadership

Authority in Iran's theocratic regime centers on Supreme Leader Ali Khamenei, who has held the position since 1989. In the words of then-DNI Clapper, "Supreme Leader Khamenei continues to view the United States as a major threat to Iran, and we assess that his views will not change, despite implementation of the JCPOA deal. In October 2015, Khamenei publicly claimed the United States was using the JCPOA to 'infiltrate and penetrate' Iran."¹⁰³ In addition, Iranian President Hassan Rouhani also has foreign policy responsibilities, though Khamenei is the ultimate decision maker.

Strategic and Regional Forces

Iran's nuclear weapons program started in the late 1980s and substantial progress has been made in weapons design.¹⁰⁴ In November 2009, the International Atomic Energy Agency (IAEA) reportedly concluded Iranian scientists have experimented with "an advanced nuclear warhead design" known as a "two-point implosion device" which allows for smaller nuclear warheads.¹⁰⁵ In February 2010, an IAEA report stated Iran had conducted work "relating to the manufacture of components for high explosives initiation systems; and experiments concerning the generation and detection of neutrons."¹⁰⁶ A November 2010 IAEA report said that Iran was making "efforts to shrink a Pakistani warhead design to fit atop its ballistic missiles..."¹⁰⁷ A May 2011 IAEA report contained information on a long list of Iranian weapons-related activities including work on initiators, high explosive testing, "Multipoint explosive initiation and hemispherical detonation studies involving highly instrumented experiments," and missile reentry vehicle redesign activities.¹⁰⁸ And, according to the former chief of the German Defense Ministry Policy Planning Staff, Hans Rühle, "Several intelligence services believe that at least one [North Korean nuclear test] was commissioned by Iran."¹⁰⁹

Despite the JCPOA, the potential for a future nuclear-armed Iran remains subject to Iranian aspirations. During the JCPOA negotiation, the United States apparently largely gave up efforts to eliminate Iran's capability to enrich uranium.¹¹⁰ As the JCPOA's provisions sunset, Iran may be able to move toward nuclear capabilities very quickly.

The JCPOA does not limit potential delivery vehicles such as missiles, in which the Iranian regime reportedly is investing heavily. Indeed, Iran has publicly disclosed multiple underground missile storage and launch facilities.¹¹¹ According to Brian McKeon, then-Principal Deputy

Undersecretary for Defense, “Iran already has the largest inventory of ballistic missiles in the Middle East and today can potentially reach targets throughout the region and into southeastern Europe. Iran is seeking to enhance the lethality and effectiveness of existing systems with improvements in accuracy and warhead designs.”¹¹² In addition, “Although Iran does not yet appear to deploy an intercontinental ballistic missile (ICBM), its progress on space launch vehicles (SLVs)—along with its desire to deter the United States and its allies and partners—provides Iran with the potential means and potential motivation to develop longer-range missiles, including an ICBM. Iran has stated publicly that it intends to launch the Simorgh SLV this year, which would be capable of ICBM ranges if Iran chose to configure it as a ballistic missile.”¹¹³

In addition to the short-range Zalzal 2, Fatah 110, Scuds B and C missiles, Iran has both medium- and intermediate-range ballistic missiles capable of delivering WMD payloads.¹¹⁴ The progress Iran is making in long-range ballistic missiles is illustrated by its successful satellite launches.¹¹⁵ The Iranian Simorgh missile, which Iran says will be used for space launch, appears to be a derivative of the North Korean TD-2 ICBM/SLV.¹¹⁶

Also, Iran and North Korea recently signed a technology-sharing agreement because the two countries share “common enemies.”¹¹⁷ Unclassified Intelligence Community assessments indicate that “ballistic missile technology cooperat[ion] between the two [countries] is significant and meaningful...”¹¹⁸ In addition, Iran reportedly recently took delivery on S-300 advanced air defense systems from Russia as part of its general military buildup.¹¹⁹ According to open sources, in 2015: “Iran’s military capabilities remained a concern in the region and beyond. Although the embargo on the sale of many conventional weapons to Iran is to remain in force for five years after the 18 October adoption of the Joint Comprehensive Plan of Action ... regional states and concerned external powers were aware that Tehran was likely planning a significant military-recapitalisation programme when it was once more able to utilise revenues for procurements on the open market.”¹²⁰

Doctrine

Little is known about Iranian leadership’s thoughts about nuclear weapons outside the religious “fatwa” issued by Iranian Supreme Leader Khamenei which nominally forbade possession or production of nuclear weapons.¹²¹ If and when Iranian leaders acquire nuclear weapons, it is unknown how they might view their utility, whether as a defensive guarantee of sovereignty or as a shield enabling provocation and territorial expansion. The possibility of the latter suggests the continuing potential for serious crises in the Middle East.

Non-state Actors

Both Presidents George W. Bush and Barack Obama declared nuclear terrorism to be the highest priority threat facing the United States.¹²² In addition, both administrations agreed that if terrorists were to obtain a nuclear weapon, they would almost certainly attempt to use it.¹²³ While open-source reports do not suggest that terrorist groups have been successful in acquiring a nuclear weapon or the materials needed to assemble one, the apparent intent remains.¹²⁴ Thus, while non-state actors appear not yet to have the capability to conduct a nuclear strike on the United States or its allies, their intent to do so makes the threat of nuclear terrorism in the future a distinct possibility. Also, it appears non-state actors will continue to pursue chemical and biological weapons, perhaps with or without state assistance.

Summary and Conclusions

The threat environment has worsened considerably since the 2010 NPR, including in unexpected and severe ways. Given the apparent intentions of adversaries and their expanding capabilities, conventional and nuclear, a fundamentally new appreciation of the threat environment is needed as a basis for assessing US nuclear policy in 2017. Russia, China, North Korea, Iran, and non-state actors are all challenging US security interests in multiple geographic areas and across multiple domains, a trend that may well continue into the future in unpredictable ways and with unpredictable consequences. The potential WMD threat posed by terrorist organizations clearly must be considered a high US priority. In the contemporary threat environment, however, nuclear threats to the United States and its allies posed by hostile states can no longer realistically be considered as other than priority threats in the formulation of US nuclear policies.

It is impossible to predict with precision what the international security environment will look like five-30 years into the future. A 2013 survey of more than 1,200 international experts illustrates the futility of predicting the international security environment even one year away: To wit, the 2014 Russian invasion of Ukraine did not even make the top 30 most likely threats expected for 2014.¹²⁵ The US Intelligence Community reportedly also did not foresee this contingency.¹²⁶ It is important to recognize that recent political and military threat trends, including those specific cases discussed above, reflect a dramatic, negative trend away from the optimistic expectations of the post-Cold War period and the earlier NPRs. These threats and uncertainties now confronting the West must form the basis for a 2017 NPR.

As the 2010 NPR states, changes in the security environment must “alter the hierarchy of our nuclear concerns and strategic objectives.”¹²⁷ Such changes have indeed taken place since this most recent NPR, and this dynamic appears to be the new norm. This development is particularly important because US nuclear modernization plans include some systems intended for use through the 2080s. Thus, it is only prudent to plan for dynamic and unpredictable threat contingencies.

As the JCS recognized in the 2015 edition of the *US National Military Strategy*: “Emerging technologies are impacting the calculus of deterrence and conflict management by increasing uncertainty and compressing decision space.... As a result, future conflicts between states may prove to be unpredictable, costly, and difficult to control.”¹²⁸ And, as then-Secretary of Energy Ernest Moniz recently stated, the security environment is causing the need for “rethinking exactly how it’s [the US nuclear deterrent] used.”¹²⁹ A more benign nuclear threat environment as anticipated in the three previous NPRs may emerge in the future but, based on the available contemporary evidence and trends, such a possibility must no longer serve as a planning assumption.

¹ Cecil D. Haney, “An Interview with Cecil D. Haney,” *Joint Force Quarterly*, Vol. 83, 4th Quarter (2016), p. 72, available at http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-83/jfq-83_66-74_Haney.pdf?ver=2016-10-19-102202-300.

² James R. Clapper, “Remarks as delivered by The Honorable James R. Clapper Director of National Intelligence,” *DNI.gov*, February 9, 2016, available at https://www.dni.gov/files/documents/2016-02-09SSCI_open_threat_hearing_transcript.pdf.

³ Philip Breedlove, "U.S. European Command Posture Statement 2016," *EUCOM.mil*, February 25, 2016, available at <http://www.eucom.mil/media-library/article/35164/u-s-european-command-posture-statement-2016>.

⁴ According to the Director of the Defense Intelligence Agency, Lieutenant General Vincent Stewart, "Russia places the highest priority on the maintenance of its robust arsenal of strategic and nonstrategic nuclear weapons. Moscow is making large investments in its nuclear weapon[s] programs." Vincent R. Stewart, "Statement for the Record: Worldwide Threat Assessment," *DIA.mil*, February 9, 2016, available at <http://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/653278/statement-for-the-record-worldwide-threat-assessment/>.

⁵ Ashton Carter, "Remarks Previewing the FY 2017 Defense Budget," *Defense.gov*, February 2, 2016, available at <http://www.defense.gov/News/Speeches/Speech-View/Article/648466/remarks-previewing-the-fy-2017-defense-budget>.

⁶ "Shoigu states increased global use of military force as a tool to pursue national interests," *Interfax.com*, January 12, 2017, available at <http://www.dialog.com/proquestdialog/>.

⁷ David Barno and Nora Bensahel, "A Guide to Stepping it Up in the South China Sea," *WarontheRocks.com*, June 14, 2016, available at <http://warontherocks.com/2016/06/a-guide-to-stepping-it-up-in-the-south-china-sea/>; Jane Perlez, "Tribunal Rejects Beijing's Claims in South China Sea," *The New York Times*, July 12, 2016, available at http://www.nytimes.com/2016/07/13/world/asia/south-china-sea-hague-ruling-philippines.html?_r=0; Bill Gertz, "Japanese Intelligence Tells Pentagon China Engaged in Multi-Year Takeover Attempt of Senkaku Islands," *The Washington Free Beacon*, November 23, 2016, available at <http://freebeacon.com/national-security/japanese-intelligence-tells-pentagon-china-engaged-multi-year-takeover-attempt-senkaku-islands/>.

⁸ Robert Work and James Winnefeld, "Statement Of Robert Work, Deputy Secretary Of Defense, and Admiral James Winnefeld, Vice Chairman Of The Joint Chiefs of Staff," *114th U.S. Congress*, House Armed Services Committee, June 25, 2015, p. 4, available at <http://docs.house.gov/meetings/AS/AS00/20150625/103669/HHRG-114-AS00-Wstate-Workr-20150625.pdf>.

⁹ Haney, "An Interview with Cecil D. Haney," op. cit., p. 66.

¹⁰ "Iran violates limit established in nuclear deal, UN finds," *FoxNews.com*, November 10, 2016, available at <http://www.foxnews.com/world/2016/11/10/iran-violates-limit-established-in-nuclear-deal-un-finds.html>.

¹¹ Joint Chiefs of Staff, *Joint Operating Environment 2035: The Joint Force in a Contested and Disordered World* (Washington, DC: Joint Chiefs of Staff, 2016), p. 52, available at http://www.dtic.mil/doctrine/concepts/joe/joe_2035_july16.pdf. (Emphasis added).

¹² Joint Chiefs of Staff, *The National Military Strategy of the United States of America 2015* (Washington, DC: Joint Chiefs of Staff, June 2015), p. i, available at http://www.jcs.mil/Portals/36/Documents/Publications/2015_National_Military_Strategy.pdf.

¹³ Walter B. Slocombe, "The Future of U.S. Nuclear Weapons in a Restructured World," in Patrick J. Garrity and Steven A. Maaranen, *Nuclear Weapons in the Changing World: Perspectives from Europe, Asia, and North America* (New York: Plenum Press, 1992), p. 56.

¹⁴ Gordon Lubold, "Joint Chiefs Chairman Nominee Says Russia Is Top Military Threat," *The Wall Street Journal*, July 9, 2015, available at <http://www.wsj.com/articles/joint-chiefs-chairman-nominee-says-russia-is-top-military-threat-1436463896>; and, Jim Garamone, "Selva Discusses Threats, Capabilities During Confirmation Hearing," *Defense.gov*, July 14, 2015, available at <http://www.defense.gov/News/Article/Article/612644>; and Carter, "Remarks Previewing the FY 2017 Defense Budget," op. cit.

¹⁵ Pavel Felgenhauer, "Putin Confirms the Invasion of Georgia Was Preplanned," *Eurasia Daily Monitor*, Vol. 9, No. 152 (August 9, 2012), available at http://www.jamestown.org/programs/edm/single/?tx_ttnews%5Btt_news%5D=39746&chash=1..#.VgQwW8u6fcS.

¹⁶ Robert Burns and Lolita C. Baldor, "Official: Russia knew in advance of Syrian chemical attack," *The Associated Press*, April 10, 2017, available at <https://apnews.com/19772be1238e49fbb62c509a5b659b3d>.

¹⁷ Richard Arnold, "Surveys show Russian nationalism is on the rise. This explains a lot about the country's foreign and domestic politics..," *The Washington Post*, May 30, 2016, available at <https://www.washingtonpost.com/news/monkey-cage/wp/2016/05/30/surveys-show-russian-nationalism-is-on-the-rise-this-explains-a-lot-about-the-countrys-foreign-and-domestic-politics/>.

¹⁸ Orysia Lutsevych, *Agents of the Russian World: Proxy Groups in the Contested Neighborhood* (London: Chatham House, April 2016), p. 2, available at <https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-04-14-agents-russian-world-lutsevych.pdf>.

¹⁹ Chris Summers, "NATO puts 300,000 troops on 'high alert' in readiness for a confrontation with Russia as fears grow Putin is preparing to attack the West," *The Daily Mail*, November 7, 2016, available at <http://www.dailymail.co.uk/news/article-3912398/NATO-puts-300-000-troops-high-alert-readiness-confrontation-Russia-fears-grow-Putin-preparing-attack-West.html>.

²⁰ John McLaughlin, "The Bear is Growling: Former CIA Chief's Report from Russia," *OZY.com*, November 6, 2016, available at <http://www.ozy.com/pov/the-bear-is-growling-former-cia-chiefs-report-from-russia/73900>.

²¹ Julian E. Barnes, "Q&A with Gen. Philip Breedlove, Top Commander of US and Alliance Forces in Europe," *The Wall Street Journal*, May 3, 2016, available at <http://blogs.wsj.com/brussels/2016/05/03/qa-with-gen-philip-breedlove-top-commander-of-u-s-and-alliance-forces-in-europe/>.

²² Alexander Vershbow, "NATO and Russia: a new strategic reality," *NATO.int*, September 2, 2014, http://www.nato.int/cps/en/natohq/opinions_112406.htm?selectedLocale=en.

²³ Andrew Roth, "Russian Premier Says Annexation of Crimea Was Worth Sanctions Fallout," *The New York Times*, April 21, 2015, available at http://www.nytimes.com/2015/04/22/world/europe/crimea-russia-sanctions-medvedev.html?_r=0.

²⁴ Vladimir Putin, "Being Strong," *Foreign Policy*, February 21, 2012, available at <http://foreignpolicy.com/2012/02/21/being-strong/>.

²⁵ Ashton Carter as quoted in, Max Fisher, "Full transcript: Vox interviews Defense Secretary Ash Carter," *Vox.com*, April 13, 2016, <http://www.vox.com/2016/4/13/11333276/ash-carter-transcript>.

²⁶ US Department of Defense, *2017 Defense Posture Statement: Taking the Long View, Investing for the Future* (Washington, DC: Department of Defense, February 2016), p. 17, available at http://www.defense.gov/Portals/1/Documents/pubs/2017DODPOSTURE_FINAL_MAR17UpdatePage4_WEB.PDF.

²⁷ National Intelligence Council, *Global Trends 2030: Alternative Worlds* (Washington, DC: Director of National Intelligence, December 2012), p. 69, available at https://www.dni.gov/files/documents/GlobalTrends_2030.pdf.

²⁸ For a brief overview, see The International Institute for Strategic Studies, *The Military Balance 2016: The Annual Assessment of Global Military Capabilities and Defence Economics* (London: Routledge, February 2016), pp. 166-169.

²⁹ Ibid., p. 172.

³⁰ Alexei Lossan, "Russia slashes military spending as revenues shrink," *Russia Beyond the Headlines*, November 1, 2016, available at https://rbth.com/defence/2016/11/01/russia-slashes-military-spending-as-revenues-shrink_644019.

³¹ "Russia Prioritizes Nuclear Weapons in Defense Budget Financing," *Sputnik News*, April 6, 2017, available at <https://sputniknews.com/russia/201704061052349786-russia-nuclear-arms-priority/>. (Italics added).

³² Mark B. Schneider, "Russian Nuclear Weapons, Strategic Defenses and Nuclear Arms Control Policy," in Fred Fleitz, editor, *Putin's Reset: The Bear is Back and How America Must Respond* (Washington, DC: Center for Security Policy Press, 2016), pp. 41-42, available at https://www.centerforsecuritypolicy.org/wp-content/uploads/2016/11/Putins_Reset.pdf. See also, Haney, "An Interview with Cecil D. Haney," op. cit., p. 66.; Rose Gottemoeller as quoted in U.S. Congress, *Russian Arms Control Cheating: Violation of the INF Treaty and the Administration's Responses One Year Later* (Washington, DC: GPO, December 1, 2015), 114th U.S. Congress, Joint Hearing before the Committee on Armed Services and Committee on Foreign Affairs, House of Representatives, p. 25, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg97826/pdf/CHRG-114hhrg97826.pdf>

³³ "Formidable Sarmat: Satan's successor that can piece any defense," *TASS*, October 25, 2016, available at <http://tass.com/defense/908575>; See also, Kathrin Hille, "Russia prepares for deep budget cuts that may even hit defence," *Financial Times*, October 30, 2016, available at <https://www.ft.com/content/806400be-9e94-11e6-891e-abe238dee8e2>.

³⁴ Dmitry Litovkin, "Russia tested hypersonic warheads for Sarmat," *Izvestia*, May 5, 2016, available at <http://www.dialog.com/proquestdialog/>; "Russian Top Secret Hypersonic Glider Can Penetrate Any Missile Defense," *Sputnik News*, June 11, 2016, available at <https://sputniknews.com/politics/201606111041185729-russia-hypersonic-glider/>; "Sarmat ICBM: 8 Megatons at Hypersonic Speeds, Arriving 2 Years Ahead of Schedule," *Sputnik News*, September 7, 2016, available at <https://sputniknews.com/military/201609071045062797-sarmat-ahead-of-schedule-analysis/>; "Object 4202": New Russian Hypersonic Warhead to Be Coupled With Sarmat ICBM," *Sputnik News*, October 29, 2016, available at <https://sputniknews.com/military/201610291046868761-hypersonic-warhead-sarmat-missile/>.

³⁵ For a more extensive overview of these, and other, programs, see Keith B. Payne and John S. Foster, *Russian Strategy: Expansion, Crisis and Conflict* (Fairfax, VA: National Institute Press, 2015), pp. 61-82, available at <http://www.nipp.org/wp-content/uploads/2016/01/FINAL-FOR-WEB-1.12.16.pdf>.

³⁶ Michael R. Gordon, "Russia Has Deployed Missile Barred by Treaty, U.S. General Tells Congress," *The New York Times*, March 8, 2017, available at <https://www.nytimes.com/2017/03/08/us/politics/russia-inf-missile-treaty.html>.

³⁷ Testimony of James Miller, as quoted in, "The Current Status and Future Direction for U.S. Nuclear Weapons Policy and Posture," 112th U.S. Congress, House Armed Services Committee, November 2, 2011, p. 7, available at https://fas.org/irp/congress/2011_hr/nw-posture.pdf.

³⁸ Mikhail I. Uliyanov, "Statement," *UN.org*, April 27, 2015, available at http://www.un.org/en/conf/npt/2015/statements/pdf/RU_en.pdf.

³⁹ Michael R. Gordon, "Russia Is Moving Ahead With Missile Program That Violates Treaty, U.S. Officials Say," *The New York Times*, October 19, 2016, available at https://www.nytimes.com/2016/10/20/world/europe/russia-missiles-inf-treaty.html?_r=0.

⁴⁰ Philip Breedlove, "Memo to Washington: Reforming National Defense to Meet Emerging Global Challenges," *Mitchell Institute Policy Papers*, Vol. 5 (March 2017), p. 8, available at http://media.wix.com/ugd/a2dd91_8b654eeae2fa4980a648d92c3f62d796.pdf.

⁴¹ "Moscow Emphasizes Quality of its Nuclear Potential," *Ghana.mid.com*, January 13, 2005, available at <http://www.ghana.mid.ru/nfr/nfr331.html>. (Emphasis added).

⁴² "Nuclear Munitions to be Improved and Revitalized -- Russian Federation Ministry of Defense," *Ria Novosti*, September 4, 2009, available at <http://www.dialog.com/proquestdialog/>.

⁴³ Central Intelligence Agency, "Evidence of Russian Development of New Subkiloton Nuclear Warheads [Redacted]," Intelligence Memorandum, August 30, 2000, approved for release October 2005, p. 6, available at http://www.foia.cia.gov/sites/default/files/document_conversions/89801/DOC_0001260463.pdf; Robert R. Monroe, "A Perfect Storm over Nuclear Weapons," *Air and SpaceJournal*. Vol. 23, No. 3 (Fall 2009), available at <http://www.airpower.au.af.mil/airchronicles/api/apj09/fal09/monroe.html>; Mark B. Schneider, *The Nuclear Forces and Doctrine of the Russian Federation* (Fairfax VA: National Institute Press, 2006), pp. 15-16, available at <http://www.nipp.org/wp-content/uploads/2014/12/Russian-nuclear-doctrine-NSF-for-print.pdf>.

⁴⁴ William J. Perry and James R. 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, 2009), p. 83, available at http://media.usip.org/reports/strat_posture_report.pdf.

⁴⁵ Matt Payton, "Russia launches massive nuclear war training exercise with '40 million people,'" *The Independent*, October 5, 2016, available at <http://www.independent.co.uk/news/world/europe/russia-nuclear-weapon-training-attack-radiation-moscow-vladimir-putin-a7345461.html>.

⁴⁶ Dave Majumdar, "Russia's Deadly S-500 Air-Defense System: Ready for War at 660,000 Feet," *The National Interest*, May 3, 2016, available at <http://nationalinterest.org/blog/russias-deadly-s-500-air-defense-system-ready-war-660000-16028>; and, "This is Why Russia's S-500 Air Defense System Makes Pentagon Nervous," *Sputnik News*, May 5, 2016, available at <https://sputniknews.com/military/201605051039106439-russia-s500-missile-defense/>.

⁴⁷ General Robin Rand as seen in House Armed Services Committee, "20160302 Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces (ID: 104619)," *Youtube.com*, March 2, 2016, beginning at minutes 53 and 23, available at <https://www.youtube.com/watch?v=dJB8cPi7W4s>. Link to official House Armed Services Committee Hearing Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces: <https://armedservices.house.gov/legislation/hearings/fiscal-year-2017-budget-request-department-defense-nuclear-forces>.

⁴⁸ James R. Clapper, "Worldwide Threat Assessment of the US Intelligence Community," 114th U.S. Congress, Senate Armed Services Committee, February 9, 2016, pp. 9-10, available at https://www.dni.gov/files/documents/SASC_Unclassified_2016_ATA_SFR_FINAL.pdf.

⁴⁹ Barnes, "Q&A with Gen. Philip Breedlove, Top Commander of U.S. and Alliance Forces in Europe," op. cit.

⁵⁰ Petr Pavel, "Top NATO General Says Russia Sees 'Compromise as Weakness,'" *Radio Free Europe / Radio Liberty.org*, May 24, 2016, available at <http://www.rferl.org/media/video/nato-pavel/27755095.html>.

⁵¹ Andrew Watts, "NATO's Perfect Storm: Donald Trump and Vladimir Putin," *Georgetown Security Studies Review*, November 25, 2016, available at <http://georgetownsecuritystudiesreview.org/2016/11/25/natos-perfect-storm-donald-trump-and-vladimir-putin/>.

⁵² "Russia to broaden nuclear strike options," *RT*, October 14, 2009, available at <http://rt.com/news/russia-broaden-nuclear-strike/>; "Russia's New Military Doctrine Does Not Rule Out Possible Nuclear Strike – Patrushev," *Daily News Bulletin*, November 20, 2009, available at <http://www.dialog.com/proquestdialog/>; Mike Rogers, "Rogers Urges President to Stay Course on Nuclear Modernization," *ArmedServices.House.gov*, July 13, 2016, available at <http://armedservices.house.gov/news/press-releases/rogers-urges-president-stay-course-nuclear-modernization>.

⁵³ National Intelligence Council, *Global Trends: Paradox of Progress* (Washington, DC: Director of National Intelligence, January 2017), p. 36, available at <https://www.dni.gov/files/images/globalTrends/documents/GT-Full-Report.pdf>.

⁵⁴ Adrian Bradshaw, "The latest security challenges facing NATO," *Rusi.org*, February 20, 2015, available at <https://www.rusi.org/go.php?structureID=videos&ref=V54E 7621089708#.VTFcJN4d0T>.

⁵⁵ Jacek Durkalec, "Russia's evolving nuclear strategy and what it means for Europe," *European Council on Foreign Relations*, July 5, 2016, available at http://www.ecfr.eu/article/commentary_russias_evolving_nuclear_strategy_and_what_it_means_for_europe.

⁵⁶ Robert Scher, "Statement of Robert Scher Assistant Secretary of Defense for Strategy, Plans, and Capabilities" 114th U.S. Congress, House Armed Services Committee, March 2, 2016, p. 3, available at <http://docs.house.gov/meetings/AS/AS29/20160302/104619/HHRG-114-AS29-Wstate-ScherR-20160302.pdf>.

⁵⁷ Ashton Carter, "Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota," *Defense.gov*, Sept. 26, 2016, available at <http://www.defense.gov/News/Transcripts/Transcript-View/Article/957408/remarks-by-secretary-carter-to-troops-at-kirtland-abf-new-mexico>.

⁵⁸ Haney, "An Interview with Cecil D. Haney," op. cit., p. 67.

⁵⁹ Kathy Eastwood, "Hogg speaks to cadets on NATO, the challenges it faces," *Army.mil*, September 8, 2015, available at https://www.army.mil/article/155107/Hogg Speaks_to_cadets_on_NATO_the_challenges_it_faces/.

⁶⁰ Justin McCurry, "China lays claim to Okinawa as territory dispute with Japan escalates," *The Guardian*, May 15, 2013, available at <https://www.theguardian.com/world/2013/may/15/china-okinawa-dispute-japan-ryukyu>.

⁶¹ U.S.-China Economic and Security Review Commission, *2015 Report to Congress* (Washington, DC: Government Publishing Office, 2015), p. 229, available at http://origin.www.uscc.gov/sites/default/files/annual_reports/2015%20Annual%20Report%20to%20Congress.PDF.

⁶² Ibid.

⁶³ U.S.-China Economic and Security Review Commission, *2012 Report to Congress* (Washington, DC: Government Publishing Office, 2012), p. 176, available at https://www.uscc.gov/sites/default/files/annual_reports/2012-Report-to-Congress.pdf.

⁶⁴ "China inaugurates PLA Rocket Force, Xi confers flag," *Xinhuanet.com*, January 1, 2016, available at http://news.xinhuanet.com/english/2016-01/01/c_134970341.htm.

⁶⁵ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2016* (Washington, DC: Department of Defense, April 26, 2016), p. 1, available at <http://www.defense.gov/Portals/1/Documents/pubs/2016%20China%20Military%20Power%20Report.pdf>.

⁶⁶ Ibid., p. 22.

⁶⁷ Ibid., pp. 25-26.; Richard D. Fisher Jr., "Questions Regarding China's Future Strategic Nuclear Capabilities," testimony before Subcommittee on Strategic Forces, Committee on Armed Services, U.S. House of Representatives, October 14, 2011, available at http://www.strategycenter.net/docLib/20111013_RDF_HASCTest_101411.pdf.

⁶⁸ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2015* (Washington, DC: Department of Defense, April 7, 2015), p. 6, available at http://www.defense.gov/Portals/1/Documents/pubs/2015_China_Military_Power_Report.pdf.

⁶⁹ "China Developing New-Generation Strategic Bomber," *Sputnik News*, September 2, 2016, available at <http://sputniknews.com/military/20160902/1044876112/china-new-strategic-bomber.html>.

⁷⁰ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2016*, op. cit., p. 38.

⁷¹ "ROK Daily: China Builds Underground 'Great Wall' Against Nuke Attack," *Chosun Ilbo Online*, December 14, 2009, available at <http://www.dialog.com/proquestdialog/>; Zhang Jun and Xia Hongqing, "Second Artillery Engineering Design Research Institute Engineers Use Blood and Sweat to Design Underground 'Great Wall' Sites One After the Other," *Jiefangjun Bao.com*, November 21, 2006, available at <http://www.defense>.

gov/pubs/d20040528prc.pdf.; Bret Stephens, "How Many Nukes Does China Have? Plumbing the secret Underground Great Wall," *The Wall Street Journal*, October 24, 2011, available at <http://online.wsj.com/article/SB10001424052970204346104576639502894496030.html>.

⁷² National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat* (Wright-Paterson Air Force Base, OH: National Air and Space Intelligence Center, 2013), p. 3, available at <http://www.afisr.af.mil/shared/media/document/AFD-130710-054.pdf>.

⁷³ U.S. Department of Defense, *Annual Report to the Congress Military and Security Developments of the Peoples Republic of China 2011*, (Washington, DC: Department of Defense, 2011), p. 34, available at http://www.defense.gov/pubs/pdfs/2011_cmpr_final.pdf; Bill Gertz, "Chinese Defense Ministry Confirms Hypersonic Missile Test," *The Washington Free Beacon*, January 15, 2014, available at <http://freebeacon.com/chinese-defense-ministry-confirms-hypersonic-missile-test/>; Bill Sweetman and Richard D. Fischer, Jr., "Air Sea Battle Concept is Focused On China," *Aviation Week*, April 7, 2011, available at http://www.aviationweek.com/aw/generic/story.jsp?id=news/awst/2011/04/04/AW_04_04_2011_p.6; NASIC, *Ballistic and Cruise Missile Threat* (Wright-Patterson Air Force Base Oh: NASIC-1031-0985-09), p. 14, available at <http://www.fas.org/programs/ssp/nukes/NASIC2009.pdf>.

⁷⁴ Mark B. Schneider, "Testimony Before the U.S., China Economic and Security Review Commission Hearing on 'Development in China's Cyber and Nuclear Capabilities,'" USCC.gov, March 26, 2012, available at <http://origin.www.uscc.gov/sites/default/files/3.26.12schneider.pdf>.

⁷⁵ "DF-15 [CSS-6 / M-9]," *Global Security.org*, no date, available at <http://www.globalsecurity.org/wmd/world/china/df-15.htm>.

⁷⁶ U.S.-China Economic and Security Review Commission, *2015 Report to Congress*, op. cit., p. 339.

⁷⁷ Clapper, "Worldwide Threat Assessment of the US Intelligence Community," op. cit., pp. 9-10.

⁷⁸ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2016*, op. cit., p. 58. See also, Eric Heginbotham, et al., *China's Evolving Nuclear Deterrent: Major Drivers and Issues for the United States* (Washington, DC: RAND Corporation, 2017), pp. 129-133, available at http://www.rand.org/content/dam/rand/pubs/research_reports/RR1600/RR1628/RAND_RR1628.pdf.

⁷⁹ Larry Wortzel, "Opinion: The Trouble With China's Nuclear Doctrine," *Jane's Defense Weekly*, February 22, 2006, available at: http://www.janes.com/defense/news/jdu/jdw060216_1_n.shtml.

⁸⁰ Jack H. Barnes, "China threatens preemptive Nuclear war," *Business Insider*, January 5, 2011, available at <http://www.businessinsider.com/china-threatens-preemptive-nuclear-war-2011-1>.

⁸¹ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2016*, op. cit., p. 57.

⁸² Ibid., p. 44.

⁸³ U.S. Department of Defense, *Military and Security Developments Involving the Democratic People's Republic of Korea* (Washington, DC: Department of Defense, 2015), p. 1, available at http://www.defense.gov/Portals/1/Documents/pubs/Military_and_Security_Developments_Involving_the_Democratic_Peoples_Republic_of_Korea_2015.PDF.

⁸⁴ Ibid., p. 5.

⁸⁵ Carter, "Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota," op. cit.

⁸⁶ Rick Gladstone, "North Korea Giving Up Nuclear Arms 'a Lost Cause,' Official Says," *The New York Times*, October 25, 2016, available at http://www.nytimes.com/2016/10/26/world/asia/north-korea-james-clapper.html?_r=0.

⁸⁷ Chung-in Moon and Illo Hwang, "Identity, Supreme Dignity, and North Korea's External Behavior: A Cultural/Ideational Perspective," *Korea Observer*, Vol. 45, No. 1 (Spring 2014), pp. 1-37.

⁸⁸ U.S. Department of Defense, *Military and Security Developments Involving the Democratic People's Republic of Korea*, 2015, op. cit., p. 5.

⁸⁹ Ibid.

⁹⁰ "Diplomat says N. Korea not interested in denuclearization dialogue," *Yonhap News*, March 14, 2017, available at <http://english.yonhapnews.co.kr/northkorea/2017/03/14/040100000AEN20170314004200315.html>.

⁹¹ RAND Corporation, "A Nuclear North Korea," *RAND.org*, 2016, available at <http://www.rand.org/research/primers/nuclear-north-korea.html>.

⁹² "Pentagon Says North Korea Can Likely Launch Nuclear Missile," *Reuters*, April 11, 2013, available at <http://www.reuters.com/article/2013/04/11/us-korea-north-usa-idUSBRE93A15N20130411>.

⁹³ U.S. Department of Defense, *Military and Security Developments Involving the Democratic People's Republic of Korea*, op. cit., p. 13.

⁹⁴ L. Todd Wood, "N. Korea warns use of nukes on first strike," *The Washington Times*, October 17, 2016, <http://www.washingtontimes.com/news/2016/oct/17/north-korea-warns-it-will-use-nuclear-weapons-firs/>.

⁹⁵ Jack Kim, "North Korea says missile test simulated attack on South's airfields," *Reuters*, July 20, 2016, available at <http://www.reuters.com/article/us-northkorea-missiles-idUSKCN0ZZ2WO>.

⁹⁶ Anna Fifield, "North Korea says it was practicing to hit U.S. military bases in Japan with missiles," *The Washington Post*, March 6, 2017, available at https://www.washingtonpost.com/world/north-korea-says-it-was-trying-to-hit-us-military-bases-in-japan-with-missiles/2017/03/06/b375ad36-327f-4d9e-9dba-398a7cde8742_story.html?utm_term=.9435d3808f00.

⁹⁷ U.S. Department of Defense, *Military and Security Developments Involving the Democratic People's Republic of Korea*, op. cit., p. 21.

⁹⁸ James R. Clapper, *Worldwide Threat Assessment of the U.S. Intelligence Community* (Washington, DC: Director of National Intelligence, February 9, 2016), p. 7, available at https://www.dni.gov/files/documents/SASC_Unclassified_2016_ATA_SFR_FINAL.pdf.

⁹⁹ Ibid., p. 24.

¹⁰⁰ U.S. Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, February 6, 2006), p. 32, available at <http://archive.defense.gov/pubs/pdfs/QDR20060203.pdf>.

¹⁰¹ Clapper, *Worldwide Threat Assessment of the U.S. Intelligence Community*, 2016, op. cit., p. 24.

¹⁰² Kristina Wong, "US general sees 'uptick' in bad behavior by Iran since nuke deal," *The Hill*, November 30, 2016, available at <http://thehill.com/policy/defense/308151-us-general-sees-uptick-in-malign-iranian-activities-since-nuclear-deal>.

¹⁰³ Clapper, *Worldwide Threat Assessment of the U.S. Intelligence Community*, 2016, op. cit., p. 24.

¹⁰⁴ Office of the Director of National Intelligence, *Iran: Nuclear Intentions and Capabilities* (Washington, DC: Office of the Director of National Intelligence, November 2007), available at https://www.dni.gov/files/documents/Newsroom/Reports%20and%20Pubs/20071203_release.pdf.

¹⁰⁵ Julian Borger, "Iran Tested Advanced Nuclear Warhead Design – Secret Report," *The Guardian*, November 5, 2009, available at <http://www.guardian.co.uk/world/2009/nov/05/irantested-nuclear-warhead-design>.

¹⁰⁶ "Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions 1737 (2006), 1747 (2007), 1803 (2008) and 1835 (2008) in the Islamic Republic of Iran," IAEA.org, May 31, 2010, available at <https://www.iaea.org/sites/default/files/gov/2010-28.pdf>.

¹⁰⁷ Jonathan Tirone and Margaret Talev, "Iran Continued Nuclear Weapons Work Seeking Warhead Design," *Business Week*, November 10, 2011, available at <http://www.businessweek.com/news/2011-11-10/iran-continued-nuclear-weapons-work-seeking-warhead-design.html>.

¹⁰⁸ Ibid.

¹⁰⁹ Raphael Ahren, "German Expert Suggests Iran Tested Nuclear Bomb in North Korea in 2010," *BBC Monitoring International Reports*, March 7, 2012, available at <http://www.accessmylibrary.com/article-1G1-282411462/german-expert-suggests-iran.html>.

¹¹⁰ Douglas J. Feith, "The Iran Deal Will Ignite Nuclear Proliferation," *National Review*, September 25, 2015, available at <http://www.nationalreview.com/article/424645/iran-deal-will-ignite-nuclear-proliferation-douglas-j-feith>.

¹¹¹ Bill Gertz, "Iran Shows Off Third Underground Missile Site," *The Washington Free Beacon*, May 12, 2016, available at <http://freebeacon.com/national-security/iran-shows-off-third-underground-missile-site/>.

¹¹² Brian McKeon, "Statement of Brian P. McKeon, Principal Deputy Under Secretary of Defense for Policy," 114th Congress, Senate Armed Services Committee, April 13, 2016, p. 1, available at http://www.armed-services.senate.gov/imo/media/doc/McKeon_04-13-16.pdf.

¹¹³ Ibid.

¹¹⁴ Ronald Burgess, "World Wide Threat Assessment," 112th U.S. Congress, Senate Armed Services Committee, March 20, 2011, p. 13, available at https://fas.org/irp/congress/2011_hr/031011burgess.pdf; David Eshel, "Iran Claims Successful Test of a New Solid Fuel Missile," *DefenseUpdate.com*, available at http://defense-update.com/analysis/151108_iranian_missiles.html#more; William J. Broad, James Glanz, and David E. Singer, "Iran Fortifies Its Arsenal With the Aid of North Korea," *The New York Times*, November 28, 2010, available at <http://www.nytimes.com/2010/11/29/world/middleeast/29missiles.html>.

¹¹⁵ Robert Tate, "Iran launches first domestically produced satellite," *The Guardian*, February 3, 2009, available at <http://www.guardian.co.uk/world/2009/feb/03/iran-satellite-launch-ormid>; "Iran launches second satellite into orbit, claims state TV," *The Guardian*, June 16, 2011, available at <http://www.guardian.co.uk/world/2011/jun/16/iran-satellite-launch-orbit>; "Iran: Small Satellite Launched Into Orbit," *The Huffington Post*, February 3, 2012, available at http://www.huffingtonpost.com/2012/02/03/iran-small-satellite-launched_n_1253270.html; Adam Kredo, "Satellite Launch Prompts Fear of Long Range Ballistic Missile Attack," *The Washington Free Beacon*, August 31, 2016, available at <http://freebeacon.com/national-security/iran-satellite-launch-prompts-fear-long-range-ballistic-missile-attack/>.

¹¹⁶ "New Iran rocket launch site shows N. Korea links: Jane's," *Space Daily*, March 5, 2010, available at http://www.spacedaily.com/reports/New_Iran_rocket_launch_site_shows_N_Korea_links_Janes_999.html.

¹¹⁷ Aliakbar Dareini, "Iran, North Korea sign technology agreement," *Yahoo.com*, September 2, 2012, available at <https://www.yahoo.com/news/iran-north-korea-sign-technology-agreement-104143016.html>.

¹¹⁸ Paul K. Kerr, Steven A. Hildreth, and Mary Beth D. Nitikin, *Iran-North Korea-Syria Ballistic Missile and Nuclear Cooperation*, (Washington D.C.: Congressional Research Service, February 2016), p. i, available at <https://www.fas.org/sgp/crs/nuke/R43480.pdf>.

¹¹⁹ Andrew Roth, "Iran announces delivery of Russian S-300 missile defense system," *The Washington Post*, May 10, 2016, available at https://www.washingtonpost.com/world/iran-announces-delivery-of-russian-s-300-missile-defense-system/2016/05/10/944afa2e-16ae-11e6-971a-dadf9ab18869_story.html.

¹²⁰ The International Institute for Strategies Studies, *The Military Balance 2016: The Annual Assessment of Global Military Capabilities and Defence Economics*, op. cit., p. 308.

¹²¹ Reuters, "Ayatollah Ali Khamenei criticises 'arrogance' of the United States following nuclear deal," *The Telegraph*, July 18, 2016, available at <http://www.telegraph.co.uk/news/worldnews/middleeast/iran/11748176/Ayatollah-Ali-Khamenei-criticises-arrogance-of-the-United-States-following-nuclear-deal.html>.

¹²² George W. Bush, "U.S. President Bush's speech to United Nations," *CNN*, November 10, 2001, available at <http://edition.cnn.com/2001/US/11/10/ret.bush.un.transcript/index.html>; and, Department of Defense, *Nuclear Posture Review Report* (Washington, DC: Department of Defense, April 2010), p. iv, available at http://www.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf.

¹²³ Ibid.

¹²⁴ U.S. Department of State, *Country Reports on Terrorism 2015* (Washington, DC: Department of State, 2015), available at <http://www.state.gov/j/crt/rls/crt/2015/index.htm>.

¹²⁵ Center for Preventive Action, *Preventive Priorities Survey 2014* (Washington, DC: Council on Foreign Relations, December 2013), available at <http://i.cfr.org/content/publications/attachments/CFR%20CPA%20Preventive%20Priorities%20Survey%202014.pdf>.

¹²⁶ James R. Clapper, *Worldwide Threat Assessment of the US Intelligence Community* (Washington, DC: Director of National Intelligence, January 29, 2014), pp. 22-25, available at https://www.dni.gov/files/documents/Intelligence%20Reports/2014%20WWTA%20%20SFR_SSCI_29_Jan.pdf.

¹²⁷ Department of Defense, *Nuclear Posture Review Report*, 2010, op. cit., p. v.

¹²⁸ U.S. Joint Chiefs of Staff, *The National Military Strategy of the United States of America 2015*, op. cit., p. 3.

¹²⁹ Tom DiChristopher, "Russia is 'stimulating' US thinking on nuclear security, says Energy Secretary," *CNBC.com*, October 14, 2016, available at <http://www.cnbc.com/2016/10/14/russia-is-stimulating-us-thinking-on-nuclear-security-says-energy-secretary.html>.

Section III. Purposes for US Nuclear Capabilities

US nuclear policies must be informed by the goals and purposes that nuclear weapons are intended to serve and the threat environment within which they are to support those goals. While there has been some notable variation in the nuclear policy goals identified in previous NPRs, Democratic and Republican administrations have shown considerable consistency for seven decades. All have placed importance on the deterrence of enemies, the extension of deterrence to allies, the assurance of allies, and the limitation of damage in the event of war. Most recently, the 2010 NPR explicitly placed nonproliferation, the prevention of nuclear terrorism, and progress toward nuclear disarmament “atop” other priorities.¹ The following discussion will examine US nuclear policy goals in the contemporary threat environment.

Deterrence

The US Department of Defense defines deterrence as, “The prevention of action by the existence of a credible threat of unacceptable counteraction and/or belief that the cost of action outweighs the perceived benefits.”² US means of deterrence are not limited to nuclear weapons; they include virtually all elements of US power. That said, nuclear weapons make an essential contribution to US deterrence goals. Indeed, US officials have regarded nuclear deterrence as a priority goal for seven decades. Historically, the most fundamental purpose for US nuclear weapons has been to deter nuclear, chemical, biological, and overwhelming conventional threats to the United States and its allies. The unclassified 2013 DoD *Nuclear Employment Strategy* report states that the United States will “maintain a credible nuclear deterrent capable of convincing any potential adversary that the adverse consequences of attacking the United States or our Allies and partners far outweigh any potential benefit they may seek to gain from such an attack.”³

As Deputy Secretary of Defense Robert Work’s and then-Vice Chairman of the Joint Chiefs of Staff Adm. James Winnefeld’s joint statement in testimony before Congress emphasizes, “Our nuclear deterrent force is the ultimate protection against a nuclear attack on the United States, the one known existential threat to the nation.”⁴ Similarly, in a report appended to the 2014 *Quadrennial Defense Review* (QDR), then-Chairman of the JCS Gen. Martin Dempsey notes that the two highest “ends” of US strategy are “1. The survival of the nation” and “2. The prevention of catastrophic attack against US territory.” Thus, based on these “ends” the highest US priority is to, “Maintain a secure and effective nuclear deterrent.”⁵ The QDR report itself concluded, “Our nuclear deterrent is the ultimate protection against a nuclear attack on the United States, and through extended deterrence, it also serves to reassure our distant allies of their security against regional aggression.”⁶

US deterrence threats must be credible to be effective, and credibility requires that adversaries recognize that the United States has the will and means to support its deterrent threats and red lines; deterrence rests on their expectation that aggression could never be successful or worth the consequences. The deterrence value of US nuclear weapons lies in their potential to ensure that adversaries cannot reach an acceptable theory of success regarding plans they might have

for aggression. Indeed, violating US deterrence red lines must be perceived as leading to “the most miserable” outcome possible.⁷

The long history of deterrence via conventional forces alone is one of periodic and catastrophic deterrence failures. For the five centuries prior to the establishment of nuclear deterrence following World War II, the great powers of Europe went to war with each other an average of five to seven times per century. This ugly cycle has not repeated itself for the seven decades since the establishment of US nuclear deterrence and the percentage of the world’s population lost to war has declined dramatically since its establishment.⁸ These statistics do not “prove” that nuclear deterrence alone has had such a pacifying effect on human behavior, but they do suggest strongly that US nuclear policy and weapons are inextricably linked to the deterrence of attack and defense of the nation.

Deterrence and the Threat Environment

In the contemporary highly-dynamic threat environment confronting the United States and its allies, events can escalate unexpectedly and in a surprising manner. Consequently, US nuclear and deterrence policies must prioritize adaptability as a primary metric of adequacy for US deterrence strategies and forces. US conventional forces can and will contribute to the deterrence of current and future threats, but US nuclear forces must provide a foundation for deterrence by denying adversaries any expectation that they could benefit by escalating a conflict.

Denying any such expectation must be a serious US deterrence goal. As noted above, Russia’s “escalate to win” nuclear strategy calls for using “limited” strikes, including nuclear first use, to end a conventional conflict on terms favorable to Russia.⁹ For example, in October 2009, then-Commander of the Strategic Missile Troops Lieutenant General Andrey Shvaychenko declared, “In a conventional war, they [Russia’s nuclear ICBMs] ensure that the opponent is forced to cease hostilities, on advantageous conditions for Russia, by means of single or multiple preventive strikes against the aggressors’ most important facilities.”¹⁰

In addition, China could attempt to enforce its land and sea claims in the South and East China Seas via the use of advanced conventional forces in the hopes of gaining a quick *fait accompli*, and then deterring any powerful US response by issuing escalation threats. Chinese generals have made such threats in the past.¹¹

In short, US deterrence policies must credibly deny Russia, China, and North Korea any expectation that escalatory strategies could be of benefit. Speaking at Minot Air Force Base, then-Secretary of Defense Ashton Carter noted US nuclear forces “deter large-scale nuclear attack against the United States and our allies” and they “help convince potential adversaries that they can’t escalate their way out of a failed conventional aggression.”¹²

Given these generally recognized threats, and the ever-present possibility of surprising threat developments, sustaining credible US deterrence is a priority US nuclear policy goal and US nuclear forces will continue to be necessary to support that priority goal in such an unpredictable and dangerous environment.

Deterrence during the Cold War focused almost exclusively on the Soviet Union, and was geared to a relationship with the Soviet Union that, while hostile and dangerous, did not often involve

dramatic, abrupt changes or surprises. The Soviet Union generally was a ponderous and consistent opponent,¹³ and the US approach to and requirements for deterrence similarly appeared relatively predictable. US strategic deterrence and arms control policies, for example, were established on the expectation of a largely predictable Cold War threat environment.¹⁴

In the contemporary, highly-dynamic threat environment, however, flexible and adaptable deterrence strategies will likely be necessary to succeed against the myriad of known and plausible threats confronting the United States. To the extent possible, US deterrence strategies must be highly-adaptable so as to be “tailored” to differing requirements posed by specific opponents and contingencies. Tailored deterrence requires an in-depth understanding of US opponents’ “worldviews”—i.e., their decision-making processes, values, goals, capabilities, and cultural parameters—and other relevant factors which are unique to specific opponents and will shape their understanding of and responses to US deterrence strategies.¹⁵ Currently, there is general agreement regarding the need for deterrence to be so tailored, and that tailoring requires highly-adaptable US strategies and forces.

Deterrence and Force Capabilities

Historically, US presidents have sought increasingly more flexible and diverse deterrent threats to provide options short of large-scale nuclear use and to help ensure deterrence credibility. Indeed, following the 1960s declared US focus on nuclear threats to an opponent’s population centers (“countervalue” targeting) for deterrence purposes, US deterrence policies have increasingly emphasized a spectrum of options, including very limited options and the capability to hold an opponent’s military forces at risk (“counterforce” targeting).¹⁶

The unclassified 2013 *Report on Nuclear Employment Strategy of the United States* describes current US nuclear policy: “The new guidance requires the United States to maintain significant counterforce capabilities against potential adversaries. The new guidance does not rely on a ‘counter-value’ or ‘minimum deterrence’ strategy... Accordingly, plans will, for example, apply the principles of distinction and proportionality and seek to minimize collateral damage to civilian populations and civilian objects. The United States will not intentionally target civilian populations or civilian objects.”¹⁷ This approach to deterrence mandates a variety of nuclear deterrence options and greater flexibility than is suggested by the relatively “easy” requirements of a deterrence strategy based on holding at risk only an opponent’s civilian/societal centers.¹⁸ For decades, US leaders have consistently viewed a “minimum deterrence” approach as incredible, immoral, and contrary to the law of war, and it has never been the basis for US nuclear deterrence policies.¹⁹

Deterrence and Nuclear Terrorism

As both Presidents George W. Bush and Barack Obama emphasized, nuclear terrorism is one of the most pressing security threats facing the United States. While US nuclear weapons have no plausible combat role for defeating terrorist organizations, US nuclear forces may contribute to deterring state sponsors of terror from providing significant technical or material support toward their clients’ acquisition of WMD.²⁰ It is likely, for example, that terrorist groups would require assistance from state sponsors to acquire a nuclear weapon and state assistance could provide nuclear weapons that are far more effective than any plausible terrorist-developed weapon. In such cases, a US deterrence strategy that threatens to hold the state sponsor responsible for the

actions of its terrorist client may be both credible and necessary to help prevent such a development. US nuclear deterrence clearly could contribute to that goal.

Deterrence and Conventional Forces

As noted above, advanced US non-nuclear capabilities have made and continue to make an invaluable contribution to US deterrence goals. Yet, as Democratic and Republican administrations have agreed, for these purposes non-nuclear weapons “are not a substitute for nuclear weapons.”²¹ As US conventional capabilities become more advanced they may, in some cases, assume a greater share of the deterrence and assurance burden now borne by nuclear forces. However, it is unknown if prospective advanced conventional capabilities—possibly including hypersonic glide vehicles, laser-based defenses, or next-generation stealth—can provide comparable deterrent or assurance effects, and it would be imprudent to assume so. In many cases, they do not promise comparable lethality or comparable psychological effects for controlling opponent decision-making—which is the heart of deterrence. It appears that only nuclear weapons, for example, can reliably hold at risk some hardened and very deep underground facilities that often are associated with protection of highly-valued assets.²²

Nuclear Weapons Contribute Uniquely to Deterrence: Some Evidence From History

The unique value of US nuclear weapons to support deterrence is not self-evident because demonstrating with clear evidence precisely why an opponent decided *not* to attack can be a challenge—as is the case for trying to prove the genesis of decision-making behind any non-event. This challenge has led a few academic commentators to suggest that nuclear weapons are not needed for deterrence.²³ This suggestion, however, is incompatible with considerable readily-available evidence.²⁴

In several historic cases it is possible to demonstrate that nuclear deterrence served a uniquely helpful role in the prevention of war and escalation of conflict. For example:

- A close examination of Soviet Politburo records in 1948-1949 reveals that US nuclear capabilities were, “the single most important factor which restrained Stalin’s possible temptation to resolve the Berlin problem by military means. Evidence obtained from [Soviet] oral history clearly supports this fact.”²⁵
- In 1962, after Khrushchev moved nuclear weapons to Cuba, President Kennedy compelled him to withdraw them. In this case, while US naval and air superiority around Cuba probably helped shape Soviet decision-making, Soviet strategic nuclear “inferiority appears to have had a profound effect on [Soviet] behavior in this crisis.”²⁶
- India’s former army chief, Gen. Shankar Roychowdhury, explained that “Pakistan’s nuclear weapons deterred India from attacking that country after the Mumbai strikes” in 2008 and, “It was due to Pakistan’s possession of nuclear weapons that India stopped short of a military retaliation.”²⁷ And,
- The most informed analyses of available evidence indicate that Saddam Hussein was deterred from the use of chemical and biological weapons in 1991 by the apparent US nuclear threat.²⁸ Non-nuclear threats appear not to have been so powerful.

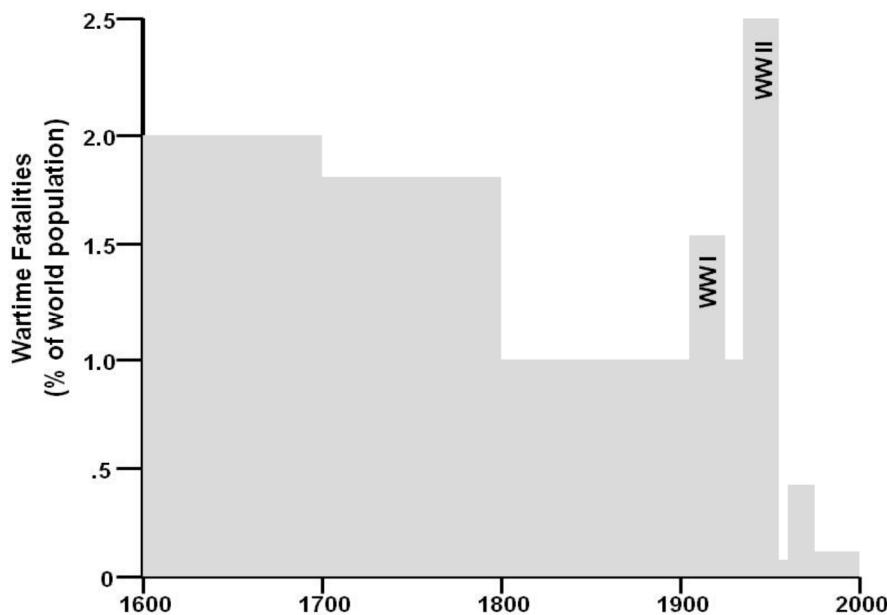
Multiple historical cases suggest that nuclear weapons can contribute uniquely to deterrence success because their presence can make the risks of provocation appear incalculable and

uncontrollable to an aggressor.²⁹ Indeed, some anthropological studies suggest the same conclusion.³⁰ In the absence of nuclear deterrence, such an effect may otherwise be difficult or impossible to establish. A cursory review of the motives and perspectives of some leaderships in the post-Cold War period suggests that this dynamic is why “conventional deterrence is likely to be less reliable than nuclear deterrence.”³¹ Evidence supports then-Commander of US Strategic Command (USSTRATCOM) General Kevin Chilton’s observation in 2010 that, “The nuclear weapon has a deterrent factor that far exceeds a conventional threat.”³²

Historical case studies do not indicate that nuclear deterrence is infallible or that conventional forces do not contribute to, or may even be adequate for, deterrence in some cases. They do demonstrate, however, that nuclear weapons have contributed uniquely to deterrence effectiveness in the past.

As noted, the value of nuclear weapons for deterrence, moreover, is underscored by the absence of major great power wars and the concomitant decline in the percentage of wartime deaths since the advent of nuclear weapons and nuclear deterrence, as is illustrated by Figure 1. In contrast, the history of conventional deterrence is one of some success, and some catastrophic failures. The roughly 100 million fatalities during little more than 10 combined years of fighting in World Wars I and II should serve as a reminder of what appears to have been prevented since—at least in part by nuclear deterrence. A comparable level of international conflict today in the absence of effective nuclear deterrence undoubtedly would involve casualty levels many times higher than those of the 20th century—even in solely conventional conflicts. If modern chemical and biological weapons were employed, the projected casualties and destruction would likely exceed any past experience.

Figure 1. Strategic Deterrence—A Transformation in Warfare



Source: Adm. Richard Mies, USN (ret.), “Strategic Deterrence in the 21st Century,” *Undersea Warfare* (Spring 2012). Presented here with permission.

In short, the historical record indicates strongly that nuclear weapons have, on important occasions, contributed uniquely to deterrence and the prevention of potentially catastrophic conflicts. The world has witnessed the reality of “nuclear zero”; most recently it looked like World Wars I and II. There is no reason to expect that nuclear deterrence will be less critical for preventing great wars in the future. As Winston Churchill said, “Be careful above all things not to let go of the atomic weapons until you are sure, and more than sure, that other means of preserving peace are in your hands.” The emergence of a new, benign world order at this point is nowhere in sight, and the value of US nuclear capabilities to support US deterrence goals continues.

Assurance

US nuclear capabilities also provide unique support for the assurance of allies. US assurance efforts are meant to create or reinforce confidence among allies and partners with regard to the US ability and will to help ensure their security against external threats. There is a long, bipartisan history of US and allied recognition of the contributions of nuclear weapons to US assurance efforts.³³ It is equally important to note that most US allies fully reject the notion that US non-nuclear capabilities alone are adequate for US extended deterrence purposes and thus, their assurance. Indeed, the long-standing evidence is overwhelming that many allies see US nuclear capabilities as an essential component of deterrence and assurance,³⁴ and recent key NATO documents continue to highlight the consensus NATO position that nuclear weapons remain essential to NATO deterrence capabilities.³⁵ There is no indication that this perspective among allies is shifting in favor of substituting US conventional forces for this purpose. Indeed, Russia’s war against Georgia in 2008, and annexation of part of the Ukraine in 2014, and China’s ongoing expansionist actions in the East China Sea, appear to have reinforced the importance of US nuclear weapons for at least some key allies. As Hans Rühle, former head of the Policy Planning Staff in the German Ministry of Defense, recently observed regarding US allies and US extended nuclear deterrence:

These states derive their security from a predictable international system—a system that is still upheld by the United States, including through the US nuclear umbrella. If the US were to reduce or even end its role as a nuclear protector, the security perceptions of its allies would change radically—and in some cases could even lead them to re-consider their attitudes vis-à-vis nuclear possession. The result could well be the largest wave of proliferation since the dawn of the nuclear age. ...US extended deterrence is a most effective non-proliferation tool and must be sustained for the deterrence of aggression, the assurance of allies and non-proliferation purposes.³⁶

While the primary audiences for US deterrence messaging are adversaries and potential adversaries, the primary audiences for US assurance efforts are allies and partner countries. US deterrence and assurance goals are closely related and “two sides of the same coin.” For example, the credibility of US extended deterrence commitments to allies (e.g., the US “nuclear umbrella”) is a key to their assurance, and a primary reason many have agreed to forego acquisition of their own independent nuclear deterrent capabilities. Indeed, following North Korea’s nuclear tests, the United States reaffirmed its “unwavering and ironclad alliance commitments,” to the ROK and Japan, “and emphasize[d] that U.S. extended deterrence

commitments are guaranteed by the full spectrum of U.S. military capabilities, including conventional, nuclear, and missile defense capabilities.³⁷

However, deterrence and assurance are separate goals and may require different supporting strategies and capabilities. One difference is reflected in the “Healey Theorem.” To wit, Denis Healey, a British Defense Minister during the Cold War, famously observed that US deterrence strategy required five percent credibility to deter the Soviet Union, but 95 percent credibility to assure allies.³⁸

The United States has extended nuclear deterrence and assurance commitments to more than 30 countries around the world—including North Atlantic Treaty Organization (NATO) allies, Japan, South Korea and Australia—to address their unique threat circumstances. Just as deterrence efforts are best tailored to specific adversaries, so too are US assurance efforts.

US assurance efforts can include all forms of US power, military and political. For example, the most recent NATO communiqué issued in Warsaw in July 2016, states that: “To protect and defend our indivisible security and our common values, the Alliance must and will continue fulfilling effectively all three core tasks as set out in the Strategic Concept: collective defence, crisis management, and cooperative security. These tasks remain fully relevant, are complementary, and contribute to safeguarding the freedom and security of all Allies.”³⁹ In October 2016, then-Secretary of Defense Ashton Carter “reaffirmed the continued U.S. commitment to provide extended deterrence for the ROK using the full range of military capabilities, including the U.S. nuclear umbrella, conventional strike, and missile defense capabilities.” In addition, he “also reiterated the long-standing U.S. policy that any attack on the United States or its allies will be defeated, and any use of nuclear weapons will be met with an effective and overwhelming response.”⁴⁰

In the contemporary highly-charged threat environment, the assurance of US allies and partners has become both increasingly relevant and challenging. Speaking of the Baltic states of Estonia, Latvia, and Lithuania, Gen. Petr Pavel, Chairman of the NATO Military Committee, stated, “Their concern is justified. They are living close to Russia. They face on a daily basis the effects of a continuous information and propaganda campaign.”⁴¹

As the Healey Theorem suggests, providing assurance to allies may be even more challenging than establishing a credible deterrent to aggression. As Russia, China, and North Korea pursue aggressive foreign policies, US allies such as Japan, South Korea, and some NATO members are expressing increased concern about the US capabilities and credibility that underpin US defense commitments, including the US nuclear umbrella.

Allied perceptions of declining US credibility could ultimately lead some allies to feel compelled to pursue independent responses to common threats, including independent nuclear deterrence capabilities. This development would, of course, significantly undermine long-standing US nuclear nonproliferation goals.

Public opinion polls in South Korea already show strong support for an independent South Korean nuclear deterrent,⁴² and a recent report by an official South Korean presidential advisory group recommended asking the United States to redeploy US nuclear weapons to the Korean peninsula.⁴³ As Robert Einhorn, a senior State Department advisor in the Obama Administration

recently observed, South Korean leaders want the US nuclear deterrent to be strengthened, including, “by permanently stationing U.S. ‘strategic assets’ (such as nuclear-capable aircraft and perhaps even U.S. nuclear weapons) in South Korea.”⁴⁴ Former South Korean President Park Geun-hye stated in 2014 that if North Korea continues testing its nuclear devices, “It would be difficult for us to prevent a nuclear domino from occurring in this area.”⁴⁵ Correspondingly, former Vice President Joseph Biden has stated that Japan could go nuclear “virtually overnight” if the threat from North Korea is not dealt with.⁴⁶

Officials in Poland apparently are considering various options, including moving toward an independent form of deterrence: “Without measures to address the new nuclear threat environment in Europe, Poland is left with three options. The first is to accept the risk of falling prey to the ‘escalate to de-escalate’ doctrine. The second is to offer political concessions to Moscow and drift towards a ‘Finlandized’ status, in order to decrease the likelihood of a military attack by Russia. The third is to create a nonnuclear deterrent for Poland (similar in logic to the French and British nuclear deterrents) that would create an alternative decision dynamic for adversaries contemplating escalation.”⁴⁷

These examples illustrate the possible causes and consequences of US assurance strategies perceived as incredible in a rapidly deteriorating threat environment. Democratic and Republican administrations have long recognized that the great benefits of assuring allies and partners include nonproliferation and stronger alliance cohesion. In short, credible assurance has been and must again be a priority goal for US nuclear policy, including in the determination of the US nuclear force posture.

Specific US Capabilities for Assurance

The United States pursued a “second-to-none” assurance standard for its nuclear forces during the Cold War and in the George W. Bush Administration’s 2001 NPR, in part to contribute to the credibility of extended deterrence. In 2008 and 2009, the bipartisan US Strategic Posture Commission held closed-door hearings with allied representatives on the subject of US nuclear capabilities and found that, “U.S. allies and friends in Europe and Asia are not all of a single mind concerning the requirements for extended deterrence and assurance. These have also brought home the fact that the requirement to extend assurance and deterrence to others may well impose on the United States an obligation to retain numbers and types of nuclear weapons that it might not otherwise deem essential to its own defense.”⁴⁸ For example, in 2010 a Japanese government report listed some of the US nuclear force requirements that Japanese officials perceived as necessary for credible assurance: “... not only possess and deploy an invulnerable nuclear force, but must also put in place an escalation control capability that will force potential aggressors to take the threat of nuclear retaliation seriously. Such capabilities must be underpinned by a superior damage-limiting capability made possible by a strong counterforce capability against the potential aggressor (the ability to effectively destroy the enemy’s nuclear strike force) and an effective strategic defense force.”⁴⁹

The US nuclear posture remains an important metric for the assurance of many allies in the contemporary international threat environment. As the NATO Warsaw Summit Communiqué states, “The strategic forces of the Alliance, particularly those of the United States, are the supreme guarantee of the security of the Allies... NATO’s nuclear deterrence posture also relies, in part, on United States’ nuclear weapons forward-deployed in Europe and on capabilities and

infrastructure provided by Allies concerned. These Allies will ensure that all components of NATO's nuclear deterrent remain safe, secure, and effective. That requires sustained leadership focus and institutional excellence for the nuclear deterrence mission and planning guidance aligned with 21st century requirements.⁵⁰

The Joint Communiqué of the 48th US-South Korea Security Consultative Meeting in Washington in October 2016 stated that part of the US extended nuclear deterrence response to the 2016 North Korean missile and nuclear tests was the B-52 deployment to South Korea and the "Minuteman III intercontinental ballistic missile demonstrations earlier this year at Vandenberg Air Force Base, California."⁵¹ The Communiqué also endorsed the "tailored deterrence" of North Korea.

US measures of nuclear posture adequacy must take into consideration the assurance needs of allies and partners, including the effects of an increasingly threatening security environment, and an emerging concern among some allies about the credibility of US commitments. As the 2010 NPR states, "A failure of reassurance could lead to a decision by one or more non-nuclear states to seek nuclear deterrents of their own, an outcome which could contribute to an unraveling of the NPT regime and to a greater likelihood of nuclear weapon use."⁵²

As noted above, these pressures already are at play in some allied capitals. Lawmakers in South Korea's ruling party recently called for the return of US non-strategic nuclear weapons to Asia or for starting their own nuclear weapons program as a way to increase their deterrence efforts against North Korea.⁵³ South Korean polling shows nearly two-thirds of the public support these ideas.⁵⁴ In Japan, Prime Minister Abe's cabinet reportedly recently ruled that, "war-renouncing Article 9 of the Constitution does not necessarily ban Japan from possessing and using nuclear weapons."⁵⁵ In addition, a panel of the ruling political party in Japan recently made an "urgent proposal" to the Abe government to procure long-range cruise missiles for deterrent and retaliatory purposes.⁵⁶ These developments signal the renewed importance of, and need for, US assurance efforts. As former US Assistant Secretary of Defense Robert Scher recently stated, "If allies and partners conclude that they cannot rely on the United States to respond effectively to restore deterrence, they might opt to pursue their own arsenals, thus undermining our nonproliferation goals. These are conditions that would be truly dangerous and destabilizing."⁵⁷

Former CIA Director Michael Hayden has described the situation *vis-à-vis* North Korea starkly: "By the end of Donald Trump's first term, we could be facing an isolated, pathological little gangster state able to obliterate Seattle." He suggested that response options include making, "U.S. missile defenses facing the Pacific Basin a lot stronger," and that "we could even revisit the decision to pull American nuclear weapons out of South Korea, or the rate at which American nuclear-capable ships visit Chinese/Korean waters..."⁵⁸ In November 2016, a US Trident submarine reportedly made a port call at Guam to reinforce extended nuclear deterrence in the Asia Pacific region.⁵⁹ Clearly, assurance is a priority goal and US assurance efforts have the potential to include moves that the United States would be unlikely to consider in the absence of this priority goal.

Damage Limitation

In the event that deterrence fails, limiting damage has been and continues to be a US policy goal.⁶⁰ This continuity is reflected explicitly in numerous past nuclear policy documents, and most recently, implicitly, in the 2013 *Report on Nuclear Employment Strategy of the United States*.⁶¹

There is an inherent linkage between the goals of deterrence and damage limitation. As then-Assistant Defense Secretary Robert Scher explained recently, “First, effective deterrence requires credibility. We sometimes distinguish between the ability to deter and the ability to achieve our objectives if deterrence fails, but the two are in fact inextricably linked. Deterrence is most effective when underwritten by forces, posture, and strategy that can credibly succeed in the event deterrence fails. At the opposite extreme, a deterrent without credibility would be no deterrent at all. The current US nuclear weapons employment strategy supports credible deterrence by sustaining a flexible range of plans and capabilities to provide options to the President in the event deterrence fails.”⁶²

Extending deterrence into a conflict, “intra-war deterrence,” is a primary form of damage limitation. The priority goal is to reestablish deterrence to minimize further damage to US military, political, and societal assets. This has been referred to as a strategy of “escalation control” that is intended to limit the escalation of a conflict, and thus its destructiveness. Robert Scher summarized US policy on this point recently, saying, “Regional deterrence requires a balanced approach to escalation risk that deters escalation, but also prepares for the possibility that deterrence might fail. We accept and convey the reality that no one can count on controlling escalation in a crisis or conflict... [but] we do not simply assume that escalation cannot be limited once the nuclear threshold has been crossed.... Possessing a range of options for responding to limited use makes credible our message that escalating to deescalate is dangerous and will ultimately be unsuccessful.”⁶³

Escalation control, or intra-war deterrence, to support the goal of damage limitation may be most possible with US nuclear options, including limited options, that can provide a proportionate response to any level of attack.⁶⁴ A renowned contributor to US nuclear deterrence theory, the late Herman Kahn, referred to this form of deterrence as *Lex Talionis* and emphasized its potential value.⁶⁵ The United States therefore should retain a spectrum of nuclear deterrent threat options as necessary to help support the goal of damage limitation via intra-war deterrence in the event deterrence fails.

Priority Goals of US Nuclear Policy

As discussed above, the current and prospective security environment is marked both by increasing uncertainty and increasingly severe threats to the United States and its allies. These developments have become blatantly evident since the 1994, 2001, and 2010 NPRs.

These earlier NPRs reflected the common post-Cold War assumption and expectation of a more benign nuclear threat environment ushered in by the end of the Cold War and significantly improved relations with Russia and China. The general view, expressed explicitly in the 2010 NPR, was that the priority threat in the post-Cold War period was terrorism, particularly the possibility of nuclear terrorism. The general corresponding view was that US nuclear capabilities had little or no role *vis-à-vis* this priority threat: “The massive nuclear arsenal we inherited from

the Cold War era of bipolar military confrontation is poorly suited to address the challenges posed by suicidal terrorists and unfriendly regimes seeking nuclear weapons.”⁶⁶

This combination of threat perceptions and expectations regarding the role of US nuclear forces led to a significant reordering of priorities for US nuclear policy priorities in the 2010 NPR. Specifically, the 2010 NPR states in this regard, “changes in the nuclear threat environment have altered the hierarchy of our nuclear concerns and strategic objectives. In coming years, we must give top priority to discouraging additional countries from acquiring nuclear weapons capabilities and stopping terrorist groups from acquiring nuclear bombs or the materials to build them.”⁶⁷ The report also adds, “As a critical element of our effort to move toward a world free of nuclear weapons, the United States will lead expanded international efforts to rebuild and strengthen the global nuclear nonproliferation regime—and for the first time, the 2010 NPR places this priority [nonproliferation] atop the U.S. nuclear agenda.”⁶⁸ As then-Secretary of Defense Robert Gates stated in the cover letter to the 2010 NPR, “This NPR places the prevention of nuclear terrorism and proliferation at the top of the US policy agenda, and describes how the United States will reduce the role and numbers of nuclear weapons.”⁶⁹

The 2010 NPR’s self-expressed new prioritization of US nuclear policy goals was based on the assumption of a more benign nuclear security environment, an assumption also common to the 1994 and 2001 NRPs. The 2010 NPR, however, explicitly elevated nonproliferation to the highest priority among other priorities, including deterrence and assurance. The 2010 NPR identified a reduction in the roles and number of nuclear weapons as a means to promote its priority nonproliferation goal. At the time, then-Secretary of State Hillary Clinton said, “as part of the NPR, the Nuclear Posture Review, we are grappling with key questions... Will our deterrence posture help the United States encourage others to reduce their arsenals and advance our nonproliferation agenda? [And] How can we provide reassurance to our allies in a manner that reinforces our nonproliferation objectives?”⁷⁰ In 2011, then-Principal Deputy Under Secretary of Defense for Policy James Miller listed “preventing nuclear proliferation and nuclear terrorism,” and “reducing the role of nuclear weapons in US strategy” as the top US strategic objectives, and stated explicitly that the Department of Defense assessed “deterrence requirements against these metrics.”⁷¹

The 2010 NPR also made explicit the connection between elevating nonproliferation and counter-nuclear terrorism as the top goals, and advancing nuclear reductions as the means of supporting those goals: “By reducing the role and numbers of US nuclear weapons—and thereby demonstrating that we are meeting our NPT Article VI obligation to make progress toward nuclear disarmament—we can put ourselves in a much stronger position to persuade our NPT partners to join with us in adopting the measures needed to reinvigorate the nonproliferation regime and secure nuclear materials worldwide against theft or seizure by terrorist groups.”⁷²

This prioritization of US policy goals, the linkage of those goals to reducing the role and numbers of US nuclear weapons, and the assessment of US deterrence requirements per this prioritization of goals appears to have had a profound effect on US nuclear policy in multiple areas, including arms control, nonproliferation, and nuclear modernization programs. As a result, many disarmament advocates and some recent senior US officials argue that the maintenance of a robust nuclear force by the United States works against the top priority US objectives by undermining US nonproliferation efforts. They recommend, therefore, that the United States

further reduce the size and salience of its nuclear arsenal in US defense policy to strengthen the global nonproliferation regime.⁷³

While nonproliferation remains an important goal, as is discussed at length in Section XII below, there is little or no logical reason or empirical evidence to suggest that the deep reductions in the size of the US nuclear arsenal since the Cold War have had the claimed effects in favor of US nonproliferation goals. Indeed, sustaining the strength and credibility of US nuclear forces appears to contribute to nonproliferation by assuring allies and thus minimizing their possible incentives to acquire separate nuclear capabilities. The credibility of the US extended nuclear deterrent is, without doubt, linked to those incentives.⁷⁴

A Change in US Nuclear Policy Priorities

Russian and Chinese expansionist policies and nuclear modernization plans, combined with an increasingly assertive and threatening nuclear-armed North Korea, demand recognition that the threat environment has become much more challenging since 2010; and, as the 1994, 2001, and 2010 NPRs indicated, changes in the security environment demanded changes in US priorities and goals.

Russia's violent expansion into Georgia in 2008 and Ukraine since 2014, plus numerous direct and indirect nuclear threats against NATO allies, signal that the US commitment to the NATO alliance will likely be increasingly challenged through the next decade, including via nuclear threats. China also is threatening international norms and institutions by openly seizing reefs and shoals and building them into artificial island military bases in the South China Sea, ignoring the rulings of the international tribunal in The Hague, and making audacious land claims to the detriment of US allies. These actions place US ally Japan especially in a progressively more difficult security position. In addition, North Korean leader Kim Jong Un has prioritized military spending, especially on the country's nuclear weapons program, while making outlandish threats against the United States, South Korea, and Japan. As the unclassified 2013 *Report on Nuclear Employment Strategy of the United States* summarizes, "The risk of nuclear attack has increased."⁷⁵

These developments mandate a fundamental reorientation of US nuclear policy priorities from that established explicitly in the 2010 NPR. The United States must now reestablish deterrence, assurance, and defense as the priority goals for US nuclear policy. No doubt, as already noted, nonproliferation remains a priority US objective, but deterring foes, assuring allies and partners, and preparing for the possible failure of deterrence should again be considered the highest priority US goals. And, there must be recognition that the greatest nonproliferation tool is the assurance of allies and partners made possible by credible US extended deterrence and the supporting US nuclear forces. The assurance that US nuclear forces provide allies and friends thus fulfills a significant part of US nonproliferation goals and policies and continues to grow in importance in the face of increasing threats to allies around the world.

US Nuclear Policy Goals and Public Messaging

A common recommendation of multiple comprehensive reviews conducted by those inside and outside the government has been that officials in the Department of Defense and White House

must do a better job telling the American public, and especially military service members, why the United States retains nuclear forces, and the importance of the goals supported by those forces.

Multiple reviews of the nuclear enterprise in the last decade have pointed to a lack of leadership support on this issue, which has had detrimental effects on the nuclear enterprise, and reinforced negative public perceptions. The “Welch-Harvey” *Independent Review of the Department of Defense Nuclear Enterprise* made two important recommendations in this regard to the Secretary of Defense in 2014: “[1] On a regular and sustained basis, make it clear to all of the DoD that nuclear forces remain an essential underpinning of US national security. [2] Establish and support programs that maintain high awareness of verbal and written public declarations that question the need for nuclear forces and respond with equally public declarations.”⁷⁶ In essence, a foundational requirement is for US military and civilian leaders to communicate consistently the importance of US nuclear goals, strategies, priorities, and capabilities to all audiences through multiple modes.

In the absence of this sustained effort, support for US nuclear forces and their missions will drift, leading to some of the problems frequently emphasized in the press.⁷⁷ After two decades of relative inattention, a consistent, coordinated, and sustained effort by senior US government officials is needed to convey the need for, and value of, ongoing programs to recapitalize US nuclear forces. As then-Chairman of the JCS Adm. Michael Mullen said regarding these nuclear modernization efforts and deterrence, “Without such improvements, an aging nuclear force supported by a neglected infrastructure only invites enemy misbehavior and miscalculation.”⁷⁸ Civilian and military leaders must effectively advocate on behalf of the nuclear modernization programs essential to support the nation’s priority goals of deterrence, assurance and damage limitation in the event of deterrence failure.

Conclusion

The 2010 NPR explicitly elevated nonproliferation “for the first time” to the highest priority of US nuclear policy, among other priorities, including deterrence and assurance.⁷⁹ It also identified a reduction in the roles and number of nuclear weapons as a means to promote its priority nonproliferation goal. As noted above, senior DoD officials identified “preventing nuclear proliferation and nuclear terrorism,” and “reducing the role of nuclear weapons in US strategy” as the top US strategic objectives, and stated explicitly that the Department of Defense assessed “deterrence requirements against these metrics.”⁸⁰

According to General Kevin Chilton, then-Commander of USSTRATCOM, a key official US assessment of future US nuclear force requirements done in the 2009-2010 timeframe was based on the presumptions that there would be no request for an increase in forces and that the Russians would comply with treaty limits:

The only assumptions we had to make with regard to the new NPR, which was, of course, in development at the time, was that there would be no request for an increase in forces. There was also an assumption that I think is valid, that the Russians, in the post-negotiation time period, would be compliant with the treaty, should they ratify that, and that we would, too. Those were really our going-in positions.⁸¹

The contemporary threat environment, however, seriously calls the first of these presumptions into question, and Russia now is in violation of numerous agreements, including nuclear arms control.

There is now something of a consensus in Washington regarding the deterioration of the security environment since 2010, and senior DoD officials accordingly have more recently identified US nuclear deterrence as the Department's "highest priority mission."⁸² The 2017 NPR should explicitly reestablish deterrence and assurance—coupled with preparations for damage limitation in the event of deterrence failure—as the priority goals for US nuclear policy. Nonproliferation remains important, but the emphasis on it as the priority goal "atop" US nuclear policy, and the corresponding prioritization accorded to the continuing reduction of US nuclear forces, should not be sustained. This alone is no small difference from the dominant post-Cold War policy narrative which has sought largely to limit and reduce US nuclear capabilities on a continuing and progressive basis.

The realities of the contemporary threat environment and the corresponding prioritization of credible deterrence, assurance, and damage limitation goals are key factors for consideration in the new Nuclear Posture Review mandated by the Trump Administration.⁸³ A central question for the new NPR is: What do these new realities suggest regarding US requirements to support these priority goals?

The first-order generalized answer is the requirement for US flexibility and resilience to adapt as necessary to a hostile, dynamic, and unpredictable environment. Section IV below examines how "adaptability," defined as the combination of flexibility and resilience, should serve as a central metric and guide for consideration of US nuclear policy and strategic forces.

¹ U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, DC: Department of Defense, April 2010), p. i, available at http://www.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf.

² U.S. Department of Defense, *DoD Dictionary of Military and Associated Terms* (Washington, DC: Department of Defense, October 16, 2016), p. 69, available at http://www.dtic.mil/doctrine/new_pubs/dictionary.pdf.

³ U.S. Department of Defense, *Report on Nuclear Employment Strategy of the United States* (Washington, DC: Department of Defense, 2013), p. 4, available at http://www.defense.gov/Portals/1/Documents/pubs/ReporttoCongressonUSNuclearEmploymentStrategy_Section491.pdf.

⁴ Robert Work and James Winnefeld, "Statement of Robert Work, Deputy Secretary of Defense, and Admiral James Winnefeld, Vice Chairman, Joint Chiefs of Staff," 114th Congress, House Armed Services Committee, June 25, 2015, p. 2, available at <http://docs.house.gov/meetings/AS/AS00/20150625/103669/HHRG-114-AS00-Wstate-WinnefeldJrUSNJ-20150625.pdf>.

⁵ U.S. Department of Defense, *Quadrennial Defense Review 2014* (Washington, DC: Department of Defense, 2014), p. 60, available at http://archive.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf.

⁶ Ibid., p. v.

⁷ Herman Kahn, *Thinking About the Unthinkable* (New York: Horizon Press, 1962), pp. 101-125.

⁸ Richard Mies, "Strategic Deterrence in the 21st Century," *Undersea Warfare*, No. 48 (Spring 2012), p. 17.

⁹ Robert Scher, "Statement of Robert Scher, Assistant Secretary of Defense for Strategy, Plans, and Capabilities," 114th Congress, Senate Armed Services Committee, February 9, 2016, p. 3, available at http://www.armed-services.senate.gov/imo/media/doc/Scher_02-09-16.pdf; See also, Keith B. Payne and John S. Foster, *Russian*

Strategy: Expansion, Crisis and Conflict (Fairfax, VA: National Institute Press, 2016), pp. 61-82, available at <http://www.nipp.org/wp-content/uploads/2016/01/FINAL-FOR-WEB-1.12.16.pdf>.

¹⁰ "Russia May Face Large-Scale Military Attack, Says Strategic Missile Troops Chief," *BBC Monitoring Former Soviet Union*, December 16, 2009, available at <http://www.dialog.com/proquestdialog/>.

¹¹ Mark Schneider, "The Future of the U.S. Nuclear Deterrent," *Comparative Strategy*, July 2008, pp. 351-352, available at <http://www.tandfonline.com/doi/abs/10.1080/01495930802358539#preview>.

¹² Ashton Carter, "Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota," *Defense.gov*, Sept. 26, 2016, available at <http://www.defense.gov/News/Transcripts/Transcript-View/Article/957408/remarks-by-secretary-carter-to-troops-at-kirtland-abf-new-mexico>.

¹³ Richard Danzig, *Driving in the Dark: Ten Propositions about Prediction and National Security* (Washington, DC: Center for a New American Security, October 2011), p. 14, available at https://s3.amazonaws.com/files.cnas.org/documents/CNAS_Prediction_Danzig.pdf.

¹⁴ 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), pp. 61-148.

¹⁵ For the initial post-Cold War discussion of "tailored deterrence" in the "second nuclear age," see, Keith B. Payne, *Deterrence in the Second Nuclear Age* (Lexington, KY: University Press of Kentucky, 1996), p. 128.

¹⁶ Payne, *The Great American Gamble*, op. cit., chapters 4 and 5. See also, Richard M. Nixon, "National Security Decision Memorandum 242," *Richard Nixon Presidential Library and Museum*, January 17, 1974, available at https://www.nixonlibrary.gov/virtuallibrary/documents/nsdm/nsdm_242.pdf.

¹⁷ U.S. Department of Defense, *Report on the Nuclear Employment Strategy of the United States*, op. cit., pp. 4-5.

¹⁸ Robert Jervis, "Why Nuclear Superiority Doesn't Matter," *Political Science Quarterly*, Vol. 94, No. 4 (Winter 1979-80), pp. 617-18.

¹⁹ Keith B. Payne, "Why Do US Nuclear Force Numbers Matter for Deterrence?" *NIPP.org*, March 9, 2016, available at www.nipp.org/016/04/05/payne-keith-b-why-do-us-nuclear-force-numbers-matter-for-deterrence/.

²⁰ Stephen Hadley, "Remarks by the National Security Advisor, Stephen Hadley, to the Center for International Security and Cooperation, Stanford University," National Defense University, February 8, 2008, available at <http://merlin.ndu.edu.archivepdf/wmd/WH/20080211-6.pdf>.

²¹ U.S. Department of Defense, *Report on Nuclear Employment Strategy of the United States*, op. cit., p. 9.

²² *Executive Summary Effects of Nuclear Earth Penetrator and Other Weapons* (Washington, DC: National Academy of Sciences, 2005), pp. S-2-S-3, available <https://www.nap.edu/catalog/11282/effects-of-nuclear-earth-penetrator-and-other-weapons>.

²³ John Mueller, "The Essential Irrelevance of Nuclear Weapons: Stability in the Postwar World," *International Security*, Vol. 13, No. 2 (Fall 1988), pp. 55-79.

²⁴ This sub-section is adapted from, Keith B. Payne and James Schlesinger, *Minimum Deterrence: Examining the Evidence* (Fairfax, VA: National Institute Press, 2014).

²⁵ Victor Gobarev, "Soviet Military Plans and Actions During the First Berlin Crisis, 1948-49," *Journal of Slavic Military Studies*, Vol. 10, No. 3 (September 1997), p. 5.

²⁶ Marc Trachtenberg, *History & Strategy* (Princeton, NJ: Princeton University Press, 1991), p. 258.

²⁷ Quoted in, "Pak's N-bomb prevented Indian retaliation after 26/11," *The Indian Express*, March 9, 2009, available at <http://www.indianexpress.com/news/paks-nbomb-prevented-indian-retaliation-after-2611/432730/0>.

²⁸ Charles A. Duelfer, testimony, Senate Armed Services Committee, Subcommittee on Emerging Threats and Capabilities: *The Weapons of Mass Destruction Program of Iraq*, Senate Hearing 107-573, 107th U.S. Congress, 2002, pp. 92-93, at http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_senate_hearings&docid=f:80791.pdf. See also the work by Kevin Woods, task leader of the Iraqi Perspectives Project at the Institute for Defense Analyses, and David Palkki, deputy director of National Defense University's Conflict Records Research Center. They presented their respective views on this subject as described at a Policy Forum Luncheon by the Washington Institute for Near East Policy, "Knowing the Enemy: Iraqi Decisionmaking Under Saddam Hussein," September 20, 2010. This forum can be found at <http://www.cspanarchives.org/program/id/233237>.

²⁹ Alexander George and Richard Smoke, *Deterrence in American Foreign Policy* (New York: Columbia University Press, 1974), p. 529

³⁰ Jared Diamond, *The World Until Yesterday: What Can We Learn from Traditional Societies?* (New York: The Penguin Group, 2012), pp. 139-141.

³¹ Kenneth Watman and Dean Wilkening, *U.S. Regional Deterrence Strategies* (Santa Monica, CA: RAND Corp., 1995), pp. 8-9.

³² Quoted in, Elaine M. Grossman, "Debate Heats Up Over Conventional, Nuclear Deterrence Tradeoffs," *Global Security Newswire*, March 19, 2010, available at <http://www.nti.org/gsn/article/debate-heats-up-over-conventionalnuclear-deterrence-tradeoffs/>.

³³ Kurt Guthe, *Ten Continuities in U.S. Nuclear Weapons Policy, Strategy, Plans, and Forces* (Fairfax, VA: National Institute Press, 2008), pp. 17-21, available at http://www.nipp.org/wp-content/uploads/2014/11/N-Continuities-Draft_Rev-2.11.pdf.

³⁴ See Kurt Guthe, *NATO Nuclear Reductions and the Assurance of Central and Eastern European Allies* (Fairfax, VA: National Institute Press, October 2013), available at <http://calhoun.nps.edu/bitstream/handle/10945/37106/NIPP%20Nuclear%20Reductions%20%26%20CEE%20Assurance%20Final.pdf?sequence=1&isAllowed=y.>; Aaron Stein, "Iran's Nuclear Diplomacy: A Response From Turkey," *Royal United Services Institute*, January 27, 2014, available at <http://www.rusi.org/analysis/commentary/ref:C52E63FEA90AB8/>; and, David Santoro and Brad Glosserman, "A Conference Report, Building Toward Trilateral Cooperation on Extended Deterrence in Northeast Asia; The First US-ROK-Japan Extended Deterrence Trilateral Dialogue," *CSIS, Issues & Insights*, Vol. 13, No. 14 (September 2013), pp. v, 2, 12, 13.

³⁵ North Atlantic Treaty Organization, "Warsaw Summit Communiqué," *NATO.int*, July 9, 2016, available at http://www.nato.int/cps/en/natohq/official_texts_133169.htm.

³⁶ Hans Rühle and Michael Rühle, *German Nukes: The Phantom Menace* (Fairfax, VA: National Institute Press, March 22, 2017), Information Series No. 419, available at <http://www.nipp.org/wp-content/uploads/2017/03/IS-419.pdf>.

³⁷ U.S. Department of Defense, "Readout of the U.S.-Republic of Korea-Japan Defense Trilateral Talks Video-Teleconference," *Defense.gov*, no date, 2016, available at https://www.defense.gov/Portals/1/Documents/pubs/Readout_of_the_U.S.-Republic_of_Korea-Japan_Defense_Trilateral_Talks_Video-Teleconference.pdf.

³⁸ Denis Healey, *The Time of My Life* (New York: W.W. Norton, 1990), p. 6.

³⁹ North Atlantic Treaty Organization, "Warsaw Summit Communiqué," op. cit.

⁴⁰ U.S. Department of Defense, "Joint Communiqué of the 48th U.S.-ROK Security Consultative Meeting Washington, DC, October 20, 2016," available at <http://www.defense.gov/Portals/1/Documents/pubs/USROKSecurityJointCommunique2016.pdf>.

⁴¹ Catharine Tunney, "Baltic countries 'justified' in concerns over Putin, says top NATO general," *CBC News*, November 18, 2016, available at <http://www.cbc.ca/news/politics/petr-pavel-nato-putin-baltics-1.3857362>.

⁴² Ryan Pickrell, "Polling Shows Nuclear Arms Race More Likely In Asia," *The Daily Caller*, October 25, 2016, available at <http://dailycaller.com/2016/10/25/polling-shows-nuclear-arms-race-more-likely-in-asia/>.

⁴³ Ser Myo-Ja, "Bring back U.S. nukes, says Blue House report," *Korea JoongAng Daily*, October 14, 2016, available at <http://koreajoongangdaily.joins.com/news/article/Article.aspx?aid=3024895>.

⁴⁴ Robert Einhorn, "Non-proliferation challenges facing the Trump administration," *Brookings Institution*, March 2, 2017, available at <https://www.brookings.edu/research/non-proliferation-challenges-facing-the-trump-administration/>; See also, Toby Dalton and Jon B. Wolfsthal "Can Trump Stop Kim Jong Un?", *Politico*, March 15, 2017, available at <http://www.politico.com/magazine/story/2017/03/can-trump-stop-kim-jong-un-214910>.

⁴⁵ Gerard Baker and Alastair Gale, "South Korea President Warns on Nuclear Domino Effect," *The Wall Street Journal*, May 29, 2014, available at <http://www.wsj.com/articles/south-korea-president-park-geun-hye-warns-on-nuclear-domino-effect-1401377403>.

⁴⁶ "US Vice President Joe Biden: Japan Can go Nuclear 'Virtually Overnight,'" *Sputnik News*, June 26, 2016, available at <https://sputniknews.com/asia/201606261041961917-Joe-Biden-Japan-Nuclear-Overnight/>.

⁴⁷ Tomasz Szatkowski as quoted in Giampaolo Di Paola, Francois Heisbourg, Patrick Keller, Richard Shirreff, Tomasz Szatkowski, and Rolf Tamnes, *Alliance at Risk: Strengthening European Defense in an Age of Turbulence*

and Competition (Washington, DC: Atlantic Council, February 2016), pp. 25-26, available at <http://publications.atlanticcouncil.org/nato-alliance-at-risk/alliance-at-risk.pdf>.

⁴⁸ William J. Perry and James R. Schlesinger, *The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Washington, DC: United States Institute of Peace, 2009), p. 21, available at http://www.usip.org/sites/default/files/America's_Strategic_Posture_Auth_Ed.pdf.

⁴⁹ The National Institute for Defense Studies, *East Asian Strategic Review 2010* (Tokyo, Japan: The Japan Times, 2010), p. 33, available at http://www.nids.go.jp/english/publication/east-asian/pdf/2010/east-asian_e2010_01.pdf.

⁵⁰ NATO, "Warsaw Summit Communiqué," op. cit., Paragraph 53.

⁵¹ "Joint Communiqué of the 48th U.S.-ROK Security Consultative Meeting Washington, DC, October 20, 2016," op. cit.

⁵² U.S. Department of Defense, *Nuclear Posture Review Report*, 2010, op. cit., p. 4.

⁵³ Jun Ji-hye, "Pro-Park lawmaker planning forum for nuclear armament," *The Korea Times*, July 25, 2016, available at http://www.koreatimes.co.kr/www/news/nation/2016/07/116_210230.html; and, The Japan Times, "Top South Korean lawmaker calls for nuclear arms," *The Japan Times*, February 15, 2016, available at <http://www.japantimes.co.jp/news/2016/02/15/asia-pacific/top-south-korean-lawmaker-calls-for-nuclear-arms/#.V6JEslpHcs>.

⁵⁴ Barbara Demick, "More South Koreans support developing nuclear weapons," *Los Angeles Times*, May 18, 2013, available at <http://articles.latimes.com/2013/may/18/world/la-fg-south-korea-nuclear-20130519>.

⁵⁵ "Abe Cabinet says Article 9 does not ban possessing, using N-weapons," *The Asahi Shimbun*, April 12, 2016, available at <http://www.asahi.com/ajw/articles/AJ201604020026.html>.

⁵⁶ Reiji Yoshida, "LDP panel urges government to let Japan strike North Korean missile bases in event of attack," *The Japan Times*, March 29, 2017, available at <http://www.japantimes.co.jp/news/2017/03/29/national/ldp-panel-urges-government-let-japan-strike-north-korean-missile-bases-event-attack/#.WN0E-G8rLcs>; See also, Isabel Reynolds and Yuki Hagiwara, "Japan Ruling Party Weighs First Offensive Weapons Since War," *Bloomberg News*, March 28, 2017, available at <https://www.bloomberg.com/politics/articles/2017-03-29/japan-said-to-renew-push-for-first-offensive-weapons-since-wwii>.

⁵⁷ Robert Scher, "Statement of Robert Scher Assistant Secretary of Defense for Strategy, Plans, and Capabilities," *114th U.S. Congress*, House Armed Services Committee, March 2, 2016, p. 5, available at <http://docs.house.gov/meetings/AS/AS29/20160302/104619/HHRG-114-AS29-Wstate-ScherR-20160302.pdf>.

⁵⁸ Yonhap News Agency, "Putting nuclear weapons back in S. Korea could be considered to pressure China to rein in N.K.: ex-CIA chief," *Yonhap News Agency.com*, November 16, 2016, available at <http://english.yonhapnews.co.kr/national/2016/11/16/43/030100000AEN20161116001100315F.html>.

⁵⁹ Barbara Starr and Brad Lendon, "US sends message to adversaries with nuclear sub visit, drills," *CNN.com*, November 2016, available at <http://www.cnn.com/2016/10/31/politics/guam-nuclear-missile-submarine-visit/>.

⁶⁰ Kurt Guthe, *Ten Continuities in U.S. Nuclear Weapons Policy, Strategy, Plans, and Forces*, op. cit., pp. 29-30.

⁶¹ U.S. Department of Defense, *Report on Nuclear Employment Strategy of the United States* (Washington, DC: Department of Defense June 12, 2013), p. 2, available at https://www.defense.gov/Portals/1/Documents/pubs/ReporttoCongressonUSNuclearEmploymentStrategy_Section491.pdf.

⁶² Robert Scher, "Statement of Robert Scher Assistant Secretary of Defense for Strategy, Plans, and Capabilities," *114th U.S. Congress*, House Armed Services Committee, April 15, 2016, pp. 5-6, available at <http://docs.house.gov/meetings/AS/AS29/20150415/103008/HHRG-114-AS29-Wstate-ScherR-20150415.pdf>.

⁶³ Robert Scher, "Statement of Robert Scher Assistant Secretary of Defense for Strategy, Plans, and Capabilities," March 2, 2016, p. 3.

⁶⁴ Ibid, p. 5.

⁶⁵ Herman Kahn, *Thinking About the Unthinkable in the 1980s* (New York, NY: Simon and Schuster, 1984), pp. 121-122, 221-223.

⁶⁶ U.S. Department of Defense, *Nuclear Posture Review Report*, 2010, op. cit., p. v.

⁶⁷ Ibid.

⁶⁸ Ibid., p. vi.

⁶⁹ Ibid., p. i.

⁷⁰ Hillary Clinton, "Remarks at the United States Institute of Peace," *State.gov*, October 21, 2009, available at <https://2009-2017.state.gov/secretary/20092013clinton/rm/2009a/10/130806.htm>.

⁷¹ James Miller, Principal Deputy Under Secretary of Defense for Policy, as quoted in U.S. Congress, "The Current Status and Future Direction for U.S. Nuclear Weapons Policy and Posture," 112th U.S. Congress, House Armed Services Committee, November 2, 2011, p. 62, available at https://fas.org/irp/congress/2011_hr/nw-posture.pdf.

⁷² U.S. Department of Defense, *Nuclear Posture Review Report*, op. cit., p. 7.

⁷³ See, for example, Barack Obama, *The National Security Strategy* (Washington, DC: The White House, 2010), p. 4, available at https://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf; Deepti Choubey, Are New Nuclear Bargains Obtainable? (Washington D.C.: Carnegie Endowment for International Peace, 2008), p. 1, available at http://carnegieendowment.org/files/new_nuclear_bargains.pdf; Jeffrey W. Knopf, "Nuclear Disarmament and Nonproliferation: Examining the Linkage Argument," *International Security*, Vol. 37, No. 3 (December 13, 2012), pp. 92–132.

⁷⁴ Scher, "Statement of Robert Scher, Assistant Secretary of Defense for Strategy, Plans, and Capabilities," March 2, 2016, op. cit., p. 5.; See also, John E. Hyten, "Advance Questions for General John E. Hyten, USAF Nominee for Commander, United States Strategic Command," 114th U.S. Congress, Senate Armed Services Committee, September 20, 2016, p. 26, available at http://www.armed-services.senate.gov/imo/media/doc/Hyten_09-20-16.pdf.

⁷⁵ U.S. Department of Defense, *Report on the Nuclear Employment Strategy of the United States*, op. cit., p. 2.

⁷⁶ Larry D. Welch and John C. Harvey Jr., *Independent Review of the Department of Defense Nuclear Enterprise* (Washington, DC: Department of Defense, June 2, 2014), p. 10, available at <http://www.defense.gov/Portals/1/Documents/pubs/Independent-Nuclear-Enterprise-Review-Report-30-June-2014.pdf>.

⁷⁷ Brendan McGarry, "Air Force General: 'There Was a Huge Morale Problem' in Nuke Force," *Military.com*, available at <http://www.military.com/daily-news/2015/06/26/air-force-general-there-was-a-huge-morale-problem-in-nuke-force.html>.

⁷⁸ Michael Mullen, "Announcement of the Release of the Nuclear Posture Review," *State.gov*, April 6, 2010, available at <http://www.state.gov/secretary/20092013clinton/rm/2010/04/139929.htm>.

⁷⁹ U.S. Department of Defense, *Nuclear Posture Review Report*, op. cit. p. vi.

⁸⁰ Miller, "The Current Status and Future Direction for U.S. Nuclear Weapons Policy and Posture," op. cit., p. 62.

⁸¹ See the testimony of Kevin Chilton, in, "Nuclear Posture Review: Hearing Before the Committee on Armed Services, United States Senate," 111th U.S. Congress, April 22, 2010, available at <http://www.gpo.gov/fdsys/pkg/CHRG-111shrg63689/pdf/CHRG-111shrg63689.pdf>.

⁸² Carter, "Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota," op. cit.

⁸³ The White House, "Presidential Memorandum on Rebuilding the U.S. Armed Forces," *WhiteHouse.gov*, January 27, 2017, available at <https://www.whitehouse.gov/the-press-office/2017/01/27/presidential-memorandum-rebuilding-us-armed-forces>.

Section IV. Adaptability and Required Characteristics: US Nuclear Forces and Posture

Introduction

Multiple factors must shape consideration of US nuclear policies and the metrics for defining US force adequacy. The first factor, discussed in Section II, is the increasingly dangerous and dynamic threat environment, and the considerable uncertainties regarding the future threat environment. US national goals supported by US nuclear capabilities and their prioritization, as discussed in Section III, are a second factor. A third factor, which is introduced in this section, is a US weapons acquisition cycle that is very slow when compared to the much shorter time frame in which international threats and crises can emerge, with shifting requirements for deterrence and assurance.

Given the need to deter, assure and defend in a dynamic threat environment, with a generally slow-moving acquisition system, “adaptability” must be a primary metric for US nuclear policy, planning, and forces. Adaptability consists of those characteristics that allow the United States to adjust as necessary to current and emerging threats in a timely and credible way to deter enemies, assure allies, and limit damage, if necessary. A 2013 Naval Studies Board (NSB) report that examined options to respond to capability surprises warned that force requirements will likely “need to adapt in ways that cannot currently be envisioned.”¹ The Trump Administration’s National Security Advisor Gen. H.R. McMaster has similarly stated recently, “What we can afford least is to define the problem of future war as we would like it to be, and by doing so introduce into our defense vulnerabilities based on self-delusion.” And, “I think we have to be prepared to fight across a range of contingency operations... So, we are emphasizing adaptability... The ability to adapt quickly to circumstances.”²

This section briefly reviews these multiple factors that must shape US nuclear policies and capabilities, and provides detail on the value and meaning of adaptability as a central metric for US policies and posture.

Complex Security Environment

Section II provided an overview of the contemporary security environment. It is increasingly threatening, multifaceted, and dynamic. In 2014, then-DNI James Clapper stated, “Looking back over my more than half a century in intelligence I have not experienced a time when we've been beset by more crises and threats around the globe. My list is long.”³ In addition, numerous senior military leaders have testified about the great uncertainties in the threat environment and the possibilities for future conflict.

For example, in July 2015 Gen. Martin Dempsey, then-Chairman of the JCS, told the Senate Armed Services Committee, “I’ve said before that the global security environment is as uncertain as I’ve ever seen it. ... The world is rapidly changing everywhere, and we’re seeing significant

shifts in an already complex strategic landscape.⁴ In February 2016, DNI Clapper, in his opening statement to Congress on the *Worldwide Threat Assessment*, similarly stated, “unpredictable instability has become the ‘new normal,’ and this trend will continue for the foreseeable future.”⁵

It is not possible to predict with precision or confidence how adversarial relationships will emerge, how adversaries will employ technological developments, or how unknown future foreign leaders will act toward the United States and its allies. But there no longer is any question whether the global environment is now moving to a more benign “new world order” (as often claimed following the Cold War) among nations, or toward increasingly dangerous competition in which nuclear weapons have considerable salience. The direction clearly is toward the latter.

Existing threats to the United States and its allies stress our understanding of the capabilities that will be necessary over time to deter and assure, and to limit damage in the event deterrence fails. Russia, China, North Korea, and prospectively other states, appear determined to test US deterrence policies and US assurance policies by provoking US allies to such an extent that, in some cases, they appear to have increasing doubts about the credibility of the US extended deterrence commitment. Russian nuclear strategy, in particular, appears designed to test US credibility and resolve.

Neither the United States nor its allies can predict the future as would be needed to identify a rigid or enduring number or set of forces adequate to deter and assure.⁶ Few in or out of government predicted the ominous changes in Russian nuclear policy and aggressive Russian expansion into Georgia, Ukraine, and Syria. As already noted, a late-2013 survey of 1,200 defense experts in academia and government failed to list Russian aggression in the top 30 most likely threats for 2014.⁷ In addition, a key official calculation of US nuclear force requirements done in the 2009-2010 time frame was predicated on assumptions about threat conditions that now appear quite optimistic.⁸ It is in this context that US strategies and capabilities underwriting national goals must adjust as necessary to shifting threat conditions.

US Policy Priorities

Section III examined how changes in the security environment led the Obama Administration, as presented in its 2010 NPR, to prioritize *most highly* nonproliferation and the prevention of nuclear terrorism as US nuclear policy goals, with reductions in the role and number of nuclear weapons (leading toward “nuclear zero”) a preferred avenue to achieve those goals. Yet, Russia, China, and North Korea did not respond to the Obama Administration’s nonproliferation agenda or call to de-emphasize nuclear weapons as hoped, and instead have expanded and made more salient the role of nuclear weapons in their defense strategies and threats to Western allies.

Deterrence, assurance, and damage limitation must again be the priority US nuclear policy goals so that the United States can maintain credible capabilities to support those goals in the face of a threatening and uncertain security environment. As adversaries’ nuclear capabilities and doctrines shift, and threat circumstances change, US policies and capabilities supporting deterrence, assurance, and damage-limitation goals should correspondingly adapt to new requirements in the most expeditious manner possible to avoid “gaps” in needed policies or capabilities. If adversaries perceive exploitable “gaps” in those policies and capabilities, they may be tempted to test US credibility and resolve in a dangerous and destabilizing manner—with corresponding challenges to US goals. If, instead, the United States focuses its efforts on policies

and capabilities that enable the United States to adjust as necessary to different adversaries and contingencies, it will be more able to minimize potential perceived “gaps” in its ability to support deterrence, assurance, and damage-limitation goals.

Weapon Acquisition Cycles

In addition to the increasingly dangerous and unpredictable security environment, and the need to support US goals adequately in that environment, the relative slow pace of US weapon acquisition cycles is another factor which must help shape pertinent US policies and nuclear capabilities. Major defense programs typically take well over a decade to field. And to be sustained, acquisition programs need to win the support of multiple presidential administrations and numerous Congresses. Major new acquisition programs for modern weapon systems cannot be expected to be initiated and completed in time to adjust effectively to rapidly changing geopolitical shifts and new threat developments among adversaries. As former Secretary of the Navy Richard Danzig notes, “...aspects of the world will change unpredictably and faster than procurement and production systems can adapt. Accordingly, the equipment itself should be adaptive whenever possible.”⁹

In short, US nuclear force requirements for deterrence, assurance, and defense can change much more rapidly than changes in capability that depend on new acquisition programs. In addition, US strategic capabilities, such as those now in development, are slated to have service lives that span many decades. For example, the development of a new class of ballistic missile submarine (SSBN)—the *Columbia*-class—to replace *Ohio*-class submarines was initiated in 2010. Current plans call for the first of the *Columbia*-class SSBNs to be deployed in 2031 and for these submarines to remain in service into the 2080s.¹⁰ Obviously, there is significant potential for changes in the geopolitical environment and the capabilities of adversaries during the long service lives of these SSBNs. US strategic systems must be built to accommodate changes in threat, mission, and the priority of US policy goals—changes that are beyond feasible projections decades prior.

Therefore, again, the United States must pursue adaptability for its nuclear policies and force posture as a primary metric of adequacy. By shortening the lengthy procurement schedule where possible, and integrating adaptability into its policies and capabilities, the United States will be in a more advantageous position to meet dynamic deterrence, assurance, and damage-limitation requirements.

Adaptability as a Requirement

The US government and military leaders have long recognized the need for adaptability in US policies and capabilities for the military generally. Given the increasingly dangerous and dynamic security environment, however, this adaptability has become even more important. The National Intelligence Council recognized the implications of this point in its 2017 report *Global Trends*, stating, “In a world where surprises hit harder and more frequently, the most successful actors will be those that are resilient, enabling them to better adapt to changing conditions, persevere in the face of adversity, and act quickly to recover after mistakes.”¹¹ In his February 2016 *Defense Posture Statement*, then-Secretary of Defense Ashton Carter wrote that the Department of Defense would “continue adapting our forces, posture, operations, and capabilities to deter aggression, defend our allies, and sustain our military edge...”¹² In addition, the US *National*

Military Strategy 2015 states that, “As we develop new capabilities to counter threats along the continuum of conflict, we also must procure sufficient capacity and readiness to sustain our global responsibilities. This may include evolving traditional platforms. Or it may require developing entirely new systems that are affordable and flexible. In all cases, our programs must allow us to quickly adapt, to counter adversaries employing unexpected techniques or weapons.”¹³ As the security environment shifts in unpredictable ways, the United States must also be prepared to adapt its strategies and capabilities to support deterrence, assurance, and defense goals in perhaps unforeseen ways for unforeseen purposes.

In a similar manner, US strategy also emphasizes the need for adaptability specifically for US nuclear forces. Then-Commander of USSTRATCOM Admiral Cecil Haney recently wrote that, “we must ensure that we have a credible strategic nuclear deterrent that has diversity and flexibility such that no adversaries can think that they will benefit from escalating to include the employment of a nuclear weapon, that it will be costly to them, and that restraint is a better option.”¹⁴ In 2016, speaking on the necessity of modernizing US nuclear weapons, then-Secretary of Defense Ashton Carter stated, “Indeed, how we deter cannot be static. Rather, it must adapt as threats evolve while continuing to preserve strategic stability, reinforcing nuclear restraint rather than inviting competition or attack.”¹⁵

There is broad recognition that a complex security environment magnifies the need for US nuclear capabilities that are adaptable to remain effective and credible. Some implications of this requirement for the character of US nuclear forces are straightforward and well-recognized. For example, former USSTRATCOM Commander Gen. C. Robert Kehler testified, “The value of the [nuclear] triad lies in its flexibility and responsiveness to the changing world environment and in its ability to hedge against technical failure, geopolitical change, or a breakthrough in another nation’s capabilities.”¹⁶

There also is growing recognition that adaptability is necessary to tailor US nuclear capabilities to the shifting demands for credible deterrence, assurance, and damage limitation. Explaining the concept of tailored nuclear deterrence, General Kehler testified: “It is also increasingly clear that we must carefully shape our deterrence planning to specific actors and situations. To do this will require a deeper and more comprehensive understanding of our potential adversaries and their decision-making processes, a robust understanding of the threats they pose, and more flexibility and speed in our strategy development and planning processes.”¹⁷

The implications for US capabilities to support assurance are similar. Then-Assistant Secretary of Defense Robert Scher in 2016 testified on the need for the United States to sustain “credible, proportionate response options” in the US nuclear posture because, “If allies and partners conclude that they cannot rely on the United States to respond effectively to restore deterrence, they might opt to pursue their own nuclear arsenals, thus undermining our nonproliferation goals.”

Finally, speaking of the value of flexibility for damage limitation, Scher stated, “Retaining more diverse nuclear options gives us the ability to minimize collateral damage in the event the President determines that a nuclear response is required.”¹⁸

In short, adaptability is a key metric for determining the adequacy of US nuclear forces to support the highest-priority national goals given the contemporary realities of an increasingly dangerous and dynamic threat environment.

Adaptability Defined

The security context, US goals in that context, and lengthy weapon acquisition cycles combine to establish the need for US capabilities that are adaptable to best support deterrence, assurance, and damage limitation. The term *adaptability* refers to overall policies and capabilities that provide *flexibility* to adjust as needed for different adversaries, contingencies, and employment plans, and *resilience*, which allows national leadership to adjust the force posture and capabilities to respond readily to adverse political, military, or technological changes. For the purposes of discussion in this assessment, these terms are defined in greater detail below.

- *Flexibility* is the ability to enable deliberate and adaptive planning for a variety of options to deter or counter attacks that present a grave danger to US or allied security (e.g., nuclear strikes, extensive chemical or biological use, or overwhelming conventional offensives). Flexibility is enhanced by maintaining diverse capabilities and the associated nuclear command and control needed to support a broad range of deterrent threat options.¹⁹
- *Resilience* in general is the ability to withstand, recover from, or adjust to adverse change in order to mitigate risk and maintain effectiveness. Resilience includes the ability to fix, modify, or build more or different forces and to develop and deploy improved capabilities and implement different employment methods.

Specific attributes of US nuclear capabilities and supporting infrastructure that provide flexibility and resilience are discussed below.

Adaptability Attributes of the Nuclear Force²⁰

Adaptability, comprising the elements of flexibility and resilience, is a metaphor with real meaning. The following list identifies nuclear force attributes deemed particularly valuable for flexibility and resilience. These are the US nuclear force characteristics that will be 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 adaptability, the US nuclear force as a whole—ICBMs, SLBMs, heavy bombers, and non-strategic nuclear forces (NSNF)—requires certain basic attributes. These include:

- *Survivability* – allows forces to withstand or escape attack on their bases and to evade or overcome enemy defenses.
- *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 US nuclear-capable forces to deploy to locations in or near allied countries as a forward presence that can be important to both deterrence and assurance.
- *Prompt response capability* – permits the United States to hold a variety of potential targets at risk with a flight time of an hour or less which, in some situations, can be important for deterrence, assurance, and damage limitation.

- *Variable payload* – provides the ability of bombers and ballistic missiles to carry different types and numbers of weapons, making possible a better matching of weapons to contingencies, plans, and missions.
- *Assorted weapon yields* – allows the United States to hold at risk a wide range of target types for the purposes of deterring conflict or, if deterrence fails, potentially limiting escalation and thus damage in a variety of contingencies.
- *High delivery accuracy* – along with yield, serves as a critical determinant of whether a weapon can hold a given target at risk, with a minimum of unwanted and unintended potential effects.

Other sources of adaptability for the US nuclear force include:

- *Diversity and readiness of the extant force posture* – assures that the different elements that comprise the force structure—SSBNs, ICBMs, heavy bombers, and NSNF—are not all vulnerable to a single type of failure or enemy attack. Keeping parts of the force on peacetime alert contributes to resilience by providing insurance against a surprise attack and thus ensuring that the United States retains credible deterrent threats and capabilities. Diversity of weapon types within the force structure hedges against problems with the safety, security, or effectiveness of a particular weapon type.
- *Ability to make changes in the deployed force* – assures that the nuclear force can be adapted to some adverse military-technical or geopolitical changes by functionally adjusting existing weapon systems. For example, bombers could be placed on alert and the alert rate for SSBNs could be increased to counter a new threat to prelaunch survivability, increase preparedness for conflict, or deter escalation of a crisis. (Nearly all ICBMs reportedly are already on alert.) Non-deployed 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. The ability to adjust the types of weapons and warheads deployed requires extra capacity in weapon delivery systems and a reserve of non-deployed warheads.
- *Potential to modify existing capabilities through hardware changes* – permits incorporation of new technologies in existing weapon systems for surety, fuzing, guidance, penetration of defenses, or other functions. Responsiveness of this type demands a modern, capable infrastructure and a skilled, professional workforce.

In the future, US force modernization will provide another source of adaptability, one which has been lacking for decades. If current plans for the strategic and nonstrategic nuclear forces are realized, the United States will be building SSBNs, ICBMs, bombers, dual-capable aircraft (DCA), air-launched cruise missiles, and nuclear weapons over approximately the next 20 years. This will offer important options over this time frame for responding to adverse geopolitical developments or decreases in force effectiveness beyond altering the existing force posture or modifying current weapon systems. The adaptability characteristics of the planned modernization program for US nuclear forces are outlined and examined in detail in Section VI below.

The Nuclear Infrastructure, Adaptability and “Hedging”

An important element of flexibility and resilience is a responsive nuclear infrastructure.²¹ This infrastructure, which includes the national labs, manufacturers of both nuclear and nonnuclear

components, and the warhead stockpile, allows the United States to build capabilities which fit tailored deterrence, assurance, and damage-limitation requirements. The Clinton, Bush, and Obama Administrations articulated the need for a strong and responsive nuclear infrastructure as part of a “hedging” strategy as detailed below. Thus, it is important to review the critical role of the nuclear infrastructure in generating adaptability in US capabilities and how a US strategy that prioritizes adaptability could in turn affect the nuclear infrastructure.

As noted above, all three previous NPRs have included the policy of maintaining a nuclear “hedge” as an important part of resilience against adverse changes, such as the return of a hostile authoritarian regime in Russia, the collapse of nuclear arms control limits, and a Russian and/or Chinese nuclear buildup. Part of the “hedge” strategy is the US nuclear stockpile, which includes non-deployed warheads which could be uploaded on deployed SLBMs, ICBMs, and heavy bombers. Each of the NPRs has described the stockpile as providing insurance against reliability failure or adverse geopolitical trends.

The US hedge strategy and its implementation has evolved over the past two decades. The 1994 NPR of the Clinton Administration implemented a hedge strategy as insurance against the reemergence of a hostile Russia and a practical response to the idle status of the nuclear infrastructure. The 2001 NPR of the Bush Administration called its version of the hedge a “responsive capability.” The responsive capability was intended to provide the means to adjust the nuclear force to emerging challenges. The 2001 NPR described the recommended nuclear force as sized for “immediate contingencies” but with the potential of being adapted for “potential and unexpected contingencies.”²² To accommodate this strategy, as the number of operationally deployed nuclear warheads was reduced by about 65 percent, sufficient force structure was retained to ensure that additional warheads could be uploaded over a period of “weeks, months, and years to meet potential contingencies.” In addition, this responsive capability recognized the diminishing viability of the strategy of preserving old nuclear warheads for possible upload. It called for more dependence on a modernized nuclear infrastructure.²³ Transferring dependence to implement a hedge strategy from an aging, non-deployed stockpile of warheads to a functioning infrastructure was an evolutionary approach for the 2001 NPR.

The 2010 NPR and follow-on decisions of the Obama Administration continued the policy to retain a hedge capability and to modernize the supporting infrastructure. However, in ways similar to previous administrations, those plans were delayed.

In short, for previous administrations the hedge was a response to possible technical surprises or a possible downturn in geopolitics and a resurgence of the role of nuclear weapons in international relations. Given the emerging threat environment of the 21st century, the hedge strategy of the past three administrations appears to provide an appropriate avenue for the adaptability needed for a hostile, dynamic and uncertain future.

The focus on adaptability—the combination of flexibility and resilience—including in the US nuclear infrastructure, is consistent with the intent of the past three administrations to shift the strategy for addressing uncertainty via a large standing nuclear stockpile to greater responsiveness via a modernized nuclear infrastructure. In the absence of a responsive infrastructure, the US stockpile needs to remain larger than otherwise would be the case to address a variety of potential problems including, for example, discovery of a technical issue for a class of warheads. A responsive infrastructure would help enable the United States to adapt to

a changing threat environment. In turn, so focusing on a more responsive infrastructure will require steps to address challenges in the current nuclear infrastructure.²⁴ Nevertheless, it is clear that the US nuclear infrastructure is a potentially critical contributor to US adaptability in support of priority national goals, and that critical contribution must not be neglected. A more detailed discussion is presented in Section VI below.

Summary of Required Characteristics for US Nuclear Forces

In summary, an increasingly dangerous threat environment—including uncertainties regarding future threats and adversary capabilities, the prioritization of deterrence, assurance, and damage limitation as US goals, and the slow pace of US acquisition programs—combine to increase the significance of adaptability as a necessary attribute for US nuclear policies and capabilities. Adaptability, defined as the combination of flexibility and resilience, can help the United States tailor its deterrence and assurance strategies and capabilities as necessary for specific contexts, and respond to an adverse and unpredictable security environment in a more credible and expeditious manner.

Section V below examines the implications of force sizing concepts for adaptability. Section VI below identifies and assesses adaptability characteristics of the existing nuclear force and the force that will be fielded if existing US programs and plans to replace and modernize nuclear forces are sustained.

¹ Jerry A. Krill and J. Paul Reason, Co-chairs, Committee on Capability Surprise on U.S. Naval Forces, *Responding to Capability Surprise: A Strategy for U.S. Naval Forces* (Washington, DC: The National Academy Press, 2013), pp. 3, 72-73, available at <https://www.nap.edu/catalog/14672/responding-to-capability-surprise-a-strategy-for-us-naval-forces>.

² H.R. McMaster, “The Pipe Dream of Easy War.” *The New York Times*, July 20, 2013, available at <http://www.nytimes.com/2013/07/21/opinion/sunday/the-pipe-dream-of-easy-war.html>; and, H.R. McMaster, “Strategy, Policy, and History,” *Foreign Policy Initiative*, November 30, 2016, p. 10, available at <http://foreignpolicyi.org/files/uploads/images/2016-11-30-Transcript-McMaster-Final.pdf>.

³ James R. Clapper, “Statement of James R. Clapper, Director of National Intelligence, On Behalf of the Panel,” 113th U.S. Congress, Select Committee on Intelligence of the United States Senate, January 29, 2014, available at <http://www.intelligence.senate.gov/hearings/open-hearing-current-and-projected-national-security-threats-against-united-states#>.

⁴ Blake Seitz, “Dempsey: ‘The Global Security Environment Is As Uncertain As I’ve Ever Seen It,’” *Washington Free Beacon*, July 7, 2015, available at <http://freebeacon.com/national-security/dempsey-the-global-security-environment-is-as-uncertain-as-ive-ever-seen-it/>.

⁵ James R. Clapper, “Remarks as delivered by The Honorable James R. Clapper, Director of National Intelligence,” *DNI.gov*, February 9, 2016, available at https://www.dni.gov/files/documents/2016-02-09SSCI_open_threat_hearing_transcript.pdf.

⁶ Richard Danzig, former Secretary of the Navy, makes this point in his monograph *Driving in the Dark*. Richard Danzig, *Driving in the Dark: Ten Propositions about Prediction and National Security* (Washington, DC: Center for a New American Security, October 2011), pp. 23-35, available at https://s3.amazonaws.com/files.cnas.org/documents/CNAS_Prediction_Danzig.pdf.

⁷ Council on Foreign Relations, *Preventive Priorities Survey 2014* (Washington, DC: Council on Foreign Relations, 2013), available at <http://www.cfr.org/peace-conflict-and-human-rights/preventive-priorities-survey-2014/p32072>.

⁸ Kevin Chilton, as stated in, “Nuclear Posture Review: Hearing Before the Committee on Armed Services, United States Senate,” 111th Congress, April 22, 2010, available at [http://www.gpo.gov/fdsys/pkg/CHRG-111shrg63689.pdf](http://www.gpo.gov/fdsys/pkg/CHRG-111shrg63689/pdf/CHRG-111shrg63689.pdf).

⁹ Danzig, *Driving in the Dark: Ten Propositions about Prediction and National Security*, op. cit., p. 9.

¹⁰ Ronald O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress*, R41129 (Washington, DC: Congressional Research Service, October 25, 2016), pp. 7-8, available at <https://www.fas.org/sgp/crs/weapons/R41129.pdf>.

¹¹ National Intelligence Council, *Global Trends: Paradox of Progress* (Washington, DC: Director of National Intelligence, January 2017), p. 65, available at <https://www.dni.gov/files/images/globalTrends/documents/GT-Full-Report.pdf>.

¹² Ashton Carter, *2017 Defense Posture Statement: Taking the Long View, Investing for the Future* (Washington, DC: Department of Defense, February 2016), p. 21, available at https://www.defense.gov/Portals/1/Documents/pubs/2017DODPOSTURE_FINAL_MAR17UpdatePage4_WEB.PDF.

¹³ U.S. Joint Chiefs of Staff, *The National Military Strategy of the United States of America 2015* (Washington, DC: Joint Chiefs of Staff, June 2015), p. 17, available at http://www.jcs.mil/Portals/36/Documents/Publications/2015_National_Military_Strategy.pdf.

¹⁴ Cecil D. Haney, "An Interview with Cecil D. Haney," *Joint Forces Quarterly*, Vol. 83, 4th Quarter (2016), p. 68.

¹⁵ Ashton Carter, "Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota," *Defense.gov*, September 26, 2016, available at <https://www.defense.gov/News/Transcripts/Transcript-View/Article/956079/remarks-by-secretary-carter-to-troops-at-minot-air-force-base-north-dakota>.

¹⁶ C. Robert Kehler, "Statement of General C. Robert Kehler, Commander, United States Strategic Command," *112th U.S. Congress*, House Armed Services Committee, March 2, 2011, p. 7, available at <http://www.dod.mil/dodgc/olc/docs/testKehler03022011.pdf>; See also, Kevin P. Chilton, "Statement of General Kevin P. Chilton, Commander, United States Strategic Command," *111th U.S. Congress*, Senate Foreign Relations Committee, June 16, 2010, p. 4, available at <http://www.foreign.senate.gov/imo/media/doc/Chilton,%20Gen.%20Kevin%20P.pdf>.

¹⁷ C. Robert Kehler, Commander, United States Strategic Command, "Statement of General C. R. Kehler, Commander, United States Strategic Command," *113th U.S. Congress*, Senate Armed Services Committee, March 12, 2013, p. 4, available at <http://www.armed-services.senate.gov/imo/media/doc/Kehler%2003-12-13.pdf>.

¹⁸ Robert Scher, "Statement of Robert Scher, Assistant Secretary of Defense for Strategy, Plans, and Capabilities," *114th U.S. Congress*, House Armed Services Committee, March 2, 2016, p. 5, available at <http://docs.house.gov/meetings/AS/AS29/20160302/104619/HHRG-114-AS29-Wstate-ScherR-20160302.pdf>.

¹⁹ As defined in: Keith Payne and John Foster, et al., *Nuclear Force Adaptability for Deterrence and Assurance: A Prudent Alternative to Minimum Deterrence* (Fairfax, VA: National Institute Press, 2014), available at <http://www.nipp.org/wp-content/uploads/2014/12/MD-II-for-web.pdf>.

²⁰ Attributes listed here are a summary of the detailed discussion in Payne and Foster, *Nuclear Force Adaptability for Deterrence and Assurance: A Prudent Alternative to Minimum Deterrence*, op. cit.

²¹ U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: Department of Defense, December 2001), available at http://www.dod.mil/pubs/foi/Reading_Room/NCB/06-F-1586_Nuclear_Posture_Review.pdf.

²² Donald H. Rumsfeld, *Annual Report to the President and Congress* (Washington, DC: U.S. Department of Defense, 2002), pp. 83-92, available at http://history.defense.gov/Portals/70/Documents/annual_reports/2002_DoD_AR.pdf?ver=2014-06-24-153732-117.

²³ Rumsfeld, *Annual Report to the President and Congress*, op. cit.

²⁴ For more information on what changes may be required, see, Thomas Scheber and John R. Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps* (Fairfax, VA: National Institute Press, 2015), available at <http://www.nipp.org/wp-content/uploads/2015/10/Assessment-of-US-Readiness-for-web.pdf>.

Section V. Considering Nuclear Force Size: How Much is Enough?

Introduction

With adaptability as the guiding metric for US nuclear force adequacy, what are the implications for the size of the US nuclear arsenal?¹ The public debate about US nuclear forces typically revolves around the question of deployed warhead and launcher numbers—“how much is enough?” This focus is largely a result of the relative ease of referring to those things that can be counted, and the legacy of a strategic arms control process that has focused on the same. While this focus on numbers excludes many pertinent factors when considering the question of force adequacy to support national goals, it is not irrelevant. This section examines the relationship between the adequacy of nuclear force numbers and the adaptability metric emphasized above. As German philosopher Georg Hegel is reputed to have said, “Quantity has a quality all its own.”

The Contemporary Debate

The US debate about nuclear forces and policy often descends into arcane details. These details can be important, but it also is important to address a basic question: for deterrence, does the United States need more and different types of nuclear capabilities than the very limited number and types of nuclear weapons necessary to threaten to “destroy” an opponent’s society? While it appears incongruous, a minimum US nuclear deterrent typically is defined as a second-strike (i.e., retaliatory) capability sufficient to threaten the destruction of an opponent’s societal or urban/industrial assets, such as “a nation’s modern economy, for example, electrical, oil, and energy nodes, transportation hubs.”²

That adequacy standard for deterrence, i.e., the nuclear capabilities necessary to threaten the destruction of an opponent’s societal assets, is “easy” to meet in quantitative and qualitative terms given the high vulnerability of unprotected, fixed societal targets (e.g., urban-industrial areas) to nuclear strikes.³ Indeed, the number of US retaliatory, or “second-strike” weapons typically considered adequate to meet a minimalist standard for deterrence ranges from “several” weapons to hundreds of weapons.⁴ Such numbers are modest compared to the approximately 1,600 US nuclear weapons reportedly now deployed.⁵

US nuclear capabilities beyond those necessary for threatening opponents’ societies and populations typically are criticized by minimalists as unnecessary and destabilizing. Indeed, these are the criticisms leveled against the Obama and now Trump Administrations’ nuclear modernization programs.⁶

The connection between the advocacy of minimal US nuclear capabilities and a deterrence policy based on targeting opponents’ societies has been explicit for decades. For example, in 1961, a prominent academic commentator observed, “Would the Soviets be deterred by the prospect of losing ten cities? Or fifty cities? No one knows, although one might intuitively guess that the

threshold is closer to ten than to either two or fifty.⁷ Whatever the number, the presumed object of the US deterrence threat was Soviet cities.

More recently, two prominent commenters recommended a US “responsive force” of 400-500 nuclear warheads because this number of weapons would be adequate to target Russian sites, “affecting industrial recovery—the major nodes in the electric power grid and air, ground, and rail transportation systems, as well as major industrial sites.”⁸ In 2010, a minimum deterrence-oriented assessment by US Air Force personnel concluded that a US nuclear force of “311 weapons” would be more than adequate because, “There is not a state on the planet that could withstand that sort of punishment or a leader who would run that sort of risk.”⁹

The critical question here is, “how much is enough?” for deterrence. As illustrated above, precise answers derived from the minimum deterrence approach range from several weapons to hundreds. However, every Republican and Democratic administration for five decades has rejected this minimalist standard for and approach to nuclear deterrence.¹⁰ There are six basic reasons for rejecting a minimalist numeric standard of adequacy for US nuclear capabilities.

First, as illustrated above, there are many claims regarding the number of nuclear weapons adequate for deterrence. The problem with all such claims is that no one knows with precision the minimal US nuclear capability necessary to deter attack, now or in the future, or how many and what types of weapons will be adequate to deter over time and across a spectrum of circumstances and opposing leaderships. And, if that number somehow could be known, it would likely change rapidly with shifting circumstances. That is, US requirements for effective deterrence cannot prudently be based on a fixed type of deterrent threat, number of weapons or capability; requirements will change depending on the opponent, the time, and the context.¹¹ It is because the requirements for deterrence can vary greatly depending on opponents’ goals, perceptions, values, levels of determination and willingness to take risks that deterrence strategies must be “tailored” to opponents and contexts.

Developments in circumstances that can shift deterrence requirements may be technical, political, operational, or even personal to a given leadership. For example, the possibility that a US nuclear system could experience an unexpected reliability problem that would disable or degrade many US weapons may best be mitigated by having a level of diversity and overlapping capabilities in the deterrent arsenal. This factor alone could lead US requirements beyond the typical minimal definitions of adequacy. Deterrence requirements involve inherent uncertainties and can shift, and the goals of deterring attack and assuring allies are crucial. Thus, it is only prudent to hedge with flexible, diverse and overlapping capabilities rather than risk the failure of deterrence due to unexpected requirements or reliability problems, or otherwise having too few or the wrong types of nuclear forces needed to deter and assure.

Consequently, every Republican and Democratic administration for five decades has concluded that US nuclear deterrence forces should be diverse, flexible and overlapping to help ensure that the United States always possesses the capabilities necessary to deter attack across a wide spectrum of threats and circumstances.¹²

Second, to pose a retaliatory deterrent threat, US nuclear forces must be able to survive an opponent’s “first-strike” attack on those US forces themselves. US forces thought to be vulnerable to a first strike would be useless as a retaliatory deterrent threat. Consequently, the US deterrent

must be sufficiently large and diverse to survive a nuclear first strike by a determined foe under all conditions. This requirement has led to a 50-year consensus in favor of ensuring that the United States possesses a sufficient number of nuclear weapons to survive an attack and a diverse nuclear triad of carriers for those weapons, i.e., nuclear bombers, SLBMs, and ICBMs. The diversity of this overlapping triad of nuclear systems, with their different operations and locations, helps to ensure that under all conditions an opponent could not anticipate destroying the US retaliatory nuclear deterrent in a first strike. This is one of the rationales for and great values of the US nuclear triad that again takes US nuclear capabilities beyond the numbers and types typically associated with a minimal deterrent.

Third, as noted above, intentionally planning to destroy societal or urban-industrial centers establishes a minimal set of deterrence requirements for US nuclear capabilities, i.e., it makes for “easy” nuclear deterrence requirements. But, it also involves the intentional plan to kill innocents and non-combatants on a massive scale. Thus, it is widely and rightly considered immoral, a potential violation of international law, and inconsistent with the Just War tradition. Instead, the United States should strive for deterrence capabilities that are not limited to or dependent upon threatening opponents with intentional societal destruction. Consequently, the US nuclear deterrent must have the diverse and flexible nuclear capabilities necessary to pose threats to a variety of other types of targets and, indeed, to avoid to the extent possible an opponent’s societal centers—thereby potentially minimizing the threat to an opponent’s innocent non-combatants. This deterrence standard again imposes US force requirements that are more diverse qualitatively and larger quantitatively than typically is deemed adequate to meet the “easy” minimal deterrence standard of threatening the destruction of an opponent’s population and societal assets.

It should be noted here that this particular point stings advocates of minimal US nuclear capabilities and deterrence. Consequently, they often claim in response that the types and scale of US nuclear capabilities and the targeting plans underlying US deterrent threats essentially make no real difference in the prospective level of societal destruction in a nuclear war.¹³ They claim, therefore, that a minimal deterrent based on societal threats and capabilities is no more guilty of violating humanitarian norms than any other approach to nuclear deterrence. There is, however, no doubt whatsoever that the types of nuclear weapons and the targeting plans followed can dramatically affect the levels of destruction and casualties—with weapons and targeting plans advocated by minimalists unsurprisingly causing the greatest levels of societal destruction. Many careful studies over decades have reached this conclusion.¹⁴ The United States should not help to ensure that any use of nuclear weapons leads to unmitigated levels of societal destruction by adopting an approach to deterrence that is “easy” simply because societal targets are so vulnerable to nuclear weapons that a relatively small and narrowly-capable arsenal is needed to threaten them.

Fourth, and related to the above, for US deterrence strategies to function most reliably, the US deterrent must be able to threaten retaliation against those potentially different types of assets that opponents value most highly. In some cases, the minimalist deterrence threat to destroy an opponent’s societal infrastructure as the basis of US deterrence strategy will *not* threaten what an opponent values most. There are many historical examples wherein leaderships have willingly and knowingly accepted a high risk of societal destruction in pursuit of a goal judged to be *more important* than avoiding that risk.¹⁵ In short, threats against an opponent’s society embraced by minimalists may deter in some cases; in other cases, however, the opposing leaderships’ goals

and values may demand an alternative approach to deterrence and require more and different types of US nuclear forces.

During the Cold War, Democratic and Republican administrations agreed that a spectrum of deterrent options was needed for the deterrence of Soviet leaders, and consequently rejected narrow societal targeting plans as the basis for US deterrence strategies. President Carter's Secretary of Defense Harold Brown and other US senior leaders addressed the question, "What does it take to deter?" and emphasized that, in principle, the US deterrent threat should hold at risk those assets most highly valued by opposing leaderships: "We need to remember in making a judgment on that matter that we are trying to deter the Soviet leaders from aggressive actions and specifically from nuclear war. We therefore need to form a judgment on what it is that is so valuable to them that they would be left in no doubt that, whatever kind of nuclear attack they might launch, the U.S. response would leave them worse off in terms of those assets that they consider valuable...it is important for U.S. forces to be able to threaten retaliation against the assets that the Soviet leaders appear to prize..."¹⁶

Consequently, US deterrence policy reportedly was predicated on the expectation that Soviet leaders placed highest value *not* on urban-industrial centers, but on Soviet political and military assets, including the Soviet control structure itself and Soviet military/nuclear capabilities. As Secretary Brown said in 1980, the US deterrent should be capable of posing a threat to "what the Soviets consider most important to them,"¹⁷ which could include Soviet conventional and nuclear military forces, the Soviet political and military control structure ("their power structure"), and military industry.¹⁸ Thus, US forces had to be large enough in size and possess the diverse qualities necessary to threaten for deterrence purposes those assets valued most highly by the Soviet leadership. This was a standard for US deterrent forces well beyond the relatively small number of weapons typically deemed adequate to meet the minimal deterrence standard of threatening society. Why? Because Soviet political control and military assets were numerous and often protected.

In today's international threat context, there is no reason to assume that current and future opponents, potentially including Russia and China, will not similarly place greatest value on numerous assets that are realistically vulnerable *only* to US nuclear threats,¹⁹ and impose higher standards of adequacy on US deterrence capabilities than a minimal deterrent. The size and diversity of the US nuclear arsenal for deterrence must be paced accordingly.

The fact that this deterrence principle evolved during the Cold War does not mean that it is an outmoded "Cold War" notion. It is, rather, a principle that logically applies in general across the spectrum of opposing leaderships, including in the contemporary period: if deterrence is to be as effective as possible, US deterrent threats must seek to hold at risk that which the opponents value, and preferably value most highly. Those diverse sets of values may or may not include society and the material assets of society. Presuming that those values are and will be entirely or largely societal corresponds well to the minimum deterrence recommendation of low force numbers, but as Henry Kissinger observed of this minimum deterrence presumption in 1973: "They believe in assured destruction [societal threats] because it guarantees the smallest expenditure."²⁰ Such a presumption, however, does not correspond to considerable historical evidence of the extreme diversity in opponents' value hierarchies. The primary rationale for assuming that deterrence can be served adequately by holding opponents' societal assets at risk

appears to be that such deterrent threats can be deemed compatible with very low force numbers—not because such threats can be deemed predictably adequate for deterrence.

Fifth, the minimum deterrence approach to sizing US nuclear forces provides little, if any, provision for the failure of deterrence, i.e., in most plausible contingencies, it would provide a president the most miserable options possible were the United States or allies to suffer a nuclear attack. In the event of a nuclear attack, a president certainly would want the scope and size of any US response to help discourage any further nuclear escalation by the opponent. Yet, retaliating against, say, many Russian or Chinese societal targets, per minimum deterrence notions, would be likely to undo whatever targeting restraint Moscow or Beijing might have practiced in the initial attack, and do little or nothing to protect the United States from further attack. Then-Secretary of Defense Robert McNamara emphasized precisely this point in 1962: “In the event of war, the use of such a force against the cities of a major nuclear power would be tantamount to suicide.”²¹ Similarly, in 1967, then-Air Force Secretary (and later Defense Secretary) Harold Brown said, “the execution of the option to destroy Soviet population and industry would be our poorest choice.”²²

There is almost no conceivable circumstance in which US retaliation against numerous societal targets in the event of an initial Russian or Chinese attack could help to restore deterrence and limit carnage. The president, instead, would want flexible and diverse US nuclear retaliatory options to have available response options best suited to the crisis and to limiting further escalation and levels of destruction. This is particularly likely to be the case given apparent Russian limited nuclear employment planning under the “escalate-to-de-escalate” concept. Discriminate US nuclear options may be particularly important for deterring such a Russian first use of nuclear weapons, or responding to it should deterrence fail.

The hope that efforts to limit escalation in the event of war will be successful may be optimistic, but the United States should not by the narrowness of its capabilities and rigidity of its planning be limited to a response that would likely ensure that nuclear escalation proceeds unabated. Again, the US deterrence goal should be, and has been, to have flexible and diverse response options for the purpose of deterring further escalation and limiting damage,²³ not the very narrow types of responses imposed by a minimum deterrence approach to sizing US forces. This point is not a rejection of deterrence or a call for a US “nuclear war-fighting” policy as critics contend; it is a call for diverse US capabilities that make available to the president a variety of options best suited for deterrence, reestablishing deterrence, and limiting nuclear escalation in the event deterrence fails. Once again, this goal would likely require a US arsenal beyond the number and types of weapons deemed adequate for minimum deterrence.

Sixth, and finally, the United States has formal extended deterrence responsibilities to provide a “nuclear umbrella” for over 30 allies. Many of these allies consider the US nuclear umbrella essential to their security (particularly those in close proximity to Russia, China and North Korea); they see the credibility of the US extended deterrent as central to their assurance. However, a minimalist US nuclear deterrent capability limited to threatening an opponent’s society may be judged *incredible* as an extended deterrent (i.e., not believed by the opponent) because of the well-recognized US desire to limit civilian destruction in its military operations and also, again, because of the likelihood that a US nuclear response against an opponent’s society could lead that opponent simply to launch strikes in return against US urban-industrial centers. In this case, a US extended deterrent threat focusing on an opponent’s society essentially would be a US

threat to commit national suicide on behalf of an ally. Opponents may understandably doubt that any US president would ever choose to proceed along such a course. Indeed, former Secretary of State Henry Kissinger long ago publicly explained to allies that they should never expect the United States to follow such a course.²⁴ An opponent's doubts along these lines would render that US minimal nuclear deterrent threat incredible for extended deterrence purposes. This potential credibility problem is not a vestige of the Cold War; given Russia's new expansionism and numerous, explicit nuclear threats to US allies, it is again a serious contemporary concern.

Consequently, for decades US policy has been to have diverse, flexible and limited nuclear response options, including DCA deployed in NATO countries, that are intended to be more credible for extended deterrence purposes than a minimal deterrent. DoD officials in the Obama Administration fully recognized this need for “diverse nuclear options,” and the corresponding continuing need for the US triad and DCA. Why? Because, “sustaining a diverse set of U.S. nuclear capabilities is essential for the role they play in regional deterrence.”²⁵

For all of the reasons noted above, US officials have long recognized a minimalist US nuclear arsenal as inadequate to support US deterrence requirements. Minimal US nuclear force numbers may sound appealing to some but, in general, the smaller and less diverse the US force is: the less survivable it is, the less flexible it is, the more narrow the available US deterrent threat options are, and the less credible it is likely to be in some potentially critical contingencies.

It must be acknowledged that there is considerable speculation regarding “how much is enough” in both the minimum-deterrence approach to US nuclear forces sizing and a US approach that emphasizes flexible, diverse, and overlapping capabilities. But, while both approaches involve speculation, the latter is by far the more prudent in a subject area that begs for prudence.

Why so? Because deterrence is an art that includes numerous moving parts with some inherent and irreducible uncertainties. “How much is enough” for deterrence is not fully predictable because we have an inherently limited capacity to predict reliably and precisely how prospective foreign leaders will think and act in crises. Given the great variety of international threats and the equally great variation in the perceptions, values and decision-making modes of foreign leaderships, no one knows with any level of confidence whether a small, minimum deterrence-oriented US arsenal will deter on any given occasion, much less universally for all plausible occasions now and in the future.

Given this reality, the most *imprudent* approach to deterrence is to have an “easy” small and narrow set of US deterrence threat options based on the presumptions that opponents will be deterred by nuclear threats to their societies and that the United States can make such threats credibly. The effective functioning of deterrence and assurance is too important to depend on the assumption that the United States will face only opponents who are susceptible to minimum deterrent threats. The US goal must be for deterrence to work in all cases, which again suggests the value of diverse, flexible and overlapping capabilities that are adaptable for deterrence purposes across a wide variety of potential circumstances.

The significance of US adaptability given the great and often surprising variation in opponents' worldviews and behaviors is noted as one of the most significant lessons of the 1991 Gulf War by those who studied it most closely. Kevin Woods and Mark Stout conclude that this variation produces, “a sufficiently broad spectrum of possible adversary courses of action that American

policies and strategies to deal with them would have to be quite adaptable. That greater degree of adaptability would probably be very helpful when the reality—which will certainly, to a greater or lesser extent, differ from expectations—becomes clear.”²⁶ This lesson applies with particular significance to US strategies for deterrence.

In addition, US planning must recognize the possibility that deterrence will fail. Yet, as noted above, minimum deterrence makes no useful provision for the failure of deterrence. Indeed, it likely maximizes the prospect for uncontrolled societal destruction if deterrence fails. The functioning of deterrence is not foolproof and thus making no provision for its failure is grossly imprudent.

In summary, while all approaches to determining “how much is enough” for deterrence involve speculation about how opponents will think and act, for the United States the only prudent approach lies in the possession of flexible, diverse and overlapping capabilities. This is particularly so in the contemporary threat environment characterized by an expansionist, revanchist and hostile Russia that is adding to its nuclear arsenal and making explicit nuclear first-use threats,²⁷ and also by an increasingly aggressive, expansionist China that also is adding to its nuclear capabilities.²⁸

Advocates of a minimal US nuclear deterrent continue to call for revising US nuclear deterrence policies and targeting plans per the minimum deterrence adequacy standard to facilitate lower US nuclear force requirements.²⁹ They typically argue against diverse and flexible US forces,³⁰ often because those attributes suggest the requirement for retaining larger US force numbers than they prefer. But, given the stark reality of increasing nuclear threats to the United States and its allies, US deterrence policies should not be determined by how well they comport with “easy” adequacy standards and provide a rationale for eliminating US nuclear capabilities; indeed, US deterrence policies serve purposes other than rationalizing the elimination of US nuclear forces. The adequacy of US nuclear forces and policies should be determined primarily by threat conditions and the requirements for deterring enemies and assuring US allies in the most prudent manner possible. Consequently, the reasons described here for continuing to reject a minimalist US nuclear deterrent force remain sound.

Conclusion

US nuclear force numbers should be the product of a careful assessment of the threat environment and the US goals and priorities in that environment, not the starting point based on an imprudent, narrow concept of deterrence, or other static boundaries. The number and characteristics of US nuclear forces must contribute to the adaptability necessary to support US deterrence, assurance and damage-limitation goals in dangerous, shifting, and uncertain circumstances. This adaptability as a metric for adequacy imposes requirements on the US nuclear arsenal, including its overall size and diversity. US nuclear policy must recognize the potential contribution to adaptability made by the size and diversity of the US nuclear force, and thus to the importance of these attributes in support of US deterrence, assurance, and damage-limitation goals.

¹ This section is adapted from, Keith B. Payne, "Why Do US Nuclear Force Numbers Matter for Deterrence?" *Information Series No. 404* (Fairfax, VA: National Institute Press, 2016), available at <http://www.nipp.org/wp-content/uploads/2016/03/IS-404.pdf>.

² See for example, Hans Kristensen, Robert Norris, Ivan Oelrich, *From Counterforce to Minimal Deterrence*, (Washington, DC: Federation of American Scientists and The Natural Resources Defense Council, Occasional Paper No. 7, April 2009), pp. 31-32. See also pp. 2, 43, 44.

³ Robert Jervis, "Why Nuclear Superiority Doesn't Matter," *Political Science Quarterly*, Vol. 94, No. 4 (Winter 1979-80), pp. 617-618. See also, Steven Pifer and Michael O'Hanlon, *The Opportunity: Next Steps in Reducing Nuclear Arms* (Washington, DC: Brookings Institution Press, 2012), pp. 20-21.

⁴ "Several" is the level identified as adequate in, James Wood Forsyth, Col. B. Change Saltzman, Gary Schaub, "Minimum Deterrence and its Critics," *Strategic Studies Quarterly*, Vol. 4, No. 4 (Winter 2010), p. 7.

⁵ Hans Kristensen and Robert Norris, "United States Nuclear Forces, 2016," *Bulletin of the Atomic Scientists*, Vol. 72, No. 2 (December 2016), pp. 63-71.

⁶ See for example, Center for Arms Control and Nonproliferation, "Is a New Nuclear Cruise Missile Necessary?," *ArmsControlCenter.org*, February 2, 2016, available at <http://armscontrolcenter.org/is-a-new-nuclear-cruise-missile-necessary/>.

⁷ Glenn Snyder, *Deterrence and Defense: Toward a Theory of National Security* (Princeton, NJ: Princeton University Press, 1961), p. 57.

⁸ Sidney Drell and James Goodby, *What are Nuclear Weapons for? Recommendations for Restructuring U.S. Strategic Nuclear Forces* (Washington, DC: Arms Control Association, October 2007), p. 15.

⁹ James Wood Forsyth, Col. B. Change Saltzman, USAF, Gary Schaub, "Minimum Deterrence and its Critics," op. cit., p. 6.

¹⁰ The Obama Administration too has explicitly rejected "minimum deterrence". See, U.S. Department of Defense, *Report on Nuclear Employment of the United States*, (Washington, DC: Department of Defense, June 12, 2013), p. 4, available at available at http://www.defense.gov/Portals/1/Documents/pubs/ReporttoCongressonUSNuclearEmploymentStrategy_Section491.pdf.

¹¹ See Keith B. Payne, *Fallacies of Cold War Deterrence* (Lexington, KY: University Press of Kentucky, 2001), chapters 1-4.

¹² See for example, National Security Council, National Security Decision Memorandum 242, *Policy for Planning the Employment of Nuclear Weapons*, January 17, 1974 (declassified June 29, 2007); The White House, Presidential Directive NSC-59, *Nuclear Weapons Employment Policy*, July 25, 1980 (declassified July 24, 2012); and, Department of Defense, *Report on Nuclear Employment of the United States Specified in Section 491 of 10 U.S.C.*, op. cit.

¹³ Bruce Blair, et al., *Toward True Security* (Cambridge, MA: Union of Concerned Scientists, February 2008), pp. 17-18, available at <http://www.ucsusa.org/assets/documents/nwgs/toward-true-security.pdf>; See also, Daryl Kimball and Matthew McKinzie, "Nuclear Dangers: Myth, Reality, Response," *Defense News*, February 23, 2015, p. 21; and, Walter Pincus, "Nuclear Weapons Modernization: Not Fast Enough for Kyl," *Washington Post*, February 27, 2014, available at https://www.washingtonpost.com/world/national-security/nuclear-weapons-modernization-not-fast-enough-for-kyl/2012/02/25/gIQANAJoeR_story.html.

¹⁴ A study by the Natural Resources Defense Council showed that a small "countervalue" strike with up to 192 weapons would inflict 54-56 million casualties in an exchange with Russia, while a very large "counterforce" strike employing many times that number of weapons (approximately 1,300) would inflict 11-17 million casualties. See Matthew McKinzie, et al., *The U.S. Nuclear War Plan: A Time for a Change* (New York: National Resources Defense Council, June 2001), pp. x, 125. Other studies find far fewer casualty levels from "counterforce" targeting scenarios and much higher possible casualty levels from intentional "countervalue" targeting. The distinction here involves literally scores of millions of potential casualties. See for example, United States Senate, Subcommittee on Arms Control, International Law and Organization of the Committee on Foreign Relations, Hearing, *Briefing on Counterforce Attacks*, 93rd Congress, 2nd Session, September 11, 1974, pp. 12-22; Keir Lieber and Daryl Press,

"The Nukes We Need: Preserving the American Deterrent," *Foreign Affairs*, Vol. 88, No. 6 (November/December 2009), p. 47.; and, U.S. Congress, Office of Technology Assessment, *The Effects of Nuclear War* (Washington, DC: USGPO, May, 1979), p. 10.

¹⁵ See Payne, *The Fallacies of Cold War Deterrence*, op. cit., and Keith B. Payne, *Deterrence and the Second Nuclear Age* (Lexington, KY: University Press of Kentucky, 1996), especially chapters 2-4.

¹⁶ See the prepared statement by Harold Brown in, United States Senate, Committee On Armed Services, Hearing, "MX Missile Basing System And Related Issues," 98th U.S. Congress, 1983, pp. 6-7. See also, R. James Woolsey, "US Strategic Force Decisions for the 1990s," *Washington Quarterly*, Vol. 12, No. 1 (Winter 1989), p. 82.

¹⁷ See, the testimony by Secretary of Defense Harold Brown in, U.S. Senate, Committee on Foreign Relations, *Nuclear War Strategy*, Hearings, 96th U.S. Congress, (Top Secret hearing held on September 16, 1980; sanitized and printed on February 18, 1981), p. 10.

¹⁸ See, the testimony by Secretary of Defense Harold Brown and the "Administration's Responses to Questions Submitted Before the Hearing," in Ibid., pp. 10, 16, 25, 29-30. See also, *Remarks Prepared for Delivery by the Honorable Harold Brown, Secretary of Defense, at the Convocation Ceremonies for the 97th Naval War College Class, Naval War College, Newport, Rhode Island*, August 20, 1980; and, the discussion in, Walter Slocombe, "The Countervailing Strategy," *International Security*, Vol. 5, No. 4 (Spring 1981), pp. 18-27.

¹⁹ For reasons explained in, Keith B. Payne and James Schlesinger, et al., *Minimum Deterrence: Examining the Evidence* (Fairfax, VA: National Institute Press, July 2013), pp. 22-25.

²⁰ And, as Kissinger concluded, "To have the only option that of killing 80 million people is the height of immorality." National Archives, Nixon Presidential Materials, NSC Institutional Files (H-Files), Box H-108, Minutes of Meetings, Verification Panel Minutes, Originals 3-15-72 to 6-4-74 [3 of 5]. Top Secret; Sensitive. The meeting took place in the White House Situation Room. Declassified and available in *Department of State, Foreign Relations of the United States, 1969-1976*, Vol. XXXV, *National Security Policy, 1973-1976* (Washington, DC: USGPO, 2014), p. 105.

²¹ Remarks by Secretary McNamara, NATO Ministerial Meeting, 5 May 1962, Restricted Session (Top Secret; declassified in part, August 17, 1979) pp. 11-12, quoted in, Kurt Guthe, *Ten Continuities in U.S. Nuclear Weapons Policy, Strategy, Plans, and Forces* (Fairfax, VA: National Institute for Public Policy, 2008), p. 50.

²² *Memorandum From the Secretary of the Air Force (Brown) to Secretary of Defense McNamara*, September 14, 1967, US Department of State, Office of the Historian, Foreign Relations of the United States 1964-1968, Vol. X, *National Security Policy*, Document 191, at <https://history.state.gov/historicaldocuments/frus1964-68v10/d191>.

²³ See for example, Harold Brown, Before the US Senate, Committee on Foreign Relations, "The Department of Defense Statement on Strategic Military Balance: Military Assessment," 96th U.S. Congress, July 11, 1979, p. 3.

²⁴ Henry Kissinger, "The Future of NATO," in, *NATO: The Next Thirty Years*, Kenneth Myers, ed. (Boulder, CO: Westview Press, 1981), p. 8.

²⁵ Robert Scher, "Statement of Robert Scher, Assistant Secretary of Defense for Strategy, Plans, and Capabilities," 114th U.S. Congress, Senate Armed Services Committee, February 9, 2016, p. 4, available at https://www.armed-services.senate.gov/imo/media/doc/Scher_02-09-16.pdf.

²⁶ Kevin M. Woods and Mark E. Stout, "Saddam's Perceptions and Misperceptions: The Case of 'Desert Storm,'" *Journal of Strategic Studies*, Vol. 33, Issue 1 (February 2010), p. 38.

²⁷ See Keith B. Payne, John S. Foster, et al., *Russian Strategy: Expansion, Crisis and Conflict* (Fairfax, VA: National Institute Press, 2016).

²⁸ U.S.-China Economic and Security Review Committee, *2015 Report to Congress* (Washington, DC: Government Printing Office, November 2015), available at http://origin.www.uscc.gov/sites/default/files/annual_reports/2015%20Annual%20Report%20to%20Congress.PDF. See also, Bill Gertz, "China Adds Warheads to Older DF-5s," *The Washington Times*, February 10, 2016, available at <http://www.washingtontimes.com/news/2016/feb/10/inside-the-ring-china-adds-warhead-to-older-df-5s/>.

²⁹ See, for example, Hans Kristensen and Robert Norris, "Reviewing Nuclear Guidance," *Arms Control Association*, November 2, 2011, available at http://www.armscontrol.org/act/2011_11/Reviewing_Nuclear_Guidance_Putting_Obama_Words_Into_Action; and, Adam Mount, "The Fiscal Threat to Nuclear Strategy," *Bulletin of the Atomic Scientists*, March 15, 2015, available at <http://thebulletin.org/fiscal-threat-nuclear-strategy8080>.

³⁰ Hans Kristensen and Robert Norris, "Reviewing Nuclear Guidance," op. cit.; Tom Nichols, "Time to Change America's Atomic Arsenal," *The Diplomat*, March 14, 2013, available at <http://thediplomat.com/2013/03/time-to-change-americas-atomic-arsenal/>; and, George Perkovich, Individual Statement, "A Sustaining U.S. Nuclear Posture," CSIS Nuclear Consensus Working Group (Barry Blechman, Linton Brooks, Robert DeGrasse, Frank G. Klotz, Franklin Miller, Clark Murdoch, George Perkovich, Steven Pifer), *Forging a Consensus for a Sustainable U.S. Nuclear Posture* (Washington, DC: CSIS, April 2013), pp. 46-47, available at http://csis.org/files/publication/130422_Spies_ForgingConsensus_Web.pdf.

Section VI. An Assessment of Present and Planned US Nuclear Forces

Part I: US Nuclear Forces and the Planned Modernization Program

Introduction

The United States is in the initial stage of a planned modernization program for its nuclear force. The program will encompass all elements of the force, entail a sum in the hundreds of billions of dollars over the next quarter century, shape the force for decades after that, and affect the capabilities for deterrence, assurance, and damage limitation. The last comparable program began in the late 1970s and early 1980s and was carried out over the subsequent decade and a half. Much of the force today is the legacy of that earlier undertaking.

Basic questions with regard to the modernization program are how the planned force differs from the present force and the extent to which the changes represent capability improvements that support the priority US goals. This section offers some answers.

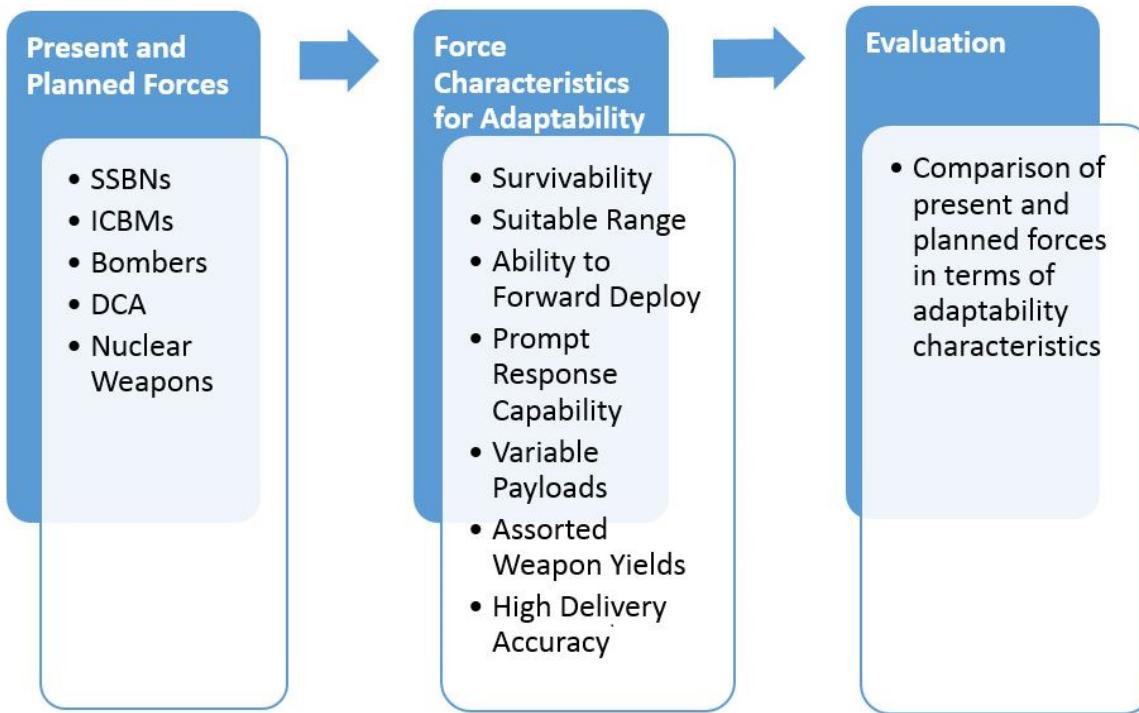
The present and planned US nuclear forces first are outlined in a set of tables that shows the intended changes in strategic and nonstrategic forces during the coming decades. The tables include information on types and numbers of delivery systems and nuclear weapons, existing types as well as their successors, times at which types enter or end service, and sustainment of the current force pending modernization.

The tables provide background for the subsequent discussion, in which the different elements of the present and planned forces are evaluated against the key characteristics of adaptability described in Section IV. The force elements are: ballistic missile submarines (SSBNs) with submarine-launched ballistic missiles (SLBMs); intercontinental ballistic missiles (ICBMs); heavy bombers; bomber-delivered cruise missiles; dual-capable aircraft (DCA); and the nuclear warheads and bombs carried by missiles and aircraft. Recall that the force characteristics that serve adaptability (flexibility and resilience) are: survivability; suitable range; ability to forward deploy; prompt response capability; variable payloads; assorted weapon yields; and high delivery accuracy.

Each force characteristic is a subsection of the discussion that follows; survivability is the first subsection, suitable range the second, and so on. The organizational structure within each subsection does not follow a common format. Adherence to a common format for a number of reasons was found not to be the best way to present the results of evaluation. Those results are summarized by force characteristic on pages 108-111 of this section; they can be read first as an overview of the evaluation. The supporting details appear in the respective subsections for the seven characteristics.

The analytic approach to be followed is depicted in Figure 2.

Figure 2: Analytic Approach



Caveat. An important caveat is in order. The analysis here evaluates the planned modernization program. That program could change in the years ahead. In fact, it would be remarkable if a plan and related projects that spanned decades remained unchanged. The planned program could be altered as a consequence of changes in presidential administrations, differences between the executive branch and Congress, leaner or larger budgets, unexpected technical challenges or advancements, growing or declining threats from abroad, and new nuclear arms control agreements or significant arms control failures. Nonetheless, this assessment provides a useful initial cut at a comparative evaluation.

The Nuclear Force Modernization Program in Outline

The four tables that follow constitute a brief overview of the changes that will occur under the planned modernization program. Open sources of information served entirely as the basis for these tables and can be found in Appendix A.

Table 1 shows US nuclear forces before the planned modernization. The strategic force structure, weapon loadings, and numbers are those of early 2018, when the United States is required to meet the central limits of the 2011 US-Russian New START Treaty. Those ceilings are: 1) 800 deployed and nondeployed ICBM launchers, SLBM launchers, and heavy bombers equipped for nuclear arms; 2) 700 deployed ICBMs, deployed SLBMs and deployed nuclear-equipped heavy bombers; and 3) 1,550 nuclear warheads on deployed ICBMs, deployed SLBMs, and deployed nuclear-equipped heavy bombers, with each bomber counting as one warhead. The table also includes the dual-capable aircraft of the nonstrategic force, which are not treaty constrained.

Table 1: US Nuclear Forces, 2018

Delivery Systems and Nuclear Weapons	Entry into Service	Projected End of Service	Number
Ohio-class SSBN; 20 SLBMs per SSBN	1981	Early 2040s	10 operational; 4 in overhaul
Trident D5 & D5 LE SLBMs; ~4 RVs per SLBM	1990 (D5) 2017 (D5 LE)	Early 2040s	240 deployed
W76-0 warhead / Mk4 RV	1978	With confidence in W76-1 LEP	~ 960 on deployed SLBMs
W76-1 warhead / Mk4A RV	2009	Late 2040s	
W88 warhead / Mk5 RV	1989	2040s	
Minuteman III ICBM; 1 RV per ICBM	1970	Early-to-mid-2030s	400 deployed; 50 nondeployed
W78 warhead / Mk12A RV	1979	2030s	400 on deployed ICBMs
W87 warhead / Mk21 RV	1986	Late 2030s	
B-52H bomber; ≤ 12 ALCMs per bomber	1961	2050s	41 deployed; 5 nondeployed
ALCM-B; 1 warhead per ALCM	1982	~ 2030	≤ 528 for deployment
W80-1 warhead	1982	~2030	≤ 528 for deployed ALCMs
B-2 bomber; ≤16 bombs per bomber	1993	~ 2058	19 deployed; 1 nondeployed
B61-7 bomb	1985	2024	Maximum capacity of deployed B-2 fleet is 304 bombs
B61-11 bomb	1997	2029	
B83-1 bomb	1993	2029	
F-16 and F-15E DCA; 2 bombs per aircraft	1981 (F-16) 1988 (F-15E)	After the 2020s	Number of nuclear-certified aircraft not publicly available
B61-3 bomb	1979	2024	A few hundred
B61-4 bomb	1979	2024	
B61-10 bomb	1990	2024	

The delivery systems in the first column of the table include SSBNs and their SLBMs, silo-based ICBMs, heavy bombers with either air-launched cruise missiles (ALCMs) or gravity (free-fall) bombs, and the two types of shorter-range strike aircraft than can deliver nuclear weapons. The nuclear weapons for each type of missile or aircraft are also listed. “W” designates a missile warhead and “B” a gravity bomb. (As the use of “warhead” in the New START limits cited above illustrates, the term also can refer to both missile warheads and gravity bombs.) The warheads or bombs with the last number preceded by a hyphen (W80-1, for example) are modifications or

variants of a single weapon design. “RV” refers to the reentry vehicle that contains a missile warhead, and “Mk” is short for “Mark.”

The two center columns are included in the table because the aging of both delivery systems and nuclear weapons is a major motivation behind the modernization program. Many systems or weapons are well past their intended service lives and another life extension program (LEP) would be impractical in a number of cases. Projected end of service life is the time when the submarine, missile, aircraft, or nuclear weapon is expected to be retired and replaced.

Numbers of SSBNs, SLBMs, ICBMs, bombers, and ALCMs, along with those for missile warheads and bombs appear in the last column. The terms “deployed” and “nondeployed” are categories defined in the New START Treaty.

Table 2 offers concise descriptions of plans for sustaining the submarines, missiles, and aircraft found in Table 1, as well as plans for building and deploying their successors.

Along with the plans for future nuclear delivery systems, there is a plan for the future stockpile of nuclear weapons. Table 3 shows the changes envisaged by this “3+2 strategy.” Under the strategy, the 12 warhead or bomb variants (see the center column) within the seven deployed warhead families (W76, W78, W80, W87, W88, B61, B83) will be reduced to *three* interoperable ballistic missile warheads (IWs), which could arm either SLBMs or ICBMs, and two air-delivered weapons, one bomb and one cruise missile warhead (see the last column).

Table 4 lays out the strategic and nonstrategic forces that will result if the modernization program for both delivery systems and nuclear weapons is implemented as planned. Between the mid-2020s and early 2030s, new *Columbia*-class SSBNs, Ground-Based Strategic Deterrent (GBSD) ICBMs, B-21 bombers, Long-Range Stand-Off (LRSO) cruise missiles, and nuclear-certified F-35A dual-capable aircraft will enter the forces, for the most part replacing their predecessors. (B-52H bombers will be retained for perhaps two and a half decades after the B-21 enters service, and the B-2 may be kept flying for roughly another decade after that.) Note that the future systems, like their older counterparts, have service lives measured not in years but decades, which underscores the importance of force characteristics that will enable SSBNs, ICBMs, and strike aircraft to adapt to the shifting geopolitical, technological, and military conditions of a distant and obscure future.

Table 2: Nuclear Delivery System Sustainment and Modernization Plans

Delivery System	Service Life	Sustainment Plan	Modernization Plan
Ballistic missile submarine (SSBN)	The Navy plans to retire the <i>Ohio</i> -class SSBNs at the rate of roughly one submarine per year beginning in 2027	Performing intermediate maintenance and industrial support for the incremental overhaul, repair, and refueling of the remaining <i>Ohio</i> -class submarines; improving land-side and in-transit security systems	Navy planning to replace all 14 <i>Ohio</i> -class submarines with 12 new <i>Columbia</i> -class SSBNs, with initial operations expected in 2031 following a decade of ship construction, testing, and crew and platform certifications
Submarine-launched ballistic missile (SLBM)	The Navy plans for the Trident D5 SLBM to be in service through at least 2042	Developing nonnuclear components to improve the reliability, safety, and security for the W88 warhead's Mk5 reentry system; redesigning and replacing missile guidance and electronic systems; sustaining other missile components reaching the end of their service lives; procuring additional missiles; executing capital maintenance projects at Navy-owned Naval Industrial Reserve Ordnance Plants	No announced plan to replace Trident D5 until the 2040s
Intercontinental ballistic missile (ICBM)	The Air Force plans for the Minuteman III ICBM to be in service through the early-to-mid 2030s	Replacing obsolete nuclear reentry system components; maintaining an engineering capability to address emerging issues in guidance, propulsion, reentry, command and control, and other subsystems; and replacing obsolete or nonserviceable weapon-system support equipment; sustaining and ultimately replacing the UH-1N helicopter to improve security at ICBM sites for routine and emergent operations	Air Force developing a replacement, the Ground-Based Strategic Deterrent ICBM, with an initial operational capability planned for 2029
Heavy bombers	The Air Force expects the B-52H to be in service through at least 2050, and the B-2 potentially until 2058	B-52H: Improving tactical datalink and voice communications capabilities, weapons bay upgrades, and additional efforts that stem from the operation and maintenance of a 50-plus-year-old aircraft B-2: Improving avionics, communications, engines, armament systems, low-observable components, and other subsystems	Air Force developing the new B-21 heavy bomber, with initial operational capability expected in the mid-2020s
Air-launched cruise missile (ALCM)	The Air Force plans for the air-launched cruise missile (ALCM-B) to be in service through 2030	Monitoring and assessing age-related issues in arming, fuzing, navigation, electrical, and other subsystems	Air Force developing a replacement, the Long-Range Stand-Off cruise missile, with an initial operational capability planned for 2030
Dual-capable aircraft (DCA)	Currently fielded Air Force dual-capable fighter aircraft expected to be able to meet Allied commitments into the 2020s	Performing regular operations and maintenance for F-16 fighter squadrons in Italy	Air Force developing a nuclear-capable variant of the F-35 strike fighter

Table 3: Current and Future US Nuclear Missile Warheads and Bombs

Delivery System	Current	Future
SLBM	W76-0 warhead	Interoperable Warhead 1 (W78/88-1)
	W76-1 warhead	Interoperable Warhead 2 (W87/88)
	W88 warhead	Interoperable Warhead 3 (W76-1 Return)
ICBM	W78 warhead W87 warhead	
Bomber Cruise Missile	W80-1 warhead	W80-4 warhead
Penetrating Bomber	B61-7 bomb B61-11 bomb B83-1 bomb	B61-12 bomb
Dual-Capable Aircraft	B61-3 bomb B61-4 bomb B61-10 bomb	

Table 4: Future US Nuclear Forces

Delivery Systems and Nuclear Weapons	Actual or Planned Entry into Service	Projected End of Service	Number
Columbia-class SSBN; 16 SLBMs per SSBN	2031	2080s	10 operational; 2 in overhaul
Trident D5 LE SLBM; ≤ 8 RVs per SLBM	2017	2040s	160 deployed
Follow-on SLBM	2040s	2080s	
W76-1 warhead / Mk4A RV	2009	2040s	
IW-1 (W78/88-1) warhead / Mk21/5 RVs	2030	2050s – 2060s	
IW-2 (W87/88) warhead / Mk21/5 RVs	2034	2050s – 2060s	
IW-3 (W76-1 Return) warhead / Mk4/5 RVs	2041	2060s – 2070s	
GBSD ICBM; 1 or multiple RVs per ICBM	2029	2075	400 deployed
W78 warhead / Mk12A RV	1979	2030s	
W87 warhead / Mk21 RV	1986	Late 2030s	
IW-1 (W78/W88-1) warhead / Mk21/5RVs	2030	2050s – 2060s	
IW-2 (W87/88) warhead / Mk21/5 RVs	2034	2050s – 2060s	
IW-3 (W76-1 Return) warhead / Mk4/5 RVs	2041	2060s – 2070s	
B-52H bomber; multiple LRSO cruise missiles per bomber	1961	2050s	≤ 41 deployed; ≤ 5 nondeployed
LRSO cruise missile; 1 warhead per missile; ~1,000 missile bodies procured	2026	2060	~500 for deployment
B-2 bomber; ≤ 16 bombs per bomber; maximum LRSO payload not publicly available	1993	~2058	≤ 19 deployed; 1 nondeployed
B61-12 bomb	2020	2040s – 2050s	Maximum bomb-carrying capacity of the B-2 fleet is 304 bombs
LRSO cruise missile	2026	2060	~500 for deployment
B-21 bomber	Mid-2020s	2050s or longer	100+
B61-12 bomb	2020	2040s – 2050s	Not publicly available
LRSO cruise missile	2026	2060	~500 for deployment
LRSO cruise missile	2026	2060	~500 for deployment
W80-4 warhead	2025	2050s	~500 for deployed LRSOs
F-35A DCA; 2 bombs per aircraft	2024	2070	Planned number of nuclear-capable F-35As not publicly available
B61-12 bomb	2020	2040s – 2050s	Not publicly available

Evaluation of the Present and Planned Forces

Survivability

Force survivability is a matter both of escaping or withstanding attack (prelaunch survivability) and penetrating defenses that could impede an effective response (postlaunch survivability). Survivability is a prerequisite for deterrence, assurance, and damage limitation. Less survivability weakens the prospective response to an attack, which can undermine the perceived lethality and credibility of a deterrent threat. Deliberate and controlled response, which would aid efforts to limit the escalation of a conflict, would depend on the availability of forces that safely could be withheld and not used in haste. Assurance would suffer if allies perceived the United States lacked sufficient, survivable forces to respond on their behalf for major acts of aggression, or would be reluctant to respond for fear that the escalation of a conflict would quickly become uncontrolled.

SSBNs. The 14 *Ohio*-class SSBNs now in the fleet operate from two bases, one at Kings Bay, Georgia and the other at Bangor, Washington.¹ At their bases, which are “soft” targets, SSBNs could be vulnerable to attack. At sea, however, conducting patrols in both the Atlantic and Pacific oceans, SSBNs currently are considered “virtually undetectable” and more survivable than ICBMs in silos or bombers at air bases.² Two submarines typically are in port for midlife refueling of their nuclear reactors and for other overhaul work and two other submarines are in port for routine maintenance, leaving 10 submarines deployable, of which roughly half are at sea, though not all are on full alert.³ In a crisis, additional SSBNs could be deployed on short notice.⁴ Keeping a significant portion of the SSBN fleet at sea at all times offers insurance against a failure to deploy submarines during a war-prone crisis because of absence of attack warning, ambiguous warning, or apprehension that acting on warning could provoke an attack.

“Today, there appears to be no credible near- or mid-term threat to the survivability of U.S. SSBNs,” concluded the 2010 Nuclear Posture Review (NPR).⁵ But the antisubmarine warfare (ASW) capabilities of adversaries are likely to improve over the next seven decades, a period in which *Ohio*-class submarines retire (late 2020s to 2040) and *Columbia*-class submarines enter service (early 2030s) and subsequently retire (2080s). To anticipate ASW advances, those designing the *Columbia*-class SSBN take into account projections of future technologies and intelligence assessments of potential threats from acoustic and non-acoustic detection means.⁶ For a reduced acoustic signature, the new submarine will have selected machinery-quieting enhancements, an electric-drive propulsion train and a propulsor (rather than the noisier mechanical-drive propulsion train and propeller of the *Ohio*-class SSBN), and, as necessary, an advanced sound-absorbing hull coating composed of anechoic tiles.⁷ As part of its own sonar system, the *Columbia*-class SSBN will be equipped with panels of acoustic sensors mounted on either side of the hull, comprising a large vertical array (LVA), which will “extend detection range and provide the submarine with an improved intelligence picture regarding threats, undersea terrain and what might be operating in a given area,”⁸ and thereby “help with stealth.”⁹ (The LVA also will be retrofitted on *Ohio*-class SSBNs.)¹⁰ With regard to the stealth of the new submarine against non-acoustic ASW, little has been said publicly.

The Defense Department anticipates that the *Columbia*-class SSBN “will have a service life that enables patrols into the 2080s, and will remain survivable even as adversary ASW technology advances and proliferates.”¹¹

US Strategic Command (STRATCOM), the combatant command for the fleet, has a requirement for a minimum of 10 operational submarines, based on what is needed for two-ocean presence, survivability, and target coverage.¹² Under present plans, there will be more than 10 operational SSBNs in the coming decades, except during 2030s, when the transition from *Ohio*-class to *Columbia*-class SSBNs occurs and the number of submarines will be at the minimum.¹³ Strategic Command and the Navy see “moderate operational risk”¹⁴ during this period because the fleet size then will provide “little margin for absorbing an unforeseen event that might force an SSBN into an unscheduled and lengthy maintenance action.”¹⁵ The full fleet of 12 *Columbia*-class submarines, in service by 2042, will provide an at-sea presence similar to that of the 14 *Ohio*-class submarines because the newer SSBNs will not need midlife refueling for their advanced reactors and are designed for shorter maintenance periods.¹⁶ Reduction in the size of the SSBN fleet below the numbers currently planned—whether the result of budget cuts, arms control, or accidental loss—could adversely affect survivability, and not only because “if you do it with less you make it easier for somebody to find them; or, you encourage somebody to try to find them.”¹⁷ In addition, according to a Navy director of undersea warfare:

We need to maintain a sufficient SSBN force size to enable flexibility in the way we operate. To avoid exploitable predictability and the damage that it would do to survivability, we need some variation in SSBN schedules. A force structure that is too low is predictable, and predictability can be taken advantage of.

...Our SSBN force is sized so that we have the ability to vary our operations, to include the duration of patrols and the intervals between them, contributing to both individual SSBN and force-level survivability.

...If the number of SSBNs gets too small...[e]ither we would have to drive too fast and compromise our stealth, or we would have to follow a path that is straighter than we want [instead of the submarines varying “how they move around the ocean to make sure that the SSBN ‘needle’ is hiding in a very large haystack”].¹⁸

The *Columbia*-class SSBN will be better able than its predecessor to survive advances in opposing ASW capabilities over the coming decades,¹⁹ but, as in the past, the Navy SSBN Security Program, which “aims to anticipate potential threats and develop appropriate countermeasures” will remain essential to maintaining the survivability of the fleet.²⁰

ICBMs. By early 2018, when New START limits are fully implemented, the ICBM force will have 400 silo-based Minuteman III missiles grouped in geographically dispersed wings located at Minot Air Force Base (AFB), North Dakota; F.E. Warren AFB, Wyoming; and Malmstrom AFB, Montana.²¹ A relatively large number of high-accuracy, high-yield ballistic missile warheads would likely be required to threaten their survivability. And, while an adversary would need to expend two warheads per silo to ensure a high kill probability (a standard assumption), each Minuteman III ICBM carries only a single warhead, making an attack an unremunerative two-for-one exchange. In addition, an adversary could not count on catching US ICBMs in their silos. Essentially all Minuteman III missiles are on continuous alert,²² and the United States long has maintained a launch-under-attack capability for its ICBMs.²³ The capability for launch under attack may complicate adversary attack planning significantly in a way beneficial for deterrence.²⁴

It should be added that in the absence of the hundreds of silo-based ICBMs, an attack on the US strategic nuclear force would be much less difficult to plan: SSBNs not on patrol and bombers not on alert could be vulnerable to the destruction of the two submarine bases and the three bases for nuclear-capable bombers. (The prelaunch survivability of the bomber force is discussed later.)

Under the ongoing Ground-Based Strategic Deterrent (GBSD) program, the 400 Minuteman III missiles will be replaced with the same number of follow-on ICBMs.²⁵ The new missiles will be placed in existing, albeit renovated, silos.²⁶ Other fixed and mobile basing modes were examined, including a hybrid option with silo and road-mobile basing, but rejected, probably because of their higher cost.²⁷

The GBSD ICBM will not enter service until the late 2020s and is projected to remain deployed until 2075. It is not hard to imagine that during the next six decades the United States could face greater danger of conflict with other powers, intensified arms competition, arms control reversals, and advances in military technologies that could render silo vulnerability of graver concern than is the case today. The ICBM survivability concern that plagued the country for years in the last quarter of the 20th century could loom large again in the second quarter of the 21st century. The executive branch and Congress eventually may require additional measures for missile survivability.

To enhance the resilience of the GBSD capability, the option of ballistic missile defense (BMD) for silo protection could be kept available for future consideration. Silo defense was a primary purpose of the Safeguard BMD system briefly deployed in the mid-1970s, as well as various BMD deployment options developed prior to the announcement of the Strategic Defense Initiative in 1983.²⁸ In addition to active defense, the option of transferring GBSD missiles to more survivable basing at some point after their silo deployment might usefully be left open. A wide variety of fixed and mobile basing modes have been conceived and analyzed, not only for the GBSD program, but in past decades for Minuteman, Peacekeeper (MX), and Small ("Midgetman") ICBMs.²⁹ Designing the GBSD ICBM for periodic movement, even if current plans call for silo deployment, could make the missile compatible with road- or rail-mobile basing options that might be adopted later in its service life.

SLBMs and ICBMs versus Missile Defenses. Threats to the survivability of ICBMs and submarine-launched ballistic missiles could be post- as well as prelaunch. Today, opposing ballistic missile defenses appear insufficient to inflict a high rate of attrition against SLBMs and ICBMs. Russia and China, however, have plans and programs to improve their capabilities for missile defense.³⁰ With an eye toward adversary defensive measures possible in the future, the commander of Air Force Global Strike Command has warned the Minuteman III "will have a difficult time surviving in the active A2/AD [anti-access/area denial] environment that we will be dealing with in the 2030-and-beyond time period."³¹ (The GBSD program, according to another Air Force representative, will "address future threats, especially those that may emerge in a post-2030 Anti-Access/Area Denial environment."³²)

A number of additional measures could be taken to counter missile defenses as needed. ICBMs and SLBMs might be uploaded with additional reentry vehicles to compensate for expected losses to defenses. Trident D5 SLBMs each can be armed with eight reentry vehicles but now carry an average of only four per missile, and 300 of the single-reentry vehicle Minuteman III ICBMs each

have the capacity to be loaded with two more.³³ An issue might be the number of ballistic missile warheads available for uploading.

The missiles also might be equipped with special means for foiling defenses. As a result of past efforts, countermeasures designed to thwart endo- and exoatmospheric defenses have been developed, tested, and, in some cases, deployed.³⁴ Examples of penetration aids are chaff (bundles of thin metallic stripes to confuse radars) and decoys (dummy reentry vehicles to create false targets). Maneuvering reentry vehicles could change trajectory to evade defense interceptors.³⁵ Other countermeasures have been, or could be, developed, although a Defense Science Board task force concluded a decade ago that, “The sophisticated Air Force countermeasures programs have been abandoned and those skills now are supporting MDA [Missile Defense Agency] initiatives. The ability to develop maneuvering vehicles, control observables, and negate defenses has been lost in the ICBM program and would require significant growing pains to reconstruct.”³⁶

Two other counters also might be pursued. Over the longer run, strategic missiles might be armed with hypersonic boost-glide vehicles, which can maneuver over much of their flight paths, making them difficult targets for interceptors. Such vehicles have been investigated as part of the program to develop prompt global strike systems with nonnuclear payloads, but they could be armed with nuclear weapons.³⁷ A fourth option would be defense suppression—attacks against critical nodes of the defensive system itself in order to reduce its effectiveness.

Bombers. The New START-compliant force of 41 deployed B-52H and 19 deployed B-2 bombers will operate from just three main bases: Minot AFB, North Dakota (B-52Hs); Barksdale AFB, Louisiana (B-52Hs); and Whiteman AFB, Missouri (B-2s).³⁸ Like the bases for SSBNs, bomber bases represent soft targets. Unlike a part of the SSBN fleet and nearly all of the ICBMs, no aircraft in the bomber force currently are kept on day-to-day alert.³⁹ During the Cold War, one-third to one-half of bombers were maintained on ground alert in peacetime, ready to take off within 15 minutes, but this alert posture ended in September 1991, a month after an abortive coup in Moscow and three months before the Soviet Union disintegrated.⁴⁰

Bombers today do, however, routinely conduct rapid-launch exercises to minimize the time needed for multiple aircraft to take off from a base.⁴¹ If necessary, a portion of the bomber force and supporting aerial tankers could be returned to ground alert in a matter of days.⁴² As another survivability measure, bombers could be dispersed during a crisis to alternative airfields in the United States, if adequate nuclear-certified security forces and maintenance personnel are retained to support operations from such locations.⁴³

Because of their potential vulnerability to integrated air defenses with long-range surface-to-air missiles and advanced interceptor aircraft, B-52H bombers in nuclear missions would be armed with air-launched cruise missiles, which the aircraft could deliver without penetrating defended airspace.⁴⁴ In the years ahead, the continued survivability, as well as reliability, of the missile itself, the ALCM-B, will be in question. In the stark judgment of one official, “extensive surveillance data shows that as a result of aging and increasingly capable foreign air defense systems, the ALCM will soon no longer meet military requirements, and thus, a new replacement missile is needed to meet those requirements.”⁴⁵ The 1980s-vintage ALCM-B currently is undergoing its third service life extension program, which will keep it in the force through 2030.⁴⁶ At that time, the planned LRSO missile will begin replacing it, assuming no delays in the current schedule.

The LRSO missile is intended to ensure that into mid-century the bomber force “can continue to hold high value targets at risk in an evolving threat environment, to include targets within an anti-access environment.”⁴⁷ Few details about the missile have been released, so the attributes that will give it better in-flight survivability than the ALCM-B are a matter of speculation. One source reports the missile will incorporate “the latest stealth features.”⁴⁸ Supersonic or hypersonic speed also could aid penetration of defenses.⁴⁹

The B-2 bomber at present is the “only long-range strike aircraft capable of penetrating advanced Integrated Air Defense Systems to deliver weapons against heavily defended targets.”⁵⁰ But the “combat edge” of even the low-observable (stealthy) B-2 “is being challenged by proliferating next generational air defenses.”⁵¹ To help maintain the penetration capability of the B-2, the Air Force has under way the Defensive Management System Modernization program, which will increase the coverage and sensitivity of the system in detecting, identifying, and locating ground-based and airborne radars in sophisticated air defense networks; give bomber aircrews better situational awareness of the threat; and improve the ability of crews to avoid, engage, or negate defenses.⁵² Other ongoing projects seek to “decrease low observable (LO) maintenance, and maintain and improve the combat-ready signature of the B-2 fleet ensuring survivable combat operations.”⁵³ Over the long run, the B-2 will be capable of delivering the LRSO missile, which will reduce its exposure to air defenses as well as give it a means of suppressing those defenses from standoff distances, thereby aiding penetration missions.⁵⁴ (US bombers in the Cold War carried supersonic short-range attack missiles for use against enemy air defense sites.)⁵⁵ And, as in the Cold War, ballistic missile attacks might be planned to disrupt parts of the defense before bombers arrived.⁵⁶

Like the B-2, the next-generation B-21 bomber will be an aircraft with low-observable features, including its flying-wing configuration.⁵⁷ Details about the survivability and most other aspects of the bomber remain cloaked in secrecy. According to a deputy assistant secretary of defense for nuclear and missile defense policy, the B-21 will be, not surprisingly, stealthier than the B-2.⁵⁸ The better low observability will make the new bomber, in the judgment of a STRATCOM commander, “highly survivable.”⁵⁹ The “open architecture” that is part of the B-21 design will contribute to the resilience of the bomber against improvements in opposing air defenses. As Air Force officials explain:

Sustainment of this aircraft during its service life of 30+ years is a key element of the acquisition strategy, which is why the [B-21] is being designed to have open system architecture as its cornerstone. By implementing Modular, Open Systems Architecture (MOSA) methods, development cycle times for future upgrades are shortened; enabling the platform to rapidly adapt as the threat and/or technology changes.⁶⁰

As with the B-52H and B-2, the ability of the B-21 to employ the LRSO missile against targets in heavily defended areas will aid the in-flight survivability of the bomber. Overall, the Air Force argues, the B-21 “will form the backbone of our future deterrence and strike capability and restore critical capabilities eroded by the proliferation of modern air defenses.”⁶¹

The Triad. The foregoing discussion of force survivability can be summarized as follows. Between now and the 2080s, the survivability of SSBNs on patrol should remain high—if no major breakthrough in ASW occurs, *Columbia*-class submarines succeed those of the *Ohio* class, and

the planned fleet size suffers no significant reduction. Decreases in the number of silo-based ICBMs or the appearance of advanced nonnuclear capabilities for counter-silo attack could diminish the prelaunch survivability of the ICBM force. As insurance, other options for protecting GBSD missiles subsequent to their initial silo deployment could be left open, including the addition of BMD coverage or a shift to an alternative fixed or mobile basing mode. A launch-under-attack capability should be retained as part of the deterrent to a first strike. Maintaining ICBM and SLBM survivability against more effective missile defenses may require adding more reentry vehicles on missiles, using penetration aids, or arming missiles with maneuvering reentry vehicles. Current and future bombers when on alert should be capable of escaping attacks on their bases. Their postlaunch survivability will depend on whether bombers hold the advantage in the continuing offense-defense competition with the capabilities intended for their interception. Without programmed upgrades in the B-2, acquisition of the LRSO missile, and entry of the B-21 into the force, bombers appear less likely to have the edge.

The survivability of the triad as a whole is greater than that of each leg by itself, a quality that is essential to the resilience of the strategic nuclear force. In combination, SSBNs, ICBMs, and bombers are advantageously redundant and mutually reinforcing for force survivability. (Already mentioned in this regard is the value of hundreds of silo-based ICBMs in complicating any first-strike plan of an adversary, and the potential use of ballistic missiles to suppress air defenses that could otherwise impede US bombers.) The different triad legs are not all vulnerable to the same opposing offensive or defensive capability. Ballistic missile attack cannot destroy SSBNs at sea or bombers on rapid-launch alert. ASW cannot threaten ICBMs or bombers. Air defense is directed primarily against air-breathing systems, and missile defense against ICBMs and SLBMs, despite overlap between the two types of defense. As a consequence, an adversary hoping to undercut the credibility of the US deterrent cannot concentrate planning, investment, and capabilities on defeating submarines alone, bombers alone, or ballistic missiles alone, but instead must pursue a more difficult, diversified and diffuse approach in attempting to deal with all three legs. At the same time, if one leg develops a prevalent technical problem or confronts a serious force vulnerability, the other two legs can continue to provide deterrent cover while a remedy is sought.

After pointing out that “the United States relies on fewer types of nuclear weapon systems than in the past,” the first Nuclear Posture Review concluded, “Hedging against system failure of a leg of the triad—either because of technical failure of a delivery platform or warhead, or technological breakthroughs by potential adversaries—is a primary reason to retain a triad.”⁶² The same can be said more than two decades later, but now with even greater force because of the significant improvements in offensive and defensive capabilities that Russia and China are pursuing.

Dual-Capable Aircraft. In addition to nuclear-capable B-52H and B-2 heavy bombers, the United States has shorter-range strike aircraft capable of delivering either nuclear or conventional weapons. These dual-capable F-15E and F-16 aircraft are based in the continental United States (CONUS) and in Europe. If necessary, the aircraft in the United States, along with their nuclear bombs, could be deployed “globally” to support the defense of allies in, for example, Northeast Asia or the Middle East.⁶³ The other aircraft and their nuclear bombs long have been deployed in Europe for the defense of NATO. Nuclear bombs under US control are located at six bases in five NATO-Europe countries, according to information cited in a Congressional Research Service report.⁶⁴

As in the case of CONUS-based heavy bombers, the bases for dual-capable aircraft and their bombs may be vulnerable to attack. Russian ballistic missiles, for example, “are an incredibly capable platform that can negate our ability to use airfields and runways” in NATO-Europe, even when the missiles are armed with nonnuclear warheads.⁶⁵ Placing dual-capable aircraft on alert would be one way to increase their prelaunch survivability. During the Cold War, a portion of US and allied dual-capable aircraft in Europe were kept on “peacetime quick-reaction alert, capable of launching within minutes.” Additional aircraft could have been put alert in a crisis or conflict.⁶⁶ Currently, no aircraft are maintained on day-to-day alert.⁶⁷ The United States and other NATO countries with dual-capable aircraft are, however, “required to maintain the ability to be on alert for nuclear operations within a 30-day, 180-day, or 365-day period.”⁶⁸ Crisis dispersal of the aircraft to alternate airfields might be another possibility for reducing their vulnerability.⁶⁹ A reorientation and strengthening of active defenses also may have the potential to make the nonstrategic nuclear force more survivable against air and missile strikes.⁷⁰

Dual-capable F-15E and F-16 aircraft and their force packages could encounter difficulty in penetrating Russian air defenses. “From the Barents Sea to the Baltic Sea to the Black Sea to the Mediterranean,” Russia is creating an anti-access, area-denial zone, comprising an integrated air defense system with modern long-range surface-to-air missiles and advanced interceptor aircraft, that is “as significant in Europe as it is anywhere else on the planet.”⁷¹ So-called “fourth-generation” fighter aircraft, a category that includes F-15Es and F-16s, are “increasingly unable to operate in highly contested environments where advanced air defense systems render them ineffective.”⁷² Changes in tactics and training to a certain extent could diminish this vulnerability.⁷³ The in-flight survivability of the nonstrategic nuclear force will improve more when F-35A dual-capable aircraft equipped to deliver B61-12 bombs become available in 2024.⁷⁴ The F-35A, a “fifth-generation” aircraft, will be better able to penetrate Russian air defenses because of its “multi-spectral, low observable (LO) design features,” “self-protection and radar jamming capabilities,” and “integrated avionics, which autonomously fuse and prioritize the aircraft’s multi-spectral sensors and off board data, providing an accurate real-time operations picture for the pilot.”⁷⁵

Suitable Range

SLBMs, ICBMs, and bombers have the ranges needed to reach targets in Eurasia, where potential adversaries are located. The Trident D5 SLBM has a range greater than 4,000 nautical miles (nm), and the ability of its delivery platform, the *Ohio*-class submarine, to fire the missile from forward launch points effectively adds to its range.⁷⁶ The current average loading of four reentry vehicles per D5, rather than the eight the missile can carry, benefits range;⁷⁷ conversely, uploading reentry vehicles could incur a range penalty. The range for the follow-on SLBM, projected to enter service in the 2040s, has not been made public and perhaps has not yet been determined. Since each of the SLBM types deployed by the United States over the past half century has had a range at least as great as that of its predecessor, it seems likely that the follow-on missile will be able to fly at least 4,000 nm.⁷⁸

An Air Force fact sheet lists the range of the Minuteman III ICBM as greater than 5,200 nm; another Air Force source gives the range as 6,900 nm.⁷⁹ The downloading of the Minuteman III from three reentry vehicles per missile to one is advantageous for range. The range of the successor to the Minuteman III, the GBSD missile, has not been revealed. If the reported ranges

of previous US ICBM types are any guide, that of the next-generation missile should be somewhere between 5,500 and 7,000 nm.⁸⁰

The B-52H bomber has an unrefueled range of some 7,600 nm.⁸¹ The ALCM-B missiles with which the aircraft would be armed have a range of more than 1,500 nm.⁸² The other nuclear-capable bomber in the force, the B-2, can fly approximately 6,000 nm unrefueled.⁸³ At present, the B-2 would carry a nuclear payload of gravity bombs and no standoff missiles.⁸⁴ Both bombers can be refueled in flight, which makes their ranges, as the Air Force puts it, “unlimited.”⁸⁵ The range of the future B-21 bomber has not been released. Given that the B-21 is intended to perform missions now assigned to B-52H, B-2, and B-1B (6,000-nm range) bombers, it seems likely that it also will have an unrefueled range of a few thousand nautical miles.⁸⁶ The B-21, B-2, and B-52H all will be capable of delivering the LRSO missile.⁸⁷ Its range, too, has not been released. The range of the ALCM-B and that of the retired Advanced Cruise Missile (1,700+ nm) may offer some indication of the meaning of “long range” in Long-Range Stand-Off missile.⁸⁸

The approximate unrefueled ranges of the F-15E and F-16 are 2,000 nm and 1,600 nm, respectively.⁸⁹ Aerial refueling would extend range. Long-term or temporary deployment to overseas bases reduces the distance the aircraft must fly to reach locations within the territory of hostile powers. Shorter-range, nuclear-capable aircraft have been based in NATO-Europe since the 1950s and in the past also were based in East Asia.⁹⁰ The dual-capable aircraft now in Europe have ranges sufficient to hold Russian targets at risk. The same will hold true for the nuclear-capable F-35A when that aircraft is deployed to NATO bases. The F-35A has an unrefueled range in excess of 1,200 nm and an in-flight refueling capability.⁹¹ The F-15E and F-16 today are capable of delivering three “tactical” variants of the B61 gravity bomb (Mods 3, 4, and 10) and no standoff weapons.⁹² In the future, the older aircraft and the F-35A will be able to carry the B61-12, a gravity bomb with “a modest standoff capability, for safe aircraft escape” after weapon release.⁹³

Ability to Forward Deploy

Two of the three triad legs—bombers and SSBNs—have the mobility and operating range to deploy from their bases in the continental United States to distant overseas locations for the purposes of better deterring foes and assuring friends. Even when forward deployed without nuclear weapons and when no explicit nuclear deterrent threat is made, nuclear-capable bombers are still seen by adversaries, allies, and other observers as part of the strategic nuclear force and a manifestation of US nuclear might. As such, bombers sent abroad can demonstrate the coverage of the nuclear umbrella, underscore commitments to the security of allies, and warn opponents of the grave consequences of aggression. Through port calls, SSBNs can serve the same objectives.

Bombers. Many instances of forward deployments by nuclear-capable bombers have occurred during the past seven decades. An early example was the use of bombers as part of the response to the 1948 Berlin blockade. After the Soviet Union restricted allied access to the occupied city, the United States dispatched B-29 bombers to Germany and Britain as a show of resolve; the bombers were of the same type used in the atomic bombings of Japan.⁹⁴ With this forward deployment, “the shadow of deterrence had crossed the Atlantic,” notwithstanding the fact that the particular bombers involved were not atomic armed.⁹⁵

From the early 1950s to the early 1960s, Strategic Air Command (SAC) B-47 medium bombers and aerial tankers routinely carried out rotational training assignments from main bases in the United States to forward bases in Britain, Spain, Morocco, and Guam. (When the B-47s were phased out, they were replaced by B-52 bombers on Guam, but not at the other locations.) While each overseas deployment lasted a few days to a few months, the rotations in the aggregate established a long-term forward presence.⁹⁶ With regard to the assurance of allies, the rotational missions brought part of the US strategic nuclear deterrent closer, in both reality and perception, to allies in Europe and Asia. In terms of deterrence, the deployments “allowed SAC to further disperse its forces, thereby complicating Soviet targeting, while simultaneously positioning its strike force closer to the Soviet Union.”⁹⁷

In the early 1990s, following the end of the Cold War, the United States began a program of “long-range (out-of-CONUS) ‘show the flag’ bomber training missions designed to support our allies and deter potential enemies.”⁹⁸ For these “Global Power” missions, B-52, B-2, and B-1B bombers have made nonstop, round-trip flights from CONUS bases to points overseas, or taken off from CONUS bases, landed at forward operating locations abroad, and subsequently returned to their home stations. The missions generally have included the release of live or inert conventional weapons at overseas ranges.⁹⁹ During the missions, bombers have trained, exercised, and operated with the forces of allies and partners, cooperation which, like the sheer presence of the impressive combat aircraft, has assurance value. Countries to which Global Power missions have been flown include Britain, Norway, Denmark, Egypt, Jordan, Saudi Arabia, Bahrain, Thailand, Singapore, Australia, South Korea, and Japan.¹⁰⁰

In more recent years, bombers also have carried out “Bomber Assurance and Deterrence” (BAAD) deployments. For one of these deployments, three B-2 bombers in August 2016 flew to Guam to “conduct local and regional training sorties” and “integrate capabilities with key regional partners” in the US Pacific Command area of responsibility.¹⁰¹ This BAAD deployment was described as “part of a long-standing history of maintaining a consistent bomber presence in the Indo-Asia-Pacific in order to maintain regional stability, and provide assurance to our allies and partners in the region.”¹⁰² Approximately one year before the B-2 deployment in the Pacific, the commander of US European Command (EUCOM) tied BAAD missions in his area of responsibility to Operation Atlantic Resolve (activities to assure NATO allies of the US security commitment in the wake of Russian intervention in Ukraine) and to “maintaining the U.S. nuclear deterrent with NATO allies.” “The U.S. stands side-by-side with our NATO Allies to provide safe, secure, reliable and effective nuclear forces to deter aggression against Alliance members,” Gen. Philip Breedlove said to a congressional committee. “EUCOM and STRATCOM work closely together,” he continued, “to provide U.S. leadership options to assure our Allies of our commitment, and as part of Operation ATLANTIC RESOLVE, EUCOM has forged a link between STRATCOM Bomber Assurance and Deterrence missions to NATO regional exercises.”¹⁰³ BAAD deployments are not limited to the PACOM and EUCOM areas. B-52H and B-2 bombers “exercise with every combatant command and every joint partner annually” through BAAD missions.¹⁰⁴

Nuclear-capable bombers have been used for deterrent and assurance purposes in response to provocative acts or outright aggression by North Korea, China, and Russia. For example, in March 2013, following a number of menacing messages and moves by North Korea, including a third nuclear test, B-52H and B-2 bombers flew nonstop, round-trip missions to South Korea, where the aircraft conducted mock bomb runs as displays of force to support Seoul and warn Pyongyang.¹⁰⁵ Then-Deputy Secretary of Defense Ashton Carter, who was in the South Korean

capital at the time, made explicit in public remarks the connection between the bomber missions and the US nuclear guarantee to the South:

We've remained steadfast to our commitment to extended deterrence offered by the U.S. nuclear umbrella and will ensure that all of its capabilities are available to the alliance. For example, I should note the presence of strategic bombers taking place in flight training in the Korean peninsula area in particular, for example, but this is routine, there will be a B-52 flight tomorrow.¹⁰⁶

The March 2013 bomber missions, along with a similar January 2016 B-52H low-level flight a few days after the fourth North Korean nuclear test, have been one way of meeting the South Korean request for “visible and tangible displays” of the U.S. ability to make good on [its] commitment to maintain the capability to deploy nuclear weapons in time of crisis.”¹⁰⁷

Later in 2013, nuclear-capable bombers appear to have been used to make clear US opposition to Chinese aggrandizement and to show support for Japan. In November, Beijing unilaterally declared an Air Defense Identification Zone (ADIZ) covering a large part of the East China Sea. The ADIZ included the airspace over the Senkaku Islands, which are administered by Japan but claimed by China. The establishment of the ADIZ was seen as an attempt to strengthen the Chinese claim of sovereignty. China warned that it might take military action if aircraft entered the zone without notification. The United States refused to recognize the ADIZ. Days after the Chinese declaration, two B-52H bombers on a Global Power training mission flew through the ADIZ, following standard procedures by “not filing flight plans, not radioing ahead and not registering [their] frequencies.”¹⁰⁸ The bombers were observed but not opposed by the Chinese military. A senior Defense Department official described the bomber mission as “a demonstration of long-established international rights to freedom of navigation and transit through international airspace.”¹⁰⁹ The US response was “strongly praised” by many Japanese.¹¹⁰

Bombers recently have also participated in exercises apparently meant not only to improve aircrew proficiency and the interoperability of the aircraft with other forces, but to bolster allies on the eastern flank of NATO and discourage Russian efforts to threaten those countries. Since the Russian annexation of Crimea, bombers have been part of the annual Baltops, Sabre Strike, and Ample Strike exercises in Central and Eastern Europe. In the Baltops exercises, which are mostly maritime in nature, B-52Hs have simulated low-level minelaying missions over the Baltic Sea. In the related Sabre Strike exercises, which practice close air support in Latvia, Lithuania, and Poland, B-52Hs have dropped inert weapons at a range in Latvia in coordination with a forward air controller from that country.¹¹¹ For Ample Strike exercises, which also involve close air support but are held in the Czech Republic, B-52Hs, along with B-1Bs, have conducted “day and nighttime operations to improve NATO and partner nation interoperability.”¹¹² The commander of a bomber unit that was part of one of the exercises called it “a great opportunity to assure our allies in addition to deterring any strategic attacks as well.”¹¹³ After examining some of these and other recent bomber exercises in and around Europe, an analyst at a Polish government-affiliated research institute suggested:

New forms of NATO “collective” nuclear exercises could...involve U.S. strategic bombers. A unique benefit of such exercises would be that they could provide NATO with a proportional response to Russia’s bomber activities. Bomber presence is more visible to the public and outside world than DCA. Its nuclear dimension, while it cannot be

overlooked, can be denied by NATO, which in some circumstances could be a preferable option for NATO Allies.¹¹⁴

Forward deployment of nuclear-capable bombers for such exercises would reinforce the link between the US strategic nuclear deterrent and the defense of NATO-Europe. At the same time, the dual capability of B-52H and B-2 bombers would allow US and allied leaders to modulate the nuclear signal sent by the aircraft, depending on the respective needs for deterrence and assurance within the political-military context of a given exercise.

For the deployments involved in Global Power flights, BAAD missions, and overseas exercises, bombers have used as forward operating locations the Royal Air Force base at Fairford in Britain, the US Naval Support Facility on the Indian Ocean island of Diego Garcia, and Andersen Air Force Base on Guam. On Guam, a “continuous bomber presence” of roughly six aircraft, generally B-52Hs, has been maintained for more than a decade through rotations from CONUS bases.¹¹⁵ The purpose of the presence on Guam is “to bolster U.S. commitment to the security and stability of the Asia-Pacific region, while allowing units to become familiar in operating in the theater from a deployed location.”¹¹⁶ The United States also would like to make greater use of bases in northern Australia, where bombers have flown as part of exercises with the Royal Australian Air Force (RAAF).¹¹⁷ “The idea,” a Pacific Air Forces commander has said, “is much like [what] we do in Guam...rotation of tankers and bombers to do training and working with our Australian allies as well as training our pilots and air crews.” The RAAF bases are Darwin and Tindal.¹¹⁸ In the Mideast, B-52H bombers in April 2016 deployed to the Al Udeid Air Base in Qatar to join operations against the terrorist group Islamic State in Iraq and Syria. There they, along with B-1B bombers, will support another continuous bomber presence mission.¹¹⁹ Like the bases used for the B-47 rotations a half century ago, the forward operating locations of today are part of the overseas presence nuclear-capable bombers provide for deterrence and assurance.

Unless forward deployments might reveal or otherwise compromise its low-observable features, it would seem the B-21 should be as capable as the B-2 and other bombers of flights to, and temporary basing at, foreign locations. Its status as an advanced strategic weapons system likely would enhance the effect of any display of force for the deterrence of adversaries and the assurance of allies.

SSBNs. US ballistic missile submarines forward deploy each time they leave their bases to conduct patrols. Because the at-sea survivability of SSBNs depends in part on the submarines remaining hidden from detection by adversaries, their patrols lack the visibility of bomber flights to foreign locations. Nonetheless, SSBNs have made port calls that, whether intentionally or not, support the objectives of deterrence and assurance.

An exemplary case was the April 1963 visit of *U.S.S. Sam Houston* to the Turkish port of Izmir, the first time a ballistic missile submarine had been to a foreign port other than the US SSBN base then at Holy Loch, Scotland. The call by *Sam Houston* was part of a package of measures to reassure Ankara of the US nuclear guarantee after the Kennedy Administration decided to withdraw nuclear-armed Jupiter missiles from Turkey as part of the resolution of the Cuban missile crisis several months earlier. According to one source, the SSBN was welcomed enthusiastically by the Turks, with one Ankara newspaper running the headline, “Submarine Which Scares Soviets Is In Izmir.”¹²⁰

In December 1976, *Sam Houston* again appeared at a foreign port, this time Jinhae, South Korea. It was the second SSBN visit to a foreign port and the first one to a port in the Asia-Pacific region. Over the next five years, that submarine and eight other SSBNs made a total of 35 visits to Jinhae.¹²¹ While the port calls to South Korea ended in 1981, SSBNs reportedly continued to make “occasional visits...in Europe, the Caribbean, and Pacific during the 1980s and 1990s.”¹²²

Until recently, the last SSBN port call occurred in 2003. Security concerns were one reason for their absence. As a former commander of US Submarine Forces has explained, “the thinking after the Sept. 11 attacks was that subs were too special to assume any risk at all.”¹²³ Nuclear-powered guided missile submarines (SSGNs)—SSBNs converted to carry conventional cruise missiles—were, however, used during this time as instruments to demonstrate US forward presence. The *U.S.S. Ohio* SSGN, for example, originally the lead ship of the *Ohio*-class SSBNs, visited the South Korean port of Busan during its initial deployment in the Pacific in early 2008. Upon arrival in South Korea, where the SSGN participated in a joint exercise, its commanding officer said, “The Korean-American relationship is very important, and visiting Busan gives us the opportunity to strengthen that relationship” and to “emphasize our shared dedication to supporting regional stability.”¹²⁴

In September 2015, the SSBN *U.S.S. Wyoming* visited the naval base for British ballistic missile submarines at Faslane, Scotland. The visit was intended to assure the British and other European allies of the US security commitment, and apparently to add to the NATO responses to Russian aggressiveness. A statement issued by STRATCOM said the visit “demonstrates the closeness of the US/UK defense relationship and our commitment to the collective security of all NATO member states.”¹²⁵ A US defense official cited “strategic assurance” as an explicit aim of the port call.¹²⁶ The commander of Submarine Forces was less restrained in his description:

...our first SSBN port visit in over a decade to Faslane, Scotland, huge. Talk about showing support with the allies, showing support for NATO, demonstrating to the world that we patrol everywhere in the Atlantic. You don't need to come into our house to find us, because proving that we're up there, that's huge. It's very, very important. We hit the long ball on this one, and we look forward to more.¹²⁷

The then-deputy secretary of defense also noted that allies were not the only intended audience for the *Wyoming* appearance. “These visible examples of the deep cooperation and mutual support between our two countries,” said Robert Work, “do not go unnoticed by our adversaries.”¹²⁸ Along this line, a Scottish newspaper article covering the visit was headlined, “US Defence Send Warning to Putin as Trident Sub Docks on Clyde Armed with Ballistic Missiles.”¹²⁹

In early October 2016, a second SSBN visit to Faslane occurred when *U.S.S. Tennessee* arrived.¹³⁰ Later that same month, another SSBN paid a port call on the other side of the globe when *U.S.S. Pennsylvania* visited Apra Harbor, Guam. A press release by the US Pacific Fleet made clear the purpose of the visit was to assure US friends in the region:

The U.S. routinely and visibly demonstrates commitment to allies and partners through forward presence and operations of strategic forces. This specific visit to Guam reflects the United States’ commitment to its allies in the Indo-Asia-Pacific, and complements the many

exercises, training, operations, and other military cooperation activities conducted between the U.S. and its partner nations.¹³¹

Toward the aim of assuring Asian allies, delegations from Japan and South Korea were given tours of the SSBN during its stay at Guam.¹³²

In the future, *Columbia*-class SSBNs should be as suited as their predecessors for port calls that convey assurance and deterrent messages. A visit by one of the new submarines would display not simply a ship in the SSBN fleet, but a ship whose effectiveness derives from cutting-edge technologies. Their use in this regard may be limited, however, by two factors. First, revived security concerns or fears of revealing too much to observant opponents may affect whether, when, where, or how often visits occur. Second, the smaller size of the *Columbia*-class fleet perhaps could constrain visits. At the time of the Faslane visit, a spokesman for the commander of Submarine Forces noted that there had been “limited flexibility in scheduling [port visits] as the number of ballistic-missile subs [was] down [to 14] from the 18 the Navy had in the 1990s.”¹³³

Dual-Capable Aircraft. As discussed earlier, dual-capable F-15E and F-16 aircraft and associated nuclear bombs are forward deployed at a number of bases in NATO-Europe. The communique issued at the July 2016 NATO summit in Warsaw reiterated that “[a]s long as nuclear weapons exist, NATO will remain a nuclear alliance,” “[t]he strategic forces of the Alliance, particularly those of the United States, are the supreme guarantee of the security of the Allies,” and “NATO’s nuclear posture also relies, in part, on United States’ nuclear weapons forward-deployed in Europe and on capabilities and infrastructure provided by Allies.”¹³⁴ The aircraft and bombs that comprise the nonstrategic nuclear force help anchor the transatlantic link between the United States and NATO-Europe, present a salient and proximate sign of the strong US interest in the security of those countries, offer a tangible assurance that the allies are covered by the nuclear umbrella, counterbalance, to some extent, Russian nonstrategic nuclear capabilities, and create burden-sharing arrangements that strengthen alliance ties. The latter include the aircraft and aircrews certain European countries would provide for the delivery of US-owned and -controlled nuclear bombs, along with the support for nuclear missions other allies would lend in the form of in-flight refueling, suppression of enemy air defenses, search and rescue of downed aircrews, and the performance of additional tasks.¹³⁵

In addition to the nuclear capabilities based in Europe, there is a standing requirement to retain the option to forward deploy to other possible locations dual-capable aircraft and “a small number” of nonstrategic nuclear weapons kept in the United States: “Consistent with Presidential policy guidance contained in PPD [Presidential Policy Directive]-24 [“Nuclear Weapons Employment Guidance”] and the 2010 Nuclear Posture Review, the U.S. [besides in Europe] will also maintain the capability to forward-deploy nuclear weapons with heavy bombers and dual-capable aircraft in support of extended deterrence and assurance of U.S. Allies and partners.”¹³⁶ F-15E and F-16 dual-capable aircraft are available for such missions today, and F-35As, when nuclear certified, should be fully capable of serving in the same role. For forward deployments in regions other than Europe, infrastructure, logistics, and security preparations reportedly would be needed to support the storage of nuclear weapons.¹³⁷

Prompt Response Capability

The ability to hold at risk time-sensitive targets within the territory of an adversary could be of critical importance to deterrence, assurance, and damage limitation. For example, holding at risk launchers with weapons of mass destruction (WMD)-armed missiles that could be fired quickly, and perhaps doing the same for command-and-control facilities with launch responsibilities, could help deter by persuading an adversary contemplating an attack that the operation would fail. If the missiles menaced one or more US allies, or if they threatened the United States and thereby would, if left unchecked, inhibit US action to meet security commitments to those allies, then the ability to hold the missiles at risk also would have assurance value. If deterrence were to fail, then the capability for a prompt response against the missiles with their launchers could help in some scenarios to limit the damage the adversary would otherwise be able to inflict on the United States and allied countries.

Prompt response in part is a matter of the time needed to assess the situation, select an existing response option or plan a new one, and transmit the order to the forces charged with executing the response. The process is complex and not discussed authoritatively in open sources, so this aspect of prompt response will not be addressed here.

The readiness of forces to carry out their assigned tasks is another factor in prompt response capability. As covered earlier, virtually all ICBMs and a number of SSBNs are on day-to-day alert. No bombers are routinely on alert. In a period of heightened tensions, bombers could be placed on ground alert and additional SSBNs that were in port but not in overhaul could put to sea and go on alert.

Launch-to-target time is a third element of prompt response capability. Traveling at high hypersonic speed, ICBMs could cover intercontinental distances in roughly 30 minutes. SLBMs could reach targets in that time or less, depending on target location, SSBN launch position, and missile trajectory. With their subsonic speeds, bombers and bomber-carried cruise missiles on missions from CONUS bases would likely have launch-to-target times measured in hours rather than minutes. As a consequence, ICBMs and SLBMs are considered the triad legs most capable of prompt response.

Using short launch-to-target time as the measure of merit, the 2018 New START-constrained strategic nuclear force will have significant prompt response capability, with approximately 960 warheads on 240 deployed SLBMs and 400 warheads on 400 deployed ICBMs. (This assumes circumstances in which all 10 operational SSBNs had been sent to sea and were ready to launch.) The combined number of ballistic missile warheads will be two-thirds of the total number of warheads. The other third will comprise an estimated 800 cruise missiles and gravity bombs that, with enough time, could be uploaded on bombers, if all the dual-capable B-52Hs and B-2s were available for nuclear missions. (These numbers are derived from the data in Table 1.) Whether this significant amount would be sufficient for deterrence and damage limitation would depend in part on the nature of possible contingencies, US objectives, response options, target systems, adversary perceptions and values, interactions between US and adversary offensive and defensive capabilities, and conflict outcomes—the analysis of which is beyond the scope of this discussion.

If, in accordance with the current strategic nuclear modernization plan, the 2030s see GBSD missiles replace Minuteman III ICBMs and *Columbia*-class submarines supersede *Ohio*-class SSBNs, there could be somewhere between 1,040 and 2,480 warheads on deployed ballistic missiles available for prompt response, as compared with the approximately 1,360 SLBM and ICBM warheads in 2018. In addition to the conditions cited above, this estimate assumes the following: no particular arms control limits; 10 operational *Columbia*-class SSBNs, each with 16 Trident D5 LE (Life Extension) SLBMs, and all missiles armed with either four or eight warheads; and 400 deployed GBSD ICBMs, with all missiles carrying either one or three warheads. If the bomber force had some 500 LRSO missiles and, say, an equal number of gravity bombs, prompt-response warheads would represent one-half to two-thirds of the warhead total for deployed ballistic missiles and bombers. Note that some data are drawn from Table 4.

With regard to the US nonstrategic nuclear force, the shifting of dual-capable aircraft in Europe to an alert status when conditions warrant would support the capability for prompt response, although the time involved in the change could exceed the length of a rapidly escalating nuclear crisis, especially if the decision to order the alert is not made in a timely manner. F-16 and F-15E dual-capable aircraft have supersonic maximum speeds in the 1,000 knots (Mach 1.5) to 1,500 knots (Mach 2) range, and cruise speeds around 500 knots (Mach .75). Corresponding speeds for nuclear-certified F-35As reportedly will be roughly comparable.¹³⁸ Unless nuclear missions by dual-capable aircraft were flown entirely at maximum speeds—which would be an impracticality—launch-to-target times from bases in Europe to points in Russian territory would be measured in hours rather than minutes.

Variable Payloads

Both the number and types of weapons—gravity bombs, standoff missiles, or reentry vehicle warheads—can be changed on bombers or ballistic missiles; penetration aids for countering defenses likewise can be added to or removed from bomber or ballistic missile payloads. Since its initial deployment a half-century ago, the B-52H, for example, has been armed with several types of nuclear bombs and three types of nuclear-armed air-to-ground missiles—the LRSO missile will be a fourth. During its shorter service life, the B-2 has been capable of carrying three types of nuclear bombs; the B61-12 will be a fourth, and the LRSO missile will be the first standoff missile for the bomber. Trident D5 SLBMs have had two types of warheads. The warhead with which the Minuteman III ICBM originally was deployed later was joined by a second type and then replaced by a third, one which had armed the Peacekeeper ICBM before that missile was retired.¹³⁹ Current ICBM and SLBM warheads are planned to be replaced by the three types of interoperable warheads during the 2030s and 2040s.¹⁴⁰ All bomber weapons were downloaded and placed in storage facilities when ground alert for the bomber force ended in 1991; if necessary, stored weapons could be uploaded on some or all nuclear-capable bombers.¹⁴¹ To comply with arms control limits, each Minuteman III ICBM has been downloaded from three warheads to one, and the average number of warheads for Trident D5 SLBMs now is four rather than the eight each missile can accommodate.¹⁴² Missile warheads, too, are kept in storage and could be used to upload ICBMs or SLBMs.¹⁴³ Tables 1 and 4 include payload data for SLBMs, ICBMs, and bombers, now and in the future.

Because both the weight and volume of their payloads are less constrained than those of ballistic missiles, bombers have an advantage in the number and types of weapons they can carry. The B-52H payload is 50,000 pounds and that of the B-2 is 40,000 pounds.¹⁴⁴ The payload of the B-

21 has not yet been disclosed. In contrast, the throw-weights of the Trident D5 SLBM and Minuteman III ICBM are 6,200 pounds and 2,500 pounds, respectively.¹⁴⁵ The throw-weight of the GBSD ICBM is not publicly available. Air Force analyses have “focused on a replacement system that reflects a missile similar in size to the Minuteman III” and that “will use the existing Mk12A and Mk21 in the single and multiple RV configurations.”¹⁴⁶ To carry multiple Mk21 RVs, each of which reportedly is “larger and heavier” than the Mk12A, the GBSD ICBM would likely require more throw-weight than that of the Minuteman III missile.¹⁴⁷ Because the launch tubes of the *Columbia*-class SSBN will be of the same size as those of the *Ohio*-class submarine, a new SLBM mentioned for deployment in the 2040s and beyond may have a throw-weight similar to that of the Trident D5 missile it would be intended to replace.¹⁴⁸ As regards payload volume, the space within a bomber weapons bay is considerably less confined than that under a missile nose cone. As a consequence, bombers can carry more, larger, and more varied weapons. These could include now-unforeseen advanced weapons developed decades in the future.

Flexibility. Variable payloads, in combination with the diversity of delivery systems within the nuclear force, are valuable for a number of reasons. First, they lend flexibility to the force. Bombs and warheads can be better matched to missions and targets than otherwise would be the case. This helps make possible a range of response options to support deterrence and assurance in different sets of circumstances and to limit damage in the event deterrence fails and conflict ensues.

As part of the 3+2 strategy outlined earlier, the B61-11 bomb will be retired near the end of the 2020s.¹⁴⁹ It was developed in the mid-1990s, “to ensure a capability to continue to hold selected deeply buried targets at risk.”¹⁵⁰ Today the use of underground facilities to “increase the survivability of weapons of mass destruction, strategic command and control, leadership protection and relocation, military research and development, military production and strategic military assets” is “widespread and expanding,” including use by potential adversaries.¹⁵¹ Officials have said deployment of the more accurate, lower-yield B61-12 guided gravity bomb will allow the retirement of the B61-11.¹⁵² Unlike the B61-11, however, the B61-12 bomb reportedly is not designed as an earth-penetrating weapon that can pose a deterrent threat to deeply buried targets. As a consequence, flexibility may be adversely affected by the elimination of the B61-11 from the nuclear stockpile. This may be significant because, in some plausible cases, the US capability to “hold selected deeply buried targets at risk” may be essential for effective deterrence.

Delivery System Effectiveness. The ability to maintain or improve the effectiveness of an existing delivery system by changing the weapons it carries is a second advantage of variable payloads. This, too, is a source of flexibility and also contributes to the resilience of the nuclear force against adverse developments. For example, the addition of the B61-11 bomb to the weapons the B-2 could carry made the bomber better able to hold at risk hard and deeply buried targets. It also made possible the retirement of the B53 bomb, a much higher-yield (nine megatons), less-safe, and harder-to-deliver weapon carried by the B-52, which was increasingly vulnerable to air defenses.¹⁵³ Similarly, the ALCM-B since its entry into service in the early 1980s has been critical to retention of the venerable B-52 in a nuclear role. In the future, the LRSO missile, the planned replacement for the ALCM-B, which now has reliability, availability and survivability problems of its own, will be required to “sustain the nuclear role of our aging B-52 bomber fleet, and will enhance the survivability and extend the useful service life of the current B-2 and the next-generation B-21 stealth bomber when its ability to go undetected eventually

degrades.”¹⁵⁴ These are reasons why LRSO can reasonably be considered an essential element of the US modernization program.

Changes in ballistic missile payloads also have proved useful. One example is the transfer some years ago of W87 warheads from retired Peacekeeper ICBMs to part of the Minuteman III force. The W87 warhead reportedly has a higher yield than that of the W62 it replaced and, consequently, could be capable of holding a broader range of targets at risk for the purposes of deterrence and damage limitation. Moreover, it meets modern standards of warhead safety set after the deployment of the W62.¹⁵⁵ As another example, the aforementioned downloading of all Minuteman III missiles to a single warhead each can aid flexibility. While a ballistic missile with multiple warheads would have to deliver all of those weapons against aimpoints within a particular elliptical area (or “footprint”), each single-warhead Minuteman III could threaten just one target located anywhere within a much larger area. With this flexibility, the single-warhead missiles could support planned deterrent options involving small numbers of targets or options prepared ad hoc. While the payloads of bombers likewise could be adjusted for single targets, the aircraft lack the prompt response capability of ICBMs.

Downloading and Uploading Weapons. The third way in which variable payloads are advantageous is by making it possible to download operationally deployed weapons to meet arms control limits, to retain force structure (SSBNs, ICBMs, and bombers) as weapon loadings are thus reduced, and to upload nondeployed weapons if adverse changes in US nuclear forces or the security environment occur. Such changes could include arms control setbacks, major technical problems with deployed weapons or delivery systems, emergence of significant operational vulnerabilities, or heightened risk of confrontation with another nuclear-armed power. The 1994, 2001, and 2010 Nuclear Posture Reviews all endorsed weapon downloading as one means of implementing arms control agreements (START II, the Moscow Treaty, and New START) and weapon uploading as a hedge, particularly against “return to an authoritarian military regime in Russia hostile to the United States” (1994 NPR), “re-emergence of a hostile peer competitor” (2001 NPR), or “a geopolitical surprise” (2010 NPR).¹⁵⁶

Arms reductions through downloading can be preferable to cuts in force structure, which could diminish the survivability and flexibility of the force, and therefore its deterrent and assurance effects, and could require decades to reverse if proved unwise. The option to upload is a source of resilience through which deterrence, assurance, and capabilities for damage limitation can be sustained in the face unfavorable developments. The ability and readiness to upload weapons could help deter as well as respond to arms control violations, nuclear-backed coercion, threats of stepped-up nuclear competition, and other aggressive acts. Uploading could involve not only augmenting deployed weapons, but changing the overall weapon mix among the legs of the triad, perhaps adding to the weapons carried by one leg in order to offset an increase in the vulnerability of one or both of the others.

The SLBMs, ICBMs, and bombers of the force planned within the New START limits (see Table 1) will have the capacity to carry many more weapons than the numbers in their usual payloads. On a day-to-day basis, the deployed SLBMs and ICBMs of that force will be loaded with a total of approximately 1,360 reentry vehicle warheads.¹⁵⁷ Gravity bombs and nuclear-armed cruise missiles for the deployed bombers will not be loaded on any of the aircraft, but will be stored in facilities at air bases. The upload capacity of deployed SLBMs and ICBMs would be sufficient for an additional 1,560 reentry vehicle warheads, for a total of approximately 2,900 ballistic missile

weapons. The deployed bombers would have the capacity to be uploaded with an aggregate of 1,124 bombs and nuclear-armed cruise missiles. If fully uploaded, the strategic nuclear force as a whole could in time and in principle be armed with approximately 4,000 weapons.¹⁵⁸

Upload capacity, however, is not equivalent to the number of weapons that actually could be uploaded. The entire nuclear stockpile currently has a total of some 4,000 warheads, which include not only deployed warheads and hedge warheads for the strategic force, but a “few hundred” nonstrategic warheads (B61-3/4/10 bombs) and a significant number of inactive, nonoperational warheads.¹⁵⁹ Consequently, 2,000 or fewer warheads are likely to be available for uploading ballistic missiles and bombers.¹⁶⁰ In addition, the number of a particular weapon type may be less than what would be necessary to take full advantage of the capacity for uploading. Each of the 41 deployed B-52H bombers, for example, would be capable of carrying 20 W80-armed ALCM-Bs, but there are no more than 528 cruise missiles in the inventory, making for an average of 12 or fewer missiles per bomber.¹⁶¹ Similarly, while additional W76 warheads could be uploaded on SLBMs, “[a]ll of the Navy’s W88 warheads are either operationally deployed or retained as spares to be used when deployed weapons are withdrawn for maintenance.”¹⁶²

Based on the information that has been publicly released, a few points can be made about the payload potential of the planned strategic nuclear force of 20 to 30 years hence versus that of the 2018 force. For example, while the fleet of 12 *Columbia*-class SSBNs is expected to have an at-sea presence similar to that of the 14 submarines in the *Ohio*-class fleet, each of the newer submarines will have four fewer Trident D5 LE SLBMs than the 20 missiles of the *Ohio*-class submarine.¹⁶³ (The *Columbia*-class SSBNs may be armed with a follow-on SLBM starting sometime in the 2040s.)¹⁶⁴ Cost savings apparently was a principal reason for 16 rather than 20 missile launch tubes, but this design decision could leave the *Columbia*-class with less resilience (diminished upload potential) between its initial deployment in 2031 and its projected retirement sometime in the 2080s, a 50-year span for which changes in the security environment are impossible to foresee from the vantage point of the present.¹⁶⁵

It is noteworthy that an upload option already has been incorporated in plans for the GBSD ICBM. “The Air Force intends to retain the ability to upload multiple warheads in the Ground-Based Strategic Deterrent,” an Air Force assistant chief of staff for strategic deterrence and nuclear integration informed a congressional committee in early 2015. He went on to explain:

maintaining this capability in the follow-on ICBM is an important aspect of preserving the credibility and effectiveness of the ICBM force in the decades ahead. ICBM MIRV [multiple independently targetable reentry vehicle] capability enhances the resiliency of the Triad by providing an effective hedge against technical failure in another leg of the Triad or geopolitical surprise. The risk mitigation benefits it offers are extremely valuable, especially as the U.S. reduces its force structure to comply with arms control treaty requirements.¹⁶⁶

By the 2030s, the strategic nuclear force will include a mix of three bombers. B-21s will have entered service and all or most nuclear-capable B-2s and B-52Hs deployed today will remain in the bomber fleet. As noted, all three bomber types will have sizable payloads. The B-52Hs probably will carry only LRSO missiles, B-2s will have B61-12 bombs and be capable of carrying LRSO missiles, and B-21s, with the best in-flight survivability of the three bombers, will be armed with B61-12 bombs and also able to deliver LRSO missiles. The bomber force will likely retain

upload capacity, although how much is hard to estimate, given that future day-to-day weapon loads for the B-52H and B-2 are unknown, the number of B61-12 bombs (or LRSO missiles) each B-21 could carry has not been made public, the number of bomber hedge warheads for that time is unknown, and the specific bomber force structure mix for the 2030s has not been disclosed, or perhaps even determined.

The warhead hedge available for the future nuclear force probably will be smaller than the size of the hedge in the nuclear stockpile today. The presidential nuclear weapons employment guidance issued publicly in 2013 outlined an approach intended to maintain a hedge of smaller size through adherence to the following principles: 1) enough warheads will be kept in the stockpile to hedge against “the technical failure of any single weapon type or delivery system at a time”; 2) if warheads of another type within the same leg of the triad are insufficient to replace a failed warhead type, additional warheads will be uploaded on a different triad leg “to hedge adequately”; 3) older warheads to hedge against the failure of warheads refurbished to extend their service lives will be retained only until confidence is gained in the refurbished warheads; 4) a hedge sized for technical failures will also provide an adequate number of warheads to upload in response to increased geopolitical threats; and 5) planned improvements in the nuclear infrastructure will allow greater reliance on the production of warheads, rather than the retention of nondeployed warheads, to hedge against adverse changes in the decades ahead.¹⁶⁷

In line with these principles, reductions in the nuclear stockpile are planned. Officials of the National Nuclear Security Administration (NNSA) estimate that the life extension program for the W76 SLBM warhead, to be completed in 2019, “will enable an almost 50 percent reduction in the total number of W76 warheads,” which represent the most prevalent warhead type in both the current and planned strategic nuclear force.¹⁶⁸ Under the 3+2 strategy mentioned earlier, the replacement of four B61 bomb variants (B61-3/4/7/10) with the B61-12, and the related retirement of B61-11 and B83-1 bombs, will reduce by 50 percent the number of gravity bombs in the stockpile.¹⁶⁹ The consolidation of gravity bombs into a single type (B61-12), the retention of a single warhead type for cruise missiles (W80-4), and the replacement of current SLBM and ICBM warheads (W76-0/1, W88, W78, W87) with three interoperable warheads (IW-1/2/3) in the long term could result in “up to [a] 50 percent potential hedge reduction.”¹⁷⁰ The 3+2 strategy would support this reduction in the hedge for technical failure, but, given the nuclear weapons employment guidance cited above, it also would mean a reduction in the hedge against worsened threats from one or more nuclear-armed major powers. And a hedge intended as insurance against technical failure would not necessarily be adequate for upload options suited for responding to “geopolitical surprises” that could occur in the future.

Absence of alternatives has been the main reason the United States depends on uploading weapons from the existing nuclear stockpile as the option for augmenting the strength of its strategic nuclear force. Production lines for new submarines, missiles, aircraft, and nuclear weapons have largely been lacking. Except for production of Trident D5 LE SLBMs, no new US nuclear-capable delivery systems or nuclear weapons have been built for two decades or more. B-52H production ceased in 1962.¹⁷¹ No Minuteman III ICBMs were built after 1978.¹⁷² The last ALCM was manufactured in 1986.¹⁷³ The production run for the B-1B, originally a nuclear-capable bomber, was completed in 1988.¹⁷⁴ The last deliveries of both the Trident SSBN and the B-2 bomber occurred in 1997 (although the first B-2 subsequently was converted from a test aircraft to an operational bomber).¹⁷⁵ Over the past decade, some 100 life-extended Trident D5 missiles have been built and low-rate production of solid rocket motors (SRMs) has continued to support

the D5 program as well as the SRM industrial base.¹⁷⁶ Production of new nuclear warheads was halted in 1990, although in recent years Los Alamos National Laboratory has “produced a limited number of war reserve pits” (plutonium cores of weapons certified for inclusion in the nuclear stockpile) and “demonstrated a production rate of up to 10 pits per year.” (During the height of the Cold War, the Rocky Flats plutonium fabrication plant in Colorado produced 1,000 to 2,000 pits per year to support a much larger stockpile.)¹⁷⁷ In contrast, Russia and China, as well as North Korea, for years have been developing, producing, and deploying new nuclear weapons and associated delivery systems.¹⁷⁸

As the planned modernization program unfolds, the United States again will be producing ballistic missile submarines, ballistic and cruise missiles, bombers, and nuclear weapons. Active production lines should constitute the industrial foundation for greater resilience and flexibility in the nuclear deterrent. In the uncertain decades ahead, this production capability will offer alternatives, in addition to uploading hedge warheads, for adapting the strategic nuclear force to increased dangers in the security environment or significant decreases in the expected effectiveness of one or more parts of that force. As the then-commander of STRATCOM told a congressional committee in 2011:

...during the procurement period for the Ohio-Replacement Program (ORP) [*Columbia*-class] SSBNs, we will retain the option to build more SSBNs into the 2030s. Furthermore, at the same time the [Defense] Department is considering the ORP, the Air Force is beginning to consider strategic bomber and ICBM replacement options—both of which could result in programs sized differently from the current force structure. All of these decisions lie in the years ahead, as future strategic environment, policy, and capabilities of the Triad will ultimately determine how many ORP SSBNs, new bombers, and new ICBMs are required.

...In [the] event [of “a significantly deteriorated strategic environment”], the inherent flexibility of the Triad would allow us to compensate with hedging strategies over the short term, while additional force structure (SSBNs, ICBMs, Bombers) enhancements would be a longer term solution.¹⁷⁹

Some information is publicly available regarding production plans for the future force. For example, the scheduled start of hull construction for the first *Columbia*-class SSBN is 2021, that of the second submarine is 2024, with the remaining 10 submarines procured at a rate of one per year from 2026 through 2035.¹⁸⁰ The goal is to build each SSBN within a seven-year period.¹⁸¹ As noted, there already is an open production line for Trident D5 rocket motors.

Booster production for the GBSD is said to begin in 2026,¹⁸² with “up to 60 or more” missile bodies delivered per year during the production phase, according to the Air Force system program manager.¹⁸³ Besides the 400 operational silos for GBSD missiles, the Air Force currently plans to retain an additional 50 ICBM silos that are empty but warm, that is, “capable of receiving a booster if needed.”¹⁸⁴

Air Force officials have referred to 100 B-21 bombers as a “minimum” requirement¹⁸⁵ and said that the aircraft could be in production at a relatively low rate from the early 2020s to 2050.¹⁸⁶ The first LRSO missile for the bomber force is expected to be delivered in 2026.¹⁸⁷ Although a production run of approximately 1,000 missile bodies is planned, the total “number of nuclear-

armed LRSO cruise missiles (i.e., mated to a nuclear warhead) is expected to be equivalent to the current ALCM force,” which, as noted earlier, has no more than 528 missiles. The rest of the LRSO inventory will serve as spares for “operational availability requirements” and testing purposes.¹⁸⁸

As part of its plan for a more responsive nuclear infrastructure, NNSA intends to have the capacity to produce 10 warhead reserve pits in 2024, 20 in 2025, 30 in 2026, and 50 to 80 pits per year by 2030.¹⁸⁹

By the mid-2020s, then, *Columbia*-class SSBNs, GBSD ICBMs, B-21 bombers, LRSO cruise missiles, and the plutonium pits for nuclear warheads all will be in the initial stages of production periods extending years into the future. As a result, the United States will have options, if needed, to increase the size or change the composition of its strategic nuclear force in ways that differ from current modernization plans. This will add another dimension of potential adaptability to the force in an uncertain security environment. The potential to augment or otherwise alter the force to give it even greater effectiveness could serve to dissuade arms competition by nuclear peers or to respond selectively to developments in their offensive forces or defensive means that threatened to undermine the US nuclear deterrent. Active production lines also could support enforcement of existing arms control treaties or the negotiation of new agreements. They could offer various alternatives for deterring or correcting for arms control violations (the threat or implementation of an offsetting arms buildup, for example) and incentives for an adversary to agree to limits on nuclear arms or face even greater increases or improvements in US forces. (As Winston Churchill advocated, and John F. Kennedy frequently echoed, “we should rearm in order to parley.”)¹⁹⁰

The option of building more delivery systems or nuclear weapons would, however, complement rather than supplant the alternative of uploading weapons from the existing nuclear stockpile. Uploading generally would entail less time and less expense than producing and fielding new nuclear capabilities. The bomber force could be uploaded in days, SLBMs in months, and ICBMs in a few years.¹⁹¹ The uploading option thus would have an advantage in circumstances requiring a near-term increase in the capability of the strategic nuclear force or an expeditious offset to a military-technical problem afflicting one of the triad legs.

Dual-Capable Aircraft. The nuclear payloads for dual-capable aircraft are smaller and less variable than those for nuclear-capable bombers. Each dual-capable F-15E or F-16 aircraft reportedly can carry a nuclear payload of two B61 gravity bombs.¹⁹² As noted, these include the Mods 3, 4, and 10 of the B61, which reportedly differ in the explosive yields they can produce.¹⁹³ During the early 2020s, these mods of the B61 will be replaced by a single version of the bomb, the B61-12.¹⁹⁴ When nuclear certified in 2024, F-35A strike fighters will be capable of carrying two B61-12 bombs per aircraft.¹⁹⁵

Assorted Weapon Yields

A nuclear stockpile with weapons of assorted explosive yields is essential to the flexibility that may be necessary to support deterrence of a range of possible contingencies and to limit damage if deterrence fails. High-yield weapons may hold at risk hardened military facilities, such as silos or tunnels for WMD-armed missiles or bunkers for selected command elements of an adversary. Lower-yield weapons can hold at risk other types of targets, while at the same time offering greater

possibilities for minimizing unwanted damage that could fuel the escalation of a conflict.¹⁹⁶ It is important to note that greater weapon delivery accuracy, better target intelligence, and improved targeting can lower the yields required to achieve the damage criteria set for particular target types and specific targets.

Current reentry vehicle warheads for SLBMs and ICBMs generally are characterized as “high yield.”¹⁹⁷ W76-0/1 and W88 warheads arm Trident D5 SLBMs today and will be carried by D5 LE missiles beginning in 2017. W78 and W87 warheads comprise the payloads for Minuteman III ICBMs and also will arm GBSD missiles for some years after their initial deployment. Three interoperable warheads, which could be delivered by both SLBMs and ICBMs, are planned to enter service in the 2030s and 2040s.¹⁹⁸ Given their derivation from existing ballistic missile warheads, it is not unreasonable to suppose that the interoperable warheads, too, will be high yield. If necessary, high-yield warheads, including those for ballistic missiles, “could be modified for lower yields with high confidence,” according to a Defense Science Board task force. “An obvious possibility is the replacement of the secondary [the weapon component that produces most of the yield] with inert material.”¹⁹⁹

With regard to the weapons for bombers and dual-capable aircraft, the yields of gravity bombs now in the nuclear stockpile range “from megaton to subkiloton.”²⁰⁰ The B83-1 bomb, which would be delivered by the B-2 bomber, is the last megaton weapon in the stockpile.²⁰¹ The Mod 7 and Mod 11 “strategic” variants of the B61 bomb, which also would be carried by the B-2, reportedly have high yields. The “tactical” variants of the B61 (Mods 3, 4, and 10), the weapons that would arm F-15E and F-16 dual-capable aircraft, are reported to have less explosive power than the strategic versions.²⁰² Both the B83 and B61 bombs have variable yield options, which allow the weapons to be detonated at yields lower than the highest yield for each type.²⁰³ The B-52H-delivered ALCM-B has a warhead, the W80-1, that is said to have high and low yield options.²⁰⁴

Under present plans, the B61-12 guided gravity bomb will replace four B61 variants and allow the retirement of the B61-11 and B83 bombs during the next decade. The B61-12 will be based on the design of the B61-4, which has the lowest maximum yield of the B61 variants currently in the stockpile.²⁰⁵ As a result of the lower yield of the B61-12, the retirement of higher-yield gravity bombs, and the much smaller number of bombs, there will be a “significant reduction in the total yield (i.e., mega-tonnage) produced by air-delivered gravity weapons in the U.S. nuclear stockpile.”²⁰⁶ Officials maintain that the guided tail kit section of the bomb will give “improved accuracy [that] will allow the B61-12 to achieve the same military effects of today’s highest-yield versions, while incorporating the smallest yield design available.”²⁰⁷ Moreover, “U.S. Strategic Command determined that with the accuracy provided by the tail kit, the yield provided by today’s lowest yield B61 variant would be sufficient to meet all of the strategic and non-strategic requirements for gravity systems.”²⁰⁸ With the “much greater weapon accuracy,” coupled with the reduction in yield, would come more likelihood of “reduced collateral damage.”²⁰⁹ In that regard, it also may be the case the B61-12, like bomb variants it replaces, will have variable yield options at lower levels of explosive power. If current requirements for gravity systems change, or might be expected to change, reconsidering the retirement of the B83 may be appropriate.

The LRSO cruise missile, the replacement for the ALCM-B, will carry the W80-4 warhead. The W80-4 “will reuse the W80-1 warhead design fielded on the current ALCM, supplemented with additional surety features.”²¹⁰ (“Surety” refers to warhead safety, security, and reliability.) The LRSO warhead apparently will have a lower-yield option like that reportedly incorporated in the

W80-1: “[LRSO] is intended to retain the ALCM’s contribution to our ability to deter a limited nuclear war and mitigate the risk of uncontrolled escalation if nuclear deterrence fails. Retaining lower-yield options means retaining the ability to limit the level of destruction if the President determines a nuclear response is necessary.”²¹¹

High Delivery Accuracy

High accuracy is essential to holding at risk some targets that may be critical to the objectives of deterrence and damage limitation, while also minimizing prospective harm to noncombatants and civilian infrastructure. All three legs of the present nuclear triad are capable of delivering their weapons with a high degree of accuracy, although not with precision comparable to that of advanced conventional systems. The Trident D5 SLBM and Minuteman III ICBM reportedly have circular error probables (CEPs) on the order of a few hundred feet.²¹² (CEP is the radius of the circle within which half of the weapons aimed at a target would be expected to fall.) The ALCM-B, currently the only guided strategic nuclear weapon, is more accurate than these ballistic missiles.²¹³

As discussed above, the B61-12 guided gravity bomb will have a delivery accuracy better than that of the bombs it replaces. Whether or to what extent the accuracies of future nuclear-armed missiles and aircraft will be greater than those of their predecessors is unclear. Information from unofficial sources points to higher accuracies for the D5 LE SLBM, GBSD ICBM, and LRSO missiles.²¹⁴ Official sources, on the other hand, are silent, ambiguous, or imply no improvements are planned. For example, in early 2016, one publication reported that “[a] source who has been briefed on the new ALCM [LRSO] program...said the technical characteristics of the new missile are still being defined because the program is still in the early development stage but that the goal is to increase the range and accuracy of the missile.”²¹⁵ Several months later, the then-assistant secretary of defense for strategy, plans, and capabilities told a congressional committee that, “LRSO will not support new military missions or provide new military capabilities. Rather, it will preserve the current ALCM capability in the face of evolving air defense threats.”²¹⁶ Accuracy improvements for the next generation of nuclear delivery systems may be in the works, but if so, they are not being openly discussed, unlike some of the other attributes of future capabilities.

Summary and Conclusion

Summarized below are key points from the foregoing evaluation of present and planned US nuclear forces *vis-à-vis* the characteristics needed for flexibility and resilience in an uncertain security environment. Authoritative open source references for the summary paragraphs below may be found in the endnotes supporting the corresponding previous discussions of: survivability, suitable range, ability to forward deploy, prompt response capability, variable payloads, assorted weapon yields and high delivery accuracy. These previous discussions can be found on pages 86-108 above.

Survivability: The modernization program will not change the level of survivability of those SSBNs in port, bombers and DCA at air bases, and ICBMs in silos. The *Columbia*-class submarine, however, is designed for greater at-sea survivability than the *Ohio*-class SSBN and is expected to have a significant measure of resilience against possible advances in opposing ASW capabilities. Basing GBSD ICBMs in existing silos would appear not to improve the *prelaunch* survivability of the land-based missile leg of the nuclear triad. The B-21 bomber, LRSO missile,

and F-35A dual-capable aircraft are all designed for greater postlaunch (in-flight) survivability against advanced air defenses than that of their existing counterparts. The GBSD missile, according to one source, “will be much more ‘survivable’ than the Minuteman III, meaning it has a greater chance of reaching its intended target without being spoofed, electronically disrupted or intercepted.” (The basis for this greater survivability is unspecified.)²¹⁷ Penetration aids could be used to counter missile defenses directed against the reentry vehicles from ballistic missiles. Maneuvering reentry vehicles and boost-glide vehicles offer other possible options for evading defenses.

Suitable range: Current SLBMs, ICBMs, and bombers have intercontinental ranges. The ranges of the next-generation systems have not yet been revealed. Given historical precedents, it is not unreasonable to expect that their ranges, too, will be intercontinental. For the same reason, it might be assumed that the LRSO missile will have a range comparable to the ALCM-B and the retired Advanced Cruise Missile. Dual-capable aircraft have ranges much shorter than those of heavy bombers, but can be, and have been, forward deployed. Open-source estimates indicate the unrefueled range of the F-35A is somewhat shorter than those of the F-15E and F-16. All dual-capable aircraft, however, can be refueled in flight.

Ability to forward deploy: Bombers and SSBNs are the forward-deployable legs of the triad. Over the past seven decades, nuclear-capable bombers have been deployed scores of times, in different ways, to many countries, in various circumstances, to assure friends and deter foes. Ballistic missile submarines have been used much less frequently for presence purposes, although there are indications their role in this regard may be increasing. In the future, B-21 bombers could deploy to overseas bases and *Columbia*-class SSBNs could visit foreign ports in order to demonstrate US commitments to allies and discourage aggressive actions by adversaries. The use of these advanced weapons systems could be constrained, however, by concerns about their security abroad and caution about revealing aspects of their design or operation that would aid observant opponents. Dual-capable aircraft are forward deployed in Europe and forward deployable elsewhere. F-35A strike fighters should be entirely capable of assuming the forward-deployment duties that F-15E and F-16 DCA perform today.

Prompt response capability: Prompt response involves the ability to reach targets from long range in minutes rather than hours. ICBMs and SLBMs can cover intercontinental distances in a half hour or less and thus are considered the triad legs for prompt response. New or upgraded ballistic missiles will be built under the planned modernization program. New interoperable warheads for these missiles also will be built. Prompt-response ballistic missile warheads represent a significant portion of the deployed weapons of both the present and planned strategic forces.

Variable payloads: The types and numbers of nuclear weapons carried by present and planned ballistic missiles and bombers can be changed to meet mission requirements and adapt to adverse developments in the security environment. Today, each SLBM or ICBM is capable of carrying two types of reentry vehicle warheads.²¹⁸ In the future, each type of ballistic missile—Trident D5 LE SLBM, GBSD ICBM, and a possible circa-2040s follow-on SLBM—could carry three warhead types. Under the modernization program, the bomber force will continue to have cruise missiles—LRSO missiles in place of ALCM-Bs—but there will be fewer types of gravity bombs. Most variants of the B61 bomb, including the earth-penetrating B61-11, along with the megaton-class B83-1 bomb, will be retired. Unless the decision is made to retain the unique characteristics of the B61-11, only a single bomb, the B61-12 will remain, with potentially

significant implications for US capabilities to hold hard and deeply buried targets at risk. As with the current force, the ballistic missiles and bombers of the future force reportedly could be uploaded with additional warheads and bombs if conditions warranted. It is possible the upload capacity of both the current and future force could exceed the number of warheads in the stockpile available for uploading. With the modernization program calling for the production of new SSBNs, SLBMs, ICBMs, bombers, cruise missiles, and nuclear weapons, there could be additional options, besides uploading stored warheads, for increasing the size of the future strategic force beyond what is now planned or for changing its capability mix.

Assorted weapon yields: Current SLBMs and ICBMs are armed with warheads of high explosive yield. It seems likely that future ballistic missile warheads also will fall in the “high yield” category. Bomber weapons have yields that are low as well as high. The B61 and B83 gravity bombs have variable yield options, which the ALCM-B warhead (the W80-1) is also said to have. In the future, under current plans, there will be only two bomber weapons: the B61-12 bomb and the LRSO missile with a modified version of the ALCM-B warhead (the W80-4). Both the B61-12 and the W80-4 warhead may have variable yield options.

High delivery accuracy: All three legs of the present strategic force can deliver their weapons with high accuracy. The bomber-delivered ALCM-B, a weapon with terrain contour-matching guidance, reportedly has even better accuracy than ICBMs and SLBMs. The sole gravity bomb of the future force, the B61-12, has a guided tail kit section for improved delivery accuracy. Official descriptions of the D5 LE SLBM, GBSD ICBM, and LRSO missile to date have not advertised accuracy improvements, but given historical precedent, some of these missiles may have delivery accuracies that at least to some degree are better than what the predecessor system could achieve.

Overall, as seen in Table 5 below, the adaptability of the planned force is similar to that of the current force, with, as noted, the addition of active production lines. Perhaps the greatest virtue of the planned modernization program is that it would preserve the US nuclear triad for decades to come. The diversity of delivery systems and weapons encompassed within the triad, in combination with DCA, helps provide the flexibility needed for nuclear options suited to the deterrence of a range of potential adversaries and contingencies, the assurance of allies, and the support of various plausible US defensive objectives in the event deterrence fails. The same diversity enables adjustments that can help maintain the effectiveness of the nuclear force if foreign military threats increase or major problems with parts of the triad emerge.

Without modernization, the decades-old elements of the nuclear triad will become decrepit, obsolete, and, ultimately, defunct between now and mid-century. Given the many years required to replace existing nuclear submarines, missiles, bombers, and weapons with their next-generation counterparts, modernization must be pursued now to avoid imprudent risks in an increasingly dangerous and dynamic threat environment.

Table 5: Summary Results of the Planned Nuclear Modernization Program

Survivability: Survivability at bases unchanged. ICBM prelaunch survivability still depends on silo numbers and launch under attack option. SSBN at-sea survivability maintained. In-flight survivability of air-breathing systems enhanced. Ballistic missile postlaunch survivability may benefit from the addition of penaids, MARVs, or boost-glide vehicles.
Suitable Range: Intercontinental ranges of strategic systems likely maintained. Unrefueled range of future DCA apparently less than existing aircraft, but also have in-flight refueling capability.
Ability to forward deploy: Bombers, SSBNs, and DCA remain forward deployable, and DCA forward deployed in Europe. Security concerns and fewer submarines could constrain bomber and SSBN foreign visits.
Prompt response capability: Ballistic missile warheads remain a significant portion of strategic total.
Variable payloads: Each ballistic missile type can carry three rather than two types of reentry vehicle warheads. Bomber force continues to have cruise missiles and gravity bombs. Bomb inventory reduced from two bomb types and multiple variants to a single variant of one bomb type. Options for uploading weapons likely are retained.
Assorted weapon yields: Nuclear force continues to have high- and low-yield warheads. Ballistic missile warheads may only be high yield.
High delivery accuracy: Accuracies for all delivery systems are high. As reported, all aircraft-delivered weapons are guided; planned ballistic missile reentry vehicles are not.

In general, the modernization program, as now planned, appears focused on addressing aging and survivability problems. Possibilities for improving the discrimination of replacement weapon systems through significantly better delivery accuracies as well as nuclear weapons of advanced design seem to have received less attention. (Discriminate lethality is the ability to hold at risk targets potentially critical to deterrence while minimizing unwanted potential damage.) Greater discrimination would add to the flexibility of the nuclear force and potentially to its deterrence credibility. As regards the current program, only the guided B61-12 bomb has been officially advertised as a weapon with greater accuracy than what it replaces. And the warheads future missiles are intended to carry will be the same as, or similar to, those of today, while the B61-12 uses the nuclear explosive package of a B61 variant (Mod 4) dating from the 1970s.²¹⁹ The apparent lack of change in this area may be attributable to the Obama Administration policy against “new military capabilities” for nuclear weapons. It should be noted that the strategic force modernization programs of the late 1950s-early 1960s and the late 1970s-early 1980s greatly increased force effectiveness, including discriminate lethality, through the acquisition of advanced, even revolutionary, delivery systems and new nuclear weapons.

For the uncertain road ahead, more flexibility and resilience may be needed to support priority US national goals. Of course, more capability comes at greater cost and budget constraints discipline programmatic choices. Moreover, the connections between capability and cost on the one hand

and deterrence, assurance, and damage limitation on the other are difficult to predict with precision. Nonetheless, prudence now points to the value of US flexibility and resilience. Those charged with conducting the 2017 Nuclear Posture Review should consider plausible changes to the current modernization program that could lend greater adaptability to the US nuclear force at an affordable cost. They should look at options suitable for circumstances in which threats increase beyond what has been expected, more funding becomes available, new technological opportunities appear, or capabilities must be improved at a faster-than-normal pace. Some suggestions along this line have been offered above and others appear in subsequent parts of the report.

Part II: Advanced Technology Development

Introduction

The US military cannot depend on being able to detect emerging threat developments years in advance and in time to initiate methodical and lengthy research and acquisition programs to meet those threats. Over the past few years, senior DoD officials have emphasized the need for greater adaptability for US military capabilities. This emphasis on adaptability is the common-sense approach to dealing with a military that is reduced in size from that of previous years, a security landscape that is complex and capable of rapid change, and the long timelines and high costs of acquisition programs for modern weapon systems.

Advancing technologies associated with DoD capabilities is important to demonstrate to adversaries as well as to allies the breadth of US technical expertise. By demonstrating US technical prowess, allies are assured and adversaries less confident that an investment in military capabilities to combat the United States and its allies would be successful. The continuing need to invest in the development of advanced technologies and operational concepts applies to non-nuclear capabilities as well as to the nuclear force.

Non-Nuclear Capabilities

US advancements in non-nuclear-weapons technology could contribute to deterrence, and be used in myriad ways to respond to adversary threats or aggression. Applications of advanced technologies for defensive capabilities can reduce the effectiveness of enemy attacks, increase the uncertainty of their success, and increase the overall cost for adversaries. Applications for offensive capabilities can help to increase the expected lethality of US deterrent threats that are responsive to potential provocations. These perceptions have been demonstrated to be positive contributors to deterrence.

Several recent DoD initiatives have focused on developing and integrating new technologies for military applications. For example, a 2013 Naval Studies Board (NSB) report examined options for the Navy to respond to capability surprise. The study was directed at general purpose naval forces, but its conclusions are also applicable to adaptability and 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 emphasized that in the future the force will likely need to adapt in ways that cannot currently be envisioned.²²⁰ In

short, the NSB recommended that resilience and adaptability should be a design requirement for future forces.

In August 2014, former-Defense Department Acquisition chief, Frank Kendall, called on the US defense industry to “wake up.” In his address to a conference of defense industry executives, Kendall is quoted as stating, “Our technological superiority is very much at risk, there are people designing systems to defeat us in a very thoughtful and strategic way, and we’ve got to wake up, frankly.”²²¹ In November 2014, then-Secretary of Defense Chuck Hagel issued a directive establishing the Defense Innovation Initiative.²²² The stated objective of this initiative is to pursue in a deliberative manner “innovative ways to sustain and advance our military superiority for the 21st Century and improve business operations.” Building upon this theme, former-Secretary of Defense Ashton Carter, Hagel’s successor, championed the streamlined transfer of advanced technology from the civilian sector to the military. To help expedite this transfer of technology, DoD has created the 15-member US Defense Innovation Advisory Board and established Defense Innovation Unit-Experimental offices in Silicon Valley, in the Boston, Massachusetts area, and in Austin, Texas.²²³

And, DoD is examining how combinations of advanced technologies can be integrated into operational concepts for military use. One initiative, referred to as the “Third Offset Strategy,” is focusing on developing new operating concepts for several mission areas. According to one report, these include: countering anti-access and area-denial strategies, guided munitions, undersea warfare, cyber and electronic warfare, human-machine teaming, and war gaming.²²⁴ These and other efforts are being leveraged by initiatives to streamline DoD business practices and reform acquisition procedures.

To stay ahead of opponents in defense-related technologies, the United States needs to invest aggressively in defense-related advanced technologies so it does not cede technical advantages in any area to a potential adversary. Investment needs to include basic research to explore the potential of emerging technologies as well as applied and advanced research to develop specific military applications. The list of potential applications of advanced technologies is extensive and not the primary focus of this report. General areas of technology developments with potential for high payoff include those which enable defensive capabilities against ballistic missiles, cruise missiles, and hypersonic delivery vehicles, as well as space control capabilities, cyber capabilities (offensive and defensive), non-nuclear offensive technologies such as railguns, lasers, and hypersonic delivery vehicles, anti-submarine warfare, and flexible and secure intelligence, surveillance, and command and control systems.

Nuclear Capabilities

As the United States develops new military-related technologies for non-nuclear capabilities, the need to advance technologies associated with nuclear capabilities (including delivery systems, nuclear warheads, and nuclear command and control) will also be important. To fail to do so would cede this high-leverage dimension of military technology to potential adversaries—who are not idly standing by—and could increase the perceived value of their nuclear forces to deter or counter US conventional military capabilities.

For a number of reasons, the failure of the United States to exercise critical and unique skills and capabilities for the nuclear weapons work force over the past twenty-five years has resulted in

atrophy of intellectual capital for the nuclear weapons sector. Some have argued that the United States should cease further advances in nuclear weapons technology.²²⁵ The oft-stated rationale for such a self-limiting policy has typically been the assumption that further nuclear developments by the United States would spur other countries to either (1) acquire nuclear weapons or improve arsenals, and/or (2) curtail cooperation with the United States on a strengthened nonproliferation regime. The expectation is that restraint by the United States would be met with reciprocal restraint by potential adversaries, as well as enhanced cooperation from other countries.²²⁶ Unfortunately, the postulated benefits of self-restraint by the United States are hypothetical and have not materialized (as is discussed in detail in Section XII below).

Instead of benefits, such restraint can actually lead to long-term problems. In one well documented example of US self-restraint leading to unexpected problems, the National Defense Authorization Act (NDAA) for Fiscal Year 1994 included a prohibition for the purpose of limiting research on certain nuclear weapon developments. Section 3136 of that Act prohibited the Secretary of Energy from conducting or providing for the conduct of “research and development which could lead to the production by the United States of a new low-yield nuclear weapon, including a precision low-yield warhead...”²²⁷ This became known as the “PLYWD Law”.

This law created a dilemma for the national laboratories responsible for training and maintaining a cadre of skilled nuclear warhead designers and engineers. How were they to keep designers and engineers proficient while complying with this law? Many seemingly benign areas of research could reasonably be interpreted as “leading to” the production of new, low-yield warheads. In 2004, after a decade of working under severe constraints to conform to this law, Congress repealed the law in response to a DoD request. The legislation repealing the PLYWD Law called for the Secretaries of State, Defense, and Energy to jointly submit a report to Congress explaining the rationale for repeal of the law. The report stated:

[This prohibition] has had a “chilling effect” on advanced concepts work. It has impeded our scientists and engineers from exploring the full range of technical options. It did not simply prohibit research on new, low-yield warheads, but prohibited activities “which could lead to production by the United States” of such a warhead. The fact is that most nuclear weapons research could be characterized as fitting that criterion. The result has been, quite literally, that our design teams have had to check with lawyers before starting computer calculations exploring certain concepts ... simply because such calculations “could lead to” production of lower-yield systems.²²⁸

Furthermore, the 2004 report stated that continuing to examine advanced nuclear concepts is important to our ability to “understand possible military applications of atomic energy before anyone else does.”²²⁹ The rationale for repealing the PLYWD Law included the observation: “to our knowledge, no other nuclear weapons possessing state has imposed upon itself a comparable restriction on basic exploratory research on nuclear weapons.”²³⁰ Over the past twenty-five years, the United States has significantly reduced the number and types of nuclear weapons in its inventory and has scaled back nuclear command and control capabilities to those considered minimally essential. The current stockpile is the smallest since the Eisenhower Administration²³¹ and the oldest stockpile ever.²³² Over the past two decades, nuclear warheads have been life-extended and modernized, but no new nuclear weapons or warheads have been developed, produced, and deployed. In contrast, potential adversaries, Russia and China, have maintained active development and production programs for nuclear weapons and warheads. Any prior US

advantage in nuclear weapons technology, if it existed at all at the beginning of the post-Cold War era, has probably narrowed significantly. An open question currently exists whether the United States can still credibly claim to be “second-to-none” in nuclear capabilities.²³³

The ability to develop advanced technologies and capabilities for both weapons and nuclear warheads will likely be important for deterrence and assurance. Advances for weapons, for example, are likely to be required to ensure that weapons can survive an enemy attack, capable of prompt launch, penetrate enemy defenses, and pose the intended deterrent threat. To support deterrence and assurance goals, the US nuclear force must be modernized periodically to be effective and perceived by adversaries and allies to be effective. In testimony before Congress the commander of Air Force Global Strike Command, General Robin Rand, expressed concern that the reentry vehicles on existing Minuteman III ICBMs will have a difficult time penetrating the missile defense environments of the future. Gen. Rand stated the case for a new ground-based strategic deterrent with capabilities that keep pace with developments by adversaries.²³⁴ In his testimony before the House Armed Services Committee, Strategic Forces Subcommittee, Gen. Rand said, “The Minuteman III with each year becomes more and more obsolete, and I am concerned that if we don’t replace it …we will not be able to provide the capabilities that are needed.”²³⁵

Of prime importance right now is to address the atrophy of expertise and revitalize the intellectual expertise and critical skills at the national laboratories and plants. These skills need to be exercised routinely in order to train the next generation of nuclear warhead designers and engineers so they are proficient in their specialties and develop expert judgment. For the foreseeable future, a cadre of proficient nuclear technology experts will be needed to respond effectively to changing national needs.

Significant limitations exist in the current nuclear readiness posture. Limitations include:

- No Comprehensive Approach to Sustaining Readiness. The current approach to sustaining critical nuclear skills is piecemeal. A comprehensive approach to improving and sustaining a nuclear weapon response capability is needed.
- Not All Critical Skills and Capabilities Are Being Exercised. Currently, the approach for life-extending warheads is to consider options to *refurbish* existing warheads, to *reuse* nuclear components from warhead designs previously in the stockpile, and to *replace* warheads or the nuclear components with previously tested designs. However, all near-term warhead life extension programs (LEPs) are of limited scope—primarily *refurbishment* LEPs—which exercise only a limited set of critical skills and capabilities. One study said the approach “is not sustainable.”²³⁶
- Lack of Balance between Computation and Experimentation. Currently, the nuclear warhead development community is dependent on computer simulation. As one designer has stated, “The codes always lie.” Without experimental activities against which to test the results of computer simulations, new designers and engineers are not able to understand where the computer codes break down and why. An over-dependence on computer simulation will hamper the development of professional judgment that will be needed in the future by US nuclear design professionals.
- Infrastructure Modernization Delayed Repeatedly. Modernization of critical nuclear facilities has been delayed. The US nuclear infrastructure has not been fully operational for a quarter century. A September 2008 white paper signed jointly by the Secretary of

Defense Robert Gates and Secretary of Energy Samuel Bodman states, "...the United States is now the only nuclear weapons state party to the NPT that does not have the capability to produce a new nuclear warhead."²³⁷ In its 2009 report, the bipartisan Strategic Posture Commission stated that some facilities are "genuinely decrepit" and much still remains to be done to put in place a modern nuclear weapon infrastructure to serve national security goals for the long term.²³⁸

What Needs To Be Done?

The United States should, as a matter of policy, exercise routinely all skills critical to design, develop, and manufacture modern nuclear warheads so that these skills will be available whenever needed. Specifically, actions are needed to (1) clarify national policy regarding nuclear weapon design, development, and production of nuclear weapons, (2) initiate programs to regularly exercise all critical skills, (3) reestablish nuclear infrastructure capabilities and replace decrepit facilities, and (4) modernize nuclear command and control.

Policy. A badly needed first step is for the Trump Administration to make clear that it is US policy to maintain and exercise regularly *all* skills and expertise necessary to design, develop and produce modern nuclear warheads and to institute programs for that purpose.

All post-Cold War administrations have supported—explicitly or implicitly—the policy of maintaining the capability to design, develop, and produce modern nuclear warheads.²³⁹ However, those policies were often not clearly articulated and the programs to exercise critical nuclear skills varied significantly across administrations and had limited success in being funded by Congress.

Over the past two decades, numerous studies on sustaining nuclear warhead development skills have concluded that many critical skills cannot be maintained and transferred from one generation of designers to the next without actively exercising those skills and rigorously subjecting the judgements of young designers to empirical experimentation.²⁴⁰ For example, in 1999 a commission on maintaining US nuclear expertise reported:

Concern exists over the centrality of on-the-job training and the drastic change affecting knowledge transfer to the nuclear design groups in an environment of few development activities and the absence of testing which can validate the results of computer simulations with experimental data. ... Throughout the nuclear weapon complex, there are positions which require years of training to master requisite skills and develop technical judgment. These positions range from nuclear weapon designer, to the machinist of materials unique to nuclear weapons, to the nuclear test engineer who supervises the emplacement of the nuclear explosive.²⁴¹

The 2009 report of the bipartisan Strategic Posture Commission concluded that "the intellectual infrastructure ... is in serious trouble."²⁴²

Over the past two years, bipartisan efforts in House and Senate Armed Services Committees have sought to use legislation to help revitalize nuclear warhead development skills. For example, Section 3111 of the FY 2015 National Defense Authorization Act (NDAA) is entitled "Design and Use of Prototypes for Intelligence Purposes." It authorizes the national laboratories to "design

and build prototypes of nuclear weapons to further intelligence estimates with respect to foreign nuclear weapon activities and capabilities.” The basic idea is to broaden the US understanding of foreign nuclear weapon programs while, at the same time, providing an opportunity to train a new generation of weapon designers and engineers.

In late 2015, the FY 2016 NDAA was signed by the president and enacted into law. Section 3112 of the FY 2016 NDAA is entitled “Stockpile Responsiveness Program.” In short, Section 3112 contains several provisions intended to exercise US readiness capabilities to design, develop, and produce nuclear warheads, whenever needed. Provisions include the following:

- *Sense of Congress*: The FY 2016 NDAA establishes that the Congress supports a “modern and responsive nuclear weapons infrastructure” and that the “United States must continually exercise all capabilities required to conceptualize, study, design, develop, engineer, certify, produce, and deploy nuclear weapons.”
- *Atomic Energy Defense Act*: The NDAA amends the Atomic Energy Defense Act to include a statement of US policy to “continually exercise all capabilities” included in the sense of Congress.
- *Stockpile Responsiveness Program*: The NDAA also establishes a Stockpile Responsiveness Program which is to be carried out by the Secretary of Energy, acting through the National Nuclear Security Administrator and in consultation with the Secretary of Defense. The core provision here is the deliberate exercising of all key skills and capabilities. Specifically, NNSA is to “periodically demonstrate stockpile responsiveness throughout the range of capabilities required, including prototypes, flight testing, and development of plans for certification without the need for nuclear testing.²⁴³

In response to the Stockpile Responsiveness Program language in the FY 2016 NDAA, NNSA has initiated some activities to exercise warhead design skills.²⁴⁴ However, these activities are fairly limited in scope as Congress did not appropriate any additional funding for this initiative. Without specific funding appropriated for this task, the challenge for NNSA will be to adjust program priorities within existing budgets to provide flexibility for the laboratories and plants to sustain critical skills and capabilities.

Recommendations. Along with clarifying national policy that nuclear warhead development skills will be maintained and regularly exercised, the United States needs to implement programs that routinely exercise the entire set of skills and capabilities. Recommended initiatives that would help reverse the atrophy of nuclear warhead design, development, and production expertise include the following:

- Reverse the five-year delay imposed on the interoperable warhead (IW1) program which is intended to develop a common replacement warhead for both intercontinental ballistic missiles and submarine-launched ballistic missiles. The IW1 program would begin providing timely, important, and complex design and development challenges for young weapon scientists and engineers at the national laboratories.
- Accelerate activities to certify the safety and reliability of a warhead primary with insensitive high explosive (e.g., IW2) that employs a pit originally designed to be used with conventional high explosive.

- Explore opportunities to introduce into future warhead life extension programs (LEPs) warhead features that facilitate ease of maintenance and certification without nuclear testing.
- Increase opportunities to train nuclear weapon designers through the design and manufacture of a few prototype warheads, including ongoing programs to assess foreign nuclear weapon designs. Here, a modern warhead design would be taken from initial concept and paper studies through prototype development, flight testing and a small build to exercise the manufacturing infrastructure.
- Fund a small program for young designers to spend part of their time in “blue sky” thinking about what might be achievable in nuclear weapon technology, including technologies that are suspected to be in development by adversaries.
- Fund additional experiments to advance our understanding of the science of nuclear warhead performance and to provide better balance between computer simulation and experiments for young designers and engineers.²⁴⁵

In summary, advanced technologies and innovative operational concepts associated with military capabilities—both nuclear and non-nuclear—can be important to demonstrate to adversaries as well as allies the breadth of US technical capability and ingenuity. To adequately prepare for the future, the United States needs to be ready to tackle problems and confront challenges that are not envisioned at this time. The objective is for adversaries to view military conflict with the United States as an unacceptable undertaking with not only no plausible prospect for success, but also with severe unavoidable penalties. This perception would help deter adversaries and assure allies.

The following section addresses the current status of the US infrastructure to design, develop, maintain, and modify nuclear warheads and identifies steps to remediate existing shortcomings in order to enhance adaptability for the nuclear force.

Infrastructure for Nuclear Warhead Production

The critical infrastructure for non-nuclear capabilities is maintained by commercial industries. For nuclear warhead technologies, however, that infrastructure is maintained solely by the federal government. Currently, several key facilities for the nuclear infrastructure are inactive or non-functional. For the US nuclear arsenal to be adaptable to shifting requirements, the nuclear infrastructure will need to be ready to fix or modify existing warheads and be ready to design and produce modern nuclear warheads in support of national goals. This will require a skilled, competent workforce as well as responsive laboratories and production capabilities. Both need to be exercised and maintained in a state of readiness to meet unplanned challenges. Unfortunately for the United States, both the workforce and the infrastructure have atrophied due to inactivity over the past quarter century and are in need of revitalization.

As noted above, the bipartisan Strategic Posture Commission stated in its 2009 report that some facilities are “genuinely decrepit” and much still remains to be done to put in place a modern nuclear warhead infrastructure to serve national security goals for the long term.²⁴⁶ Of concern for the future, existing infrastructure modernization plans may not adequately address the need for reserve capacity to respond to unforeseen needs. Nearly all of the planned capacity to produce warheads over the next 25 years will be tied up with the life extension programs needed to sustain the existing stockpile. Apparently, there is little, if any, margin left for unplanned tasks

such as responding quickly to a malfunction in the reliability of a warhead type or producing additional warheads to respond to national security needs.

Revitalizing the infrastructure and maintaining a readiness capability to develop new weapons or replacements for existing nuclear weapons is fundamentally about providing resilience and reducing risk in the future. Indeed, the 2009 report of the Strategic Posture Commission cited the “unpredictable nature of the security environment” as one of the emerging challenges for the United States. Of significant concern was the “profound uncertainty about the future international roles of Russia and China” as well as uncertainty about the future roles of various “rising powers.” The Commission concluded that the United States needs “to hedge against the possibility that … these factors might not turn out for the best and that new challenges for the US nuclear strategy might emerge and, indeed, suddenly so.”²⁴⁷ Given the resurgence in nuclear weapons development by potential adversaries of the United States, the relatively static nuclear weapon capabilities and eroding intellectual nuclear infrastructure are now weak links in the US security posture.

A fully functional and operating infrastructure would provide resilience to respond to new and unforeseen challenges. The nuclear infrastructure and personnel could be called upon to diagnose and fix an unexpected reliability problem in a warhead type, replace older warheads with similar or different warhead types, increase the number of deployed warheads, or design new types of nuclear capabilities if necessary.

A fully functioning and responsive development infrastructure would also:

- Improve the credibility of US nuclear capabilities in support of deterrence and assurance;
- Provide enhanced adaptability and resilience for the nuclear force to enable a timely response to emerging challenges; and,
- Enable the United States to reduce the overall size of the nuclear stockpile. Instead of relying on a large inventory of non-deployed warheads to manage risk and hedge against reliability problems, US leaders would rely more heavily on the infrastructure and skilled workforce to be able to fix warhead problems quickly and, when needed, respond to new security challenges.

The Strategic Posture Commission called for two major replacement facilities for nuclear warhead components to be built without delay. One would be for the production of plutonium components for warhead primaries (i.e., “pits”) to be built at Los Alamos, New Mexico. The United States has not had an ability to produce pits in quantity since 1989 when the original pit production plant at Rocky Flats, Colorado was shut down. The second major facility needed is the Uranium Processing Facility (UPF), as reconceived by the NNSA “red team” study. A modern UPF will replace existing Manhattan Project-era facilities at the Y-12 Plant at Oak Ridge, Tennessee. In 2009, members of the Strategic Posture Commission were invited to tour the existing uranium facility to view the heroic measures being taken to continue operating this almost 70-year-old facility.²⁴⁸

In late 2010, President Obama sent a report to Congress pledging to modernize the aging nuclear infrastructure as one element of his pact with the Senate to ratify the New START Treaty between the United States and Russia. In that report, the president stated that replacement nuclear facilities for fabricating plutonium and highly enriched uranium components would be accelerated

and additional funding would be dedicated to reducing the backlog of deferred maintenance for nuclear facilities. The report stated, “for each facility, functionality would be attainable by FY 2020 even though completion of the total projects would take longer.”²⁴⁹ Although the Obama Administration sought to fund deferred maintenance and related infrastructure modernization, estimated dates for functionality for the two modern facilities have slid considerably. And, in a February 2016 hearing, NNSA Administrator Frank G. Klotz warned that the administration has a \$3.7 billion bill in deferred maintenance for nuclear facilities.²⁵⁰

A 2012 report by the National Research Council on technical issues for the United States related to the Comprehensive Nuclear Test Ban Treaty called for replacement facilities for plutonium component fabrication and highly enriched uranium processing to be complete by 2021.²⁵¹ As is discussed below, current US plans and anticipated funding for both facilities fall well short of that goal.

What Needs To Be Done?

Accelerating replacement of the two critical production facilities is an urgent task. The United States has not had a fully operational nuclear production complex since 1989. New nuclear force developments by Russia, China, and others have erased any wishful thinking that the nuclear era will continue to decline and end in the foreseeable future.

Plutonium Facility. As noted earlier, the government’s plan had been to have a replacement pit production facility in place at Los Alamos by the early 2020s. Plans called for a pit production capacity of 50-80 pits per year. However, changes in designs and funding shortfalls have pushed that milestone to 2030 or beyond.²⁵² Existing plans for a permanent plutonium production facility need to be accelerated and contingency plans should be developed to expand the capacity further; needed is a clear methodology for determining the adequacy of US pit production. National security challenges or warhead reliability problems could require pit production capacity much beyond the planned 50-80 per year. The limited-capacity pit production facility at Los Alamos could serve as a model for additional production modules, should such a need arise in the future.

Uranium Processing Facility. NNSA recently revised its plan to construct a modern uranium facility at Oak Ridge and end operations at the Manhattan Project-era facilities. NNSA plans now call for this facility to be complete by 2025.²⁵³ Work toward the goal of providing a safe and environmentally sound highly-enriched uranium component manufacturing capability should proceed without delay and, if practical, be accelerated.

Test Readiness. Also important is the issue of maintaining a readiness capability to resume underground nuclear testing if necessary. This is not a recommendation to resume nuclear testing, but to emphasize, as have the past three presidential administrations, that conducting one or more nuclear tests could be required by a stark new geopolitical threat condition, or to resolve issues related to the safety, security, or reliability of one or more types of nuclear warheads.

No nuclear test has been conducted by the United States since 1992 and, since FY 2011, nuclear test readiness has not been funded as a dedicated program. As a result, the US test readiness posture has declined. According to NNSA, “a number of technologies unique to underground

tests are not exercised by stockpile stewardship” and “most equipment unique to test readiness has remained in storage with minimal resources devoted to maintenance … critical personnel available to conduct an underground test has continued to decline, with no funded program to train their replacements.”²⁵⁴ One former director of the Nuclear Test Division at Los Alamos National Laboratory has openly questioned “whether the DOE has, after 25 years of being out of the testing business, any realistic appreciation of what nuclear testing involves or how to stay prepared to do it again within 24-36 months as legally required by Presidential Decision Directive 15 (1993).”²⁵⁵ As evidence, he cited numerous changes over the past 25 years that would adversely affect any attempt to resume nuclear testing for one or more shots. Included in this list are new defense-related activities located at the former Nevada Test Site, population growth in surrounding area which includes the city of Las Vegas, and that most of the equipment and technology required for nuclear testing has not been adequately maintained, is obsolete, or been sold or salvaged.²⁵⁶

The Strategic Posture Commission emphasized the test readiness issue and recommended that a dedicated test readiness program be maintained and funded.²⁵⁷ However, little corrective action has been taken to sustain such a readiness capability. A dedicated nuclear test readiness program should be funded as part of NNSA’s annual budget; increasing test readiness may be an important step toward a more responsive infrastructure.

Infrastructure Summary

A fully functional and responsive nuclear infrastructure is needed for the US nuclear force to be adaptable in support of deterrence and assurance goals. All warheads in the US stockpile are beyond their initial design life and there is no guarantee that the current types, numbers of warheads, or actions planned for life extension will be sufficient for the future. To restore functionality to the nuclear complex, modern facilities for fabricating plutonium components and for highly enriched uranium components are long overdue. In addition, renewed attention to test readiness would help sustain critical skills and capabilities to provide adaptability and resilience.

Nuclear Command, Control, and Communication

Finally, a modern, secure command, control, and communication system for strategic capabilities, including nuclear forces will continue to be required. The system is needed to ensure that the president and other national leaders receive accurate and timely information on threat warning and attack assessment, maintain the ability to support conferencing and decision making, and are able to issue properly authorized orders to US nuclear forces. All of these capabilities must be survivable and their functionality assured even in the most stressing conditions and without interference. Key elements of the existing nuclear command, control, and communications system (NC3) include early warning sensors such as launch detection satellites and fixed land-based early warning radars; facilities to receive and analyze data from these and other sensors; mobile and fixed secure command and control centers and conferencing capabilities; and communications links between nuclear forces and national leaders.

Senior US defense officials are increasingly emphasizing the urgency of modernizing the NC3. USSTRATCOM Commander Gen. John E. Hyten recently stated in testimony before Congress: “A 21st century architecture is needed to address potential adversaries’ increasingly complex and capable threats. For example, current legacy communication systems, which are critical in

providing assured / secure communications to our heavy bombers and command & control aircraft through all phases of conflict, are increasingly unreliable and in desperate need of modernization.”²⁵⁸ Vice Chairman of the Joint Chiefs of Staff Gen. Paul Selva in the same Congressional hearing warned of “major consequences” if NC3 systems do not receive adequate funding.²⁵⁹ Highlighting the most significant implication of NC3 modernization, Gen. Hyten stated, “Any delay, deferment, or cancellation of NC3 modernization will create a capability gap potentially degrading the President’s ability to respond appropriately to a strategic threat.”²⁶⁰

What Needs To Be Done?

Keeping the NC3 effective and secure is a complex task. DoD has initiated numerous programs to modernize elements of the NC3. Examples of NC3 modernization efforts that need to continue include the following:

Sensors for warning and assessment. Sensors and processing facilities for the Integrated Tactical Warning and Attack Assessment system need to be upgraded. For example, the space-based Defense Support Program is nearing the end of its operational life. Plans for modernization include continuing the process of replacing this capability with the Space-Based Infrared System.

Secure conferencing and decision making. Support for time-critical decisions will require upgrades to E-4B National Airborne Operations Center aircraft, E-6B Airborne Command Post aircraft, and completion of the Presidential and National Voice Conferencing System.

Force management and execution. Sensors and conferencing capabilities, mentioned above, also contribute to force management and execution. In addition, important programs underway include the transition to the Advanced Extremely High Frequency (AEHF) satellite communications system and follow-on systems, Advanced Beyond Line-of-Sight terminals, and a modernized Very Low Frequency/Low Frequency communications capability.²⁶¹

Permissive Action Links (PALs). PALs provide technical capabilities for warheads to safeguard against unauthorized intrusions by adversaries that might gain custody of a nuclear weapon. In this age of cyber warfare threats, modern PALs are needed to prevent unauthorized use of nuclear warheads and enable assured use when properly authorized by the president.

The NC3 is a critical but often overlooked component of the US nuclear force. Modernization efforts now underway need to continue. In the current environment of cyber warfare and threats to space-based capabilities, the United States needs to ensure that potential adversaries are unable to block or otherwise interfere with US early warning, conferencing, and nuclear command and control capabilities.

¹ “Fleet Ballistic Missile Submarine—SSBN,” *United States Navy Fact File*, January 12, 2016, available at http://www.navy.mil/navydata/fact_display.asp?cid=4100&tid=200&ct=4.

² Office of the Deputy Assistant Secretary of Defense for Nuclear Matters (OASD [NCB/NM]), *The Nuclear Matters Handbook—2016* (Washington, D.C.: Office of the Assistant Secretary of Defense for Nuclear, Chemical, and

Biological Weapons Programs/Nuclear Matters, 2016), p. 26, available at <http://www.acq.osd.mil/ncbdp/nm/NMHB/index.htm>.

³ Strategic Systems Programs [SSP] Public Affairs, "Back to the Future with Trident Life Extension," *Undersea Warfare*, issue no. 48 (Spring 2012), p. 9; Franklin C. Miller, *The Need for a Strong Nuclear Deterrent In the 21st Century*, white paper (Washington, D.C.: Submarine Industrial Base Council, 2012), p. 8; Vice Adm. William Burke, USN, deputy chief of naval operations for warfare systems, "Navy Perspectives on Trident Strategic Modernization," remarks at the AFA-NDIA-ROA Capitol Hill Breakfast Forum, April 30, 2013, National Security Reports transcript, p. 4, available at <http://secure.afa.org/HBS/transcripts/2013/April%2030%20-%20Burke.pdf>; Rear Adm. Terry Benedict, USN, director, Strategic Systems Programs, "The Trident and Its Contribution to Deterrence," remarks at the AFA-NDIA-ROA Capitol Hill Breakfast Forum, July 20, 2012, National Security Reports transcript, p. 11, available at <http://secure.afa.org/HBS/transcripts/2012/7-20-2012%20Admiral%20Terry%20Benedict.pdf>; Rear Adm. Richard Breckenridge, USN, director, Undersea Warfare (OPNAV N97), "Navy Responds to Debate Over Size of the SSBN Force," *Navy Live: The Official Blog of the United States Navy*, May 16, 2013, available at <http://navylive.dodlive.mil/2013/05/16/navy-responds-to-debate-over-the-size-of-the-ssbn-force/>; and Ronald O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress*, R41129 (Washington, D.C.: Congressional Research Service, August 18, 2016), pp. 5-6, available at <https://www.hsdl.org/?view&did=795032>.

⁴ U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, D.C.: Department of Defense, April 2010), p. 22.

⁵ Ibid., p. 23.

⁶ Rear Adm. Joe Tofalo, USN, director, Undersea Warfare (OPNAV N97), "The Strategic Nuclear Enterprise: Implementing the Roadmap Ahead," *Submarine Review*, November 2014, p. 29; Vice Adm. Terry J. Benedict, USN, director, Strategic Systems Programs, in Senate Armed Services Committee (SASC), *Department of Defense Authorization for Appropriations for Fiscal Year 2015 and the Future Years Defense Program*, Part 7, S. Hrg. 113-465, Pt. 7, 113th Cong., 2d sess. (Washington, D.C.: GPO, 2015), p. 39; and Rear Adm. Barry Bruner, director, Undersea Warfare (OPNAV N97), cited in Sydney J. Freedberg, Jr., "Navy Fears Pentagon Neglects New Missile Sub; SSBN(X) Must Survive Almost 80 Years," *Breaking Defense*, October 18, 2012, available at <http://breakingdefense.com/2012/10/navy-fears-pentagon-neglects-new-missile-sub-ssbn-x-must-surv/>.

⁷ Rear Adm. Michael Jabaley, USN, program executive officer for submarines, remarks at Naval Submarine League 2016 Corporate Member Recognition Days, March 9, 2016, in *Submarine Review*, June 2016, pp. 116, 117, 119; Rear Adm. Charles Richard, USN, director, Undersea Warfare (OPNAV N97), remarks at Naval Submarine League 2016 Corporate Member Recognition Days, March 10, 2016, *Submarine Review*, June 2016, pp. 86, 92-93; O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program*, op. cit., p. 8; Rear Adm. Richard Breckenridge, USN, director, Undersea Warfare (OPNAV N97), "Facts We Can Agree Upon About Design of Ohio Replacement SSBN," *Navy Live: The Official Blog of the United States Navy*, June 26, 2013, available at <http://navylive.dodlive.mil/2013/06/26/facts-we-can-agree-upon-about-design-of-ohio-replacement-ssbn/>; Kris Osborn, "Navy Cites Breakthrough Acoustic Technology," *Scout Warrior*, June 20, 2016, available at <http://www.scout.com/military/warrior/story/1680206-navy-cites-new-acoustic-superiority-undersea>; Kris Osborn, "Ohio Replacement Subs to Shift to Electric Drive," *Defense Tech*, September 27, 2013, available at <http://www.defensetech.org/2013/09/27/ohio-class-subs-to-shift-to-electric-drive/>; and Sam LaGrone, "Ohio Replacement Sub Class to Be Named for D.C.," *USNI News*, July 29, 2016, available at <https://news.usni.org/2016/07/28/ohio-replacement-sub-class-named-d-c>.

⁸ Kris Osborn, "Navy Makes Submarines Quieter, More Stealthy," *Defense Tech*, October 24, 2014, available at <http://www.defensetech.org/2014/10/24/navy-makes-submarines-quieter-more-stealthy/>. See also Richard, remarks at Naval Submarine League 2016 Corporate Member Recognition Days, op. cit., pp. 92-93.

⁹ George Drakeley, executive director, Program Executive Office Submarines, remarks at 2015 Annual Symposium, Naval Submarine League, October 22, 2015, in *Submarine Review*, December 2015, pp. 97-98.

¹⁰ Richard, remarks at Naval Submarine League 2016 Corporate Member Recognition Days, op. cit., pp. 92-93.

¹¹ Robert Scher, Assistant Secretary of Defense for Strategy, Plans, and Capabilities, in House Armed Services Committee, *Fiscal Year 2016 Budget Request for Nuclear Forces*, HASC No. 114-38, 114th Congress, 2015, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg94749/html/CHRG-114hhrg94749.htm>.

¹² Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 74.

¹³ O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program*, op. cit., p. 7.

¹⁴ Undersea Warfare Division (OPNAV N97), Ohio Replacement Program Office (PMS 397), Naval Sea Systems Command (NAVSEA), and Navy Strategic Systems Programs (SSP), *OHIO Replacement: Meeting America's Enduring Requirement for Sea-Based Strategic Deterrence*, briefing slides, n.d., slide 4, available at http://www.multiwebs.net/pr/uss_ohio_replacement_message.pdf; and Burke, "Navy Perspectives on Trident Strategic Modernization," op. cit., p. 3.

¹⁵ O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program*, op. cit., p. 6.

¹⁶ Undersea Warfare Division (OPNAV N97), *Ohio Replacement SSBN: 21st Century Capability in an Affordable Platform at Responsible Cost*, n.d., available at <http://www.public.navy.mil/subfor/hq/Documents/OHIO%20Replacement%20Trifold.pdf>; M. Elaine Bunn, deputy assistant secretary of defense for nuclear and missile defense policy, in House Armed Services Committee (HASC), *Fiscal Year 2015 Budget Request for Atomic Energy Defense Activities and Nuclear Forces Programs*, HASC No. 113-107, 113th Cong., 2d sess. (Washington, D.C.: GPO, 2015), p. 56; Burke, "Navy Perspectives on Trident Strategic Modernization," op. cit, p. 4; and O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program*, op. cit., p. 6.

¹⁷ Burke, "Navy Perspectives on Trident Strategic Modernization," op. cit, p. 4.

¹⁸ "Question and Answer with Rear Admiral Joseph Tofalo on SSBN Survivability," op. cit., pp. 22, 23.

¹⁹ Breckenridge, "Facts We Can Agree Upon About Design of Ohio Replacement SSBN," op. cit.; and OPNAV N97, PMS 397, NAVSEA, and SSP, *OHIO Replacement: Meeting America's Enduring Requirement for Sea-Based Strategic Deterrence*, op. cit., slide 10.

²⁰ DoD, *Nuclear Posture Review Report*, op. cit., p. 23. On the SSBN Security Program, see Capt. Michael L. McHugh, USN, "The SSBN Security Program: The 'Fine Print' of America's Strategic Insurance Policy," *Undersea Warfare*, vol. 1, no. 1 (Fall 1998), available at http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/Archives/issue_01/ssbn.htm; Jerry Razmus, "SSBN Security," *Submarine Review*, April 1996, pp. 25-35; Razmus, "SSBN Security—Part 2," op. cit., pp. 34-45; Rear Adm. Charles Richard, USN, director of Undersea Warfare (OPNAV N97), "The Mirage of a Transparent Ocean," *Navy Live: The Official Blog of the United States Navy*, July 29, 2016, available at <http://navylive.dodlive.mil/2016/07/29/the-mirage-of-a-transparent-ocean/>; Committee on Capability Surprise on U.S. Naval Forces, Naval Studies Board, Division on Engineering and Physical Sciences, *Responding to Capability Surprise: A Strategy for U.S. Naval Forces* (Washington, D.C.: National Academies Press, 2013), pp. 44-45; and *Defense Science Board Task Force on The Role and Status of DoD Red Teaming Activities* (Washington, D.C.: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2003), pp. 7-8.

²¹ Department of Defense (DoD), *Report on Plan to Implement the Nuclear Force Reductions, Limitations, and Verification and Transparency Measures Contained in the New START Treaty Specified in Section 1042 of the National Defense Authorization Act for Fiscal Year 2012*, unclassified report (Washington, D.C.: Department of Defense, April 2014), p. 2; and Maj. Gen. Garrett Harencak, USAF, assistant chief of staff for strategic deterrence and nuclear integration, Headquarters USAF, “United States Strategic Interests and Current Triad Requirements,” briefing, Precision Strike Technology Symposium (PSTS-14), October 23, 2014, slide 5, available at <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&docname=GetTRDoc.pdf&ADNumber=AD1040000>.

²² "LGM-30 Minuteman III," U.S. Air Force fact sheet, September 30, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104466/lgm-30q-minuteman-iii.aspx>.

²³ William Burr, ed., *Launch on Warning: The Development of U.S. Capabilities, 1959-1979*, National Security Archive Electronic Briefing Book No. 43, April 2001, available at <http://nsarchive.gwu.edu/NSAEBB/NSAEBB43/>; and Department of Defense, *Report on Nuclear Employment Strategy of the United States Specified in Section 491 of 10 U.S.C.*, June 12, 2013, p. 5, available at http://www.defense.gov/Portals/1/Documents/pubs/ReporttoCongressonUSNuclearEmploymentStrategy_Section491.pdf.

²⁴ On the problems with launch under attack, see Walter B. Slocombe, "De-Alerting: Diagnoses, Prescriptions, and Side-Effects," discussion paper presented at the seminar on "Re-framing De-Alert: Decreasing the Operational Readiness of Nuclear Weapons Systems in the U.S.-Russia Context" in Yverdon, Switzerland, June 21-23, 2009, pp. 8-12, available at <https://www.eastwest.ngo/sites/default/files/events-downloads/Slocombe,%20Walter.pdf>. Slocombe served as under secretary of defense for policy from 1994-2001.

²⁵ Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, pp. 7-8, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>.

²⁶ Maj. Robert Leese, USAF, media operations officer, cited in Kingston Reif, "Air Force Clarifies New ICBM Plans," *Arms Control Today*, July/August 2016, available at https://www.armscontrol.org/ACT/2016_07/News-Briefs/Air-Force-Clarifies-New-ICBM-Plans; Lt. Gen. Jack Weinstein, USAF, deputy chief of staff for strategic deterrence and nuclear integration, Headquarters USAF, cited in Daniel Wasserbly, "USAF 'Not Looking at a Mobile GBSD' to Replace Minuteman Missiles," *IHS Jane's 360*, June 6, 2016, available at <http://www.janes.com/article/61002/usaf-not-looking-at-a-mobile-gbsd-to-replace-minuteman-missiles>; "Request for Information (RFI) #1, Ground Based Strategic Deterrent," January 23, 2015, p. 1, available at https://www.fbo.gov/index?s=opportunity&mode=form&id=64f0781d91f486ab27724cc75ad95cb0&tab=core&_cview=1; and Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), pp. 102, 108.

²⁷ Government Accountability Office (GAO), *ICBM Modernization: Approaches to Basing Options and Interoperable Warhead Designs Need Better Planning and Synchronization*, GAO-13-831 (Washington, D.C.: GAO, September 2013), pp. 11-13; and Kingston Reif, "Air Force Seeks Mobile ICBM Option," *Arms Control Today*, April 2016, available at https://www.armscontrol.org/ACT/2016_04/News/Air-Force-Seeks-Mobile-ICBM-Option.

²⁸ James Walker, Lewis Bernstein, and Sharon Lang, *Seize the High Ground: The Army in Space and Missile Defense* (Washington, D.C.: Center of Military History, 2003), pp. 63-77, 84-89, 94-96, 100-101, 103-104.

²⁹ See, for example, Research and Engineering Support Division, Institute for Defense Analyses, *The STRAT-X Report*, Vol. 1, R-122 (Arlington, Va.: Institute for Defense Analyses, August 1967), partially declassified version, pp. 4-6, 12-75, 88, 94-99, available at <http://nsarchive.gwu.edu/IMG/strat-Xreport.pdf>; Office of the Deputy Under Secretary of Defense for Research and Engineering (Strategic and Space Systems), *ICBM Basing Options: A Summary of Major Studies to Define a Survivable Basing Concept for ICBMs* (Washington, D.C.: Department of Defense, December 1980), available at <http://www.dtic.mil/cgi/tr/fulltext/u2/a956443.pdf>; Office of Technology Assessment, *MX Missile Basing*, OTA-ISC-140 (Washington, D.C.: Office of Technology Assessment, September 1981), available at <http://ota.fas.org/reports/8116.pdf>; Department of Defense, *Strategic Forces Technical Assessment Review* (Washington, D.C.: Department of Defense, March 31, 1983), partially declassified version, sections 5, 7, 8, available at http://www.dod.mil/pubs/foi/Reading_Room/MDA/252.pdf; and House Armed Services Committee, *MX Rail Garrison and Small ICBM: A Program Overview*, Committee Print No. 18, 100th Cong., 1st sess. (Washington, D.C.: GPO, 1988).

³⁰ See Keir Giles, *Russian Ballistic Missile Defense: Rhetoric and Reality* (Carlisle, Pa.: U.S. Army War College Strategic Studies Institute, June 2015); Jana Hankova, *Current Developments in Russia's Ballistic Missile Defense* (Washington, D.C.: George C. Marshall Institute, April 2013); Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China—2016*, Annual Report to Congress (Washington, D.C.: Department of Defense, 2016), pp. 31, 60-61; and Bruce W. MacDonald and Charles D. Ferguson, *Understanding the Dragon Shield: Likelihood and Implications of Chinese Strategic Ballistic Missile Defense* (Washington, D.C.: Federation of American Scientists, September 2015), pp. 30-31.

³¹ Rand, in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, op. cit., p. 17.

³² Quoted in Reif, "Air Force Seeks Mobile ICBM Option," op. cit. See also Col. Heath Collins, USAF, senior materiel leader and system program manager for the GBSD, Air Force Nuclear Weapons Center, cited in James Drew, "USAF Bars Exclusive Teaming with Rocket Shops for New ICBM," Aviation Week Network, *Aerospace Daily & Defense Report*, October 12, 2016, available at <http://aviationweek.com/defense/usaf-bars-exclusive-teaming-rocket-shops-new-icbm>.

³³ Bureau of Arms Control, Verification and Compliance, Department of State, "New START Aggregate Numbers of Strategic Offensive Arms," fact sheet, July 1, 2016, available at <http://www.state.gov/documents/organization/259485.pdf>; Amy F. Woolf, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, RL33640 (Washington, D.C.: Congressional Research Service, March 10, 2016), p. 21; and Keith B. Payne and John S. Foster et al., *Nuclear Force Adaptability for Deterrence and Assurance: A Prudent Alternative to Minimum Deterrence* (Fairfax, Va.: National Institute for Public Policy, 2014), p. 27. With special fittings, the D5 SLBM could carry 12 Mk4 reentry vehicles. Department of the Navy, *Vision, Presence, Power: A Program Guide for the U.S. Navy*, 1998 edition (Washington, D.C.: Office of the Chief of Naval Operations, May 1998), available at <http://www.navy.mil/navydata/policy/vision/vis98/vis-p09.html>.

³⁴ John S. Foster, Jr., "137. Memorandum From the Director of Defense Research and Engineering, Department of Defense (Foster) to Secretary of Defense McNamara," *State.gov*, August 2, 1966, available at <https://history.state.gov/historicaldocuments/frus1964-68v10/d137>; and, Robert S. McNamara, "139. Draft Memorandum From Secretary of Defense McNamara to President Johnson," *State.gov*, September 22, 1966, available at <https://history.state.gov/historicaldocuments/frus1964-68v10/d139>.

³⁵ Richard A. Hartunian, "Ballistic Missiles and Reentry Systems: The Critical Years," *Crosslink: The Aerospace Corporation Magazine of Advances in Aerospace Technology*, vol. 4, no. 1 (Winter 2002/2003), pp. 8-9; Air Force Reentry Programs, Lockheed Martin Space Systems Company, *Air Force Reentry Programs: Supporting the Land-based Strategic Missile Force* (King of Prussia, Pa.: LMSSC Air Force Reentry Programs, 2010), pp. 2, 4; and James B. Meyers (vice president and program manager, ICBM prime integration contract, Northrop Grumman Missile Systems Division), "The History of Minuteman—America's Sole Remaining ICBM," *High Frontier*, vol. 5, no. 2 (February 2009), pp. 36-37.

³⁶ *Report of the Defense Science Board Task Force on Future Strategic Strike Skills* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, March 2006), p. 27.

³⁷ See, for example, Committee on Conventional Prompt Global Strike Capability, National Research Council, *U.S. Conventional Prompt Global Strike: Issues for 2008 and Beyond* (Washington, D.C.: National Academies Press, 2008); and Amy F. Woolf, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, R41464 (Washington, D.C.: Congressional Research Service, February 24, 2016).

³⁸ DoD, *Report on Plan to Implement the Nuclear Force Reductions, Limitations, and Verification and Transparency Measures Contained in the New START Treaty Specified in Section 1042 of the National Defense Authorization Act for Fiscal Year 2012*, op. cit., p. 2; and Harenak, "United States Strategic Interests and Current Triad Requirements," op. cit., slide 5.

³⁹ Bureau of Arms Control, Verification, and Compliance, Department of State, "U.S. Nuclear Force Posture and De-Alerting," fact sheet, December 14, 2015, available at <http://www.state.gov/t/avc/rts/250644.htm>.

⁴⁰ Office of the Historian, Headquarters Strategic Air Command, *Alert Operations and the Strategic Air Command, 1957-1991* (Offutt Air Force Base, Neb.: Strategic Air Command, December 7, 1991), pp. 4, 24, 48-50, available at <http://www.siloworld.net/DOWNLOADS/Alert%20Operations%20and%20SAC%201957-1991%20rEDUCED.pdf>; and J.C. Hopkins and Sheldon A. Goldberg, Office of the Historian, Headquarters Strategic Air Command, *The Development of Strategic Air Command, 1946-1986 (The Fortieth Anniversary History)* (Offutt Air Force Base, Neb.: Strategic Air Command, September 1, 1986), pp. 65, 98, 147, available at <https://babel.hathitrust.org/cgi/pt?id=mdp.39015012025121;view=1up;seq=12>.

⁴¹ See, for example, Minot Air Force Base Public Affairs, "Team Minot Stays Vigilant," news release, May 15, 2015, available at <http://www.minot.af.mil/News/Article-Display/Article/806401/team-minot-stays-vigilant>; Staff Sgt. Jason McCasland, USAF, 2nd Bomb Wing Public Affairs, Barksdale Air Force Base, "Bomber Crews Showcase Take-off Talents," news release, August 15, 2014, available at <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/494298/bomber-crews-showcase-take-off-talents.aspx>; and Minot Air Force Base Public Affairs, "B-52s Ready to Rumble," news release, April 13, 2011, available at <http://www.minot.af.mil/News/Article-Display/Article/265149/b-52s-ready-to-rumble>.

⁴² Dick Cheney, secretary of defense, and Gen. Colin Powell, USA, chairman, Joint Chiefs of Staff, news briefing, September 28, 1991, Department of Defense transcript; William S. Cohen, secretary of defense, *Department of Defense Annual Report to the President and the Congress* (Washington, DC: Department of Defense, 2001), p. 92; and Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, p. 7, available at <http://docs.house.gov/meetings/AS/AS29/20160714/105199/HHRG-114-AS29-Wstate-RandR-20160714.pdf>.

⁴³ Like ground alert, dispersal has been adopted in the past to increase bomber prelaunch survivability. See Office of the Historian, Headquarters Strategic Air Command, *Alert Operations and the Strategic Air Command, 1957-1991*, op. cit., pp. 4-5, 16, 28.

⁴⁴ Lt. Gen. Stephen Wilson, USAF, deputy commander, U.S. Strategic Command, "STRATCOM: Reflections on the Past and a Look into the Future," remarks at the AFA-NDIA-ROA Capitol Hill Breakfast Forum, May 6, 2016, transcript, p. 9, available at http://media.wix.com/ugd/a2dd91_fc11eb254f0c4ab19a3365900641d37e.pdf; Lt. Gen. Michael R. "Mike" Moeller, USAF (ret.) (former deputy chief of staff for strategic plans and programs, Headquarters USAF), *US Bomber Force: Sustaining an Asymmetric Advantage for America* (Arlington, Va.: Mitchell Institute for Aerospace Studies, Air Force Association, 2015), p. 16; and Hans M. Kristensen and Robert S. Norris, "Nuclear Notebook: United States Nuclear Forces, 2016," *Bulletin of the Atomic Scientists*, vol. 72, no. 2 (March 2016), pp. 64, 69.

⁴⁵ Madelyn Creedon, principal deputy administrator, National Nuclear Security Administration, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 1, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Creedon-Testimony.pdf>. See also Department of Defense, written responses for the record, Defense Subcommittee, Senate Appropriations Committee, *Department of Defense Appropriations for Fiscal Year 2016*, hearing with Ashton B. Carter, secretary of defense, and Gen. Martin E. Dempsey, USA, chairman, Joint Chiefs of Staff, May 6, 2015, p. 62, available at

<https://www.gpo.gov/fdsys/pkg/CHRG-114shrg59104641/pdf/CHRG-114shrg59104641.pdf>; Robert Scher, assistant secretary of defense for strategy, plans, and capabilities, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 1, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Scher-Testimony.pdf>; and Adm. Cecil D. Haney, USN, commander, U.S. Strategic Command, in House Armed Services Committee (HASC), *Fiscal Year 2016 Budget Request for Strategic Forces*, HASC No. 114-14, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2015), p. 74.

⁴⁶ Wilson, prepared statement before the House Armed Services Committee, March 8, 2017, pp. 9-10; and Government Accountability Office, *Nuclear Weapons Sustainment: Improvements Made to Budget Estimates Report, but Opportunities Remain to Further Enhance Transparency*, GAO-16-23 (Washington, D.C.: GAO, December 2015), p. 12.

⁴⁷ Rand, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, op. cit., pp. 9-10.

⁴⁸ "A source who has been briefed on the new ALCM [LRSO] program," cited in Kingston Reif, "New Cruise Missile Capability Debated," *Arms Control Today*, January/February 2016, available at https://www.armscontrol.org/ACT/206_0102/News/New-Cruise-Missile-Capability-Debated.

⁴⁹ A 2015 Air Force request for information from contractors listed a supersonic engine as one option for the LRSO missile. See, U.S. Air Force Life Cycle Management Center, Strategic Systems Division, Long Range Stand Off Branch, "Long Range Stand Off (LRSO) Program," Request for Information, February 26, 2015, p. 2.

⁵⁰ William A. LaPlante, assistant secretary of the Air Force for acquisition, in House Armed Services Committee, *Air Force Projection Forces Aviation Programs and Capabilities for Fiscal Year 2016*, HASC No. 114-18, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2015), p. 21.

⁵¹ Rand, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, op. cit. p. 7.

⁵² Government Accountability Office, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-16-329SP (Washington, D.C.: GAO, March 2016), pp. 129-130; Government Accountability Office, *Department of Defense's Waiver of Competitive Prototyping Requirements for the Air Force's B-2 Defensive Management System Modernization Program*, GAO-14-522R (Washington, D.C.: GAO, April 22, 2014), p. 2; *Department of Defense Fiscal Year (FY) 2014 President's Budget Submission: Air Force Justification Book, Research, Development, Test & Evaluation, Air Force*, Vol. II (Washington, D.C.: Department of the Air Force, April 2013), p. 813; and *Department of Defense Fiscal Year (FY) 2017 President's Budget Submission: Air Force Justification Book, Research, Development, Test & Evaluation, Air Force*, Vol. II (Washington, D.C.: Department of the Air Force, February 2016), p. 723.

⁵³ The projects are part of the Low Observable Signature and Supportability Modifications (LOSSM) effort. See *Department of Defense Fiscal Year (FY) 2017 President's Budget Submission: Air Force Justification Book, Research, Development, Test & Evaluation, Air Force*, Vol. III, Part 1 (Washington, D.C.: Department of the Air Force, February 2016), p. 169.

⁵⁴ Lt. Gen. Stephen Wilson, USAF, commander, Air Force Global Strike Command, "AFGSC: Five Years of Moving Forward," remarks at the AFA-NDIA-ROA Capitol Hill Breakfast Forum, June 24, 2014, National Security Reports transcript, p. 18, available at <https://higherlogicdownload.s3.amazonaws.com/AFA/6379b747-7730-4f82-9b45-a1c80d6c8fdb/UploadedImages/Events/Heussy/062414afawilsondraft.pdf>.

⁵⁵ Norman Polmar and Robert S. Norris, *The U.S. Nuclear Arsenal: A History of Weapons and Delivery Systems Since 1945* (Annapolis, Md.: Naval Institute Press, 2009), pp. 207-208.

⁵⁶ See George J. Seiler, *Strategic Nuclear Force Requirements and Issues*, Research Report No. AU-ARI-82-1, revised edition (Maxwell Air Force Base, Ala.: Air University Press, February 1983), pp. 71, 152-153.

⁵⁷ Lt. Gen. Arnold W. Bunch, Jr., USAF, military deputy to the assistant secretary of the Air Force (acquisition), and Randall G. Walden, director, Air Force Rapid Capabilities Office, joint prepared statement in House Armed Services Committee (HASC), *USAF Bomber Force Structure—Current Requirements and Future Vision*, HASC No. 114-51, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2016), p. 38; and Mike Martin, Secretary of the Air Force Public Affairs, "Air Force Reveals B-21 Long Range Strike Bomber," Air Force news release, February 26, 2016, available at <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/673784/air-force-reveals-b-21-long-range-strike-bomber.aspx>.

⁵⁸ Bunn, in HASC, *Fiscal Year 2015 Budget Request for Atomic Energy Defense Activities and Nuclear Forces Programs*, op. cit., p. 178.

⁵⁹ Adm. C.D. Haney, USN, commander, U.S. Strategic Command, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 11, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Haney-Testimony.pdf>.

⁶⁰ Lt. Gen. James M. "Mike" Holmes, USAF, deputy chief of staff (strategic plans and requirements), Headquarters USAF, and Lt. Gen. Arnold W. Bunch, Jr., USAF, military assistant to the assistant secretary of the Air Force (acquisition), joint prepared statement in House Armed Services Committee, *Air Force Projection Forces Aviation Programs and Capabilities for Fiscal Year 2017*, HASC No. 114-103, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2016), p. 34.

⁶¹ Bunch and Walden, joint prepared statement in HASC, *USAF Bomber Force Structure—Current Requirements and Future Vision*, op. cit., p. 37.

⁶² William J. Perry, secretary of defense, *Department of Defense Annual Report to the President and the Congress* (Washington, D.C.: Department of Defense, February 1995), p. 88.

⁶³ OASD (NCB/NM), *The Nuclear Matters Handbook—2016*, op. cit., p. 31; Bunn, in HASC, *Fiscal Year 2015 Budget Request for Atomic Energy Defense Activities and Nuclear Force Programs*, op. cit., p. 61; and Department of Defense (DoD) and National Nuclear Security Administration (NNSA), "B61-12 Life Extension Program," fact sheet, reprinted in House Armed Services Committee (HASC), *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), p. 73.

⁶⁴ Amy F. Woolf, *Nonstrategic Nuclear Weapons*, RL32572 (Washington, D.C.: Congressional Research Service, March 23, 2016), p. 17.

⁶⁵ Gen. Herbert J. Carlisle, USAF, commander, Air Combat Command, prepared statement in House Armed Services Committee, *Air Dominance and the Critical Role of Fifth Generation Fighters*, HASC No. 114-132, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 29.

⁶⁶ *NATO's Nuclear Forces in the New Security Environment*, fact sheet (Brussels: NATO, October 22, 2009), p. 3, available at http://www.nato.int/nato_static/assets/pdf/pdf_topics/20091022_Nuclear_Forces_in_the_New_Security_Environment-eng.pdf.

⁶⁷ Department of State, "U.S. Nuclear Force Posture and De-Alerting," op. cit.

⁶⁸ Government Accountability Office, *Nuclear Weapons: DOD and NNSA Need to Better Manage Scope of Future Refurbishments and Risks to Maintaining U.S. Commitments to NATO*, GAO-11-387 (Washington, D.C.: GAO, May 2011), p. 5. See also NATO, "NATO's Nuclear Deterrence Policy and Forces," section on "The Role of NATO's Nuclear Forces," December 3, 2015, available at http://www.nato.int/cps/en/natohq/topics_50068.htm?selectedLocale=en.

⁶⁹ See remarks by Gen. Frank Gorenc, USAF, commander, U.S. Air Forces in Europe, cited in Sydney J. Freedberg, Jr., "Russians 'Closed The Gap' For A2/AD: Air Force Gen. Gorenc," *Breaking Defense*, September 14, 2015, available at <http://breakingdefense.com/2015/09/russians-closed-the-gap-for-a2ad-air-force-gen-gorenc/>; and John A. Tirpak, "Bears Watching," *Air Force Magazine*, vol. 99, no. 9 (September 2016), p. 43.

⁷⁰ See the discussion in Thomas Karako, *Looking East: European Air and Missile Defense after Warsaw* (Washington, D.C.: Center for Strategic and International Studies, July 14, 2016).

⁷¹ See remarks by Gen. Frank Gorenc, USAF, commander, U.S. Air Forces in Europe, in Tirpak, "Bears Watching," op. cit., pp. 41-42, and Freedberg, "Russians 'Closed The Gap' For A2/AD: Air Force Gen. Gorenc," op. cit.

⁷² Carlisle, in House Armed Services Committee, *Air Dominance and the Critical Role of Fifth Generation Fighters*, op. cit., p. 30.

⁷³ Gorenc, cited in Freedberg, "Russians 'Closed The Gap' For A2/AD: Air Force Gen. Gorenc," op. cit.

⁷⁴ Harencak, "United States Strategic Interests and Current Triad Requirements," op. cit., slide 13.

⁷⁵ Maj. Gen. Jeff Harrigian, USAF (director, F-35A Integration Office, Headquarters USAF) and Col. Max M. Marosko, USAF (deputy director, Air and Cyberspace Operations, Headquarters Pacific Air Forces), *Fifth Generation Air Combat: Maintaining the Joint Force Advantage*, Mitchell Forum Paper No. 6 (Arlington, Va.: Mitchell Institute for Aerospace Studies, July 2016), pp. 2-3.

⁷⁶ "Trident Fleet Ballistic Missile," *United States Navy Fact File*, January 17, 2009, available at http://www.navy.mil/navydata/fact_display.asp?cid=2200&tid=1400&ct=2.

⁷⁷ U.S. Department of State, “New START Aggregate Numbers of Strategic Offensive Arms,” *State.gov*, July 1, 2016, available at <https://2009-2017.state.gov/t/avc/rls/2016/259273.htm>.

⁷⁸ SSP Public Affairs, “Back to the Future with Trident Life Extension,” op. cit., p. 11.

⁷⁹ “LGM-30 Minuteman III,” U.S. Air Force fact sheet, op. cit.; and Lt. Gen. James M. Kowalski, USAF, commander, Air Force Global Strike Command, “Air Force Global Strike Command,” briefing, May 7, 2013, slide 17, available at <http://fas.org/programs/ssp/nukes/nuclearweapons/AFGSC-CommandBrief-May2013.pdf>.

⁸⁰ See the ranges cited in Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., pp. 166, 167, 170, 172, 173, 176, 182, 183.

⁸¹ “B-52 Stratofortress,” U.S. Air Force fact sheet, December 16, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104465/b-52-stratofortress.aspx>.

⁸² “AGM-86B/C/D Missiles,” U.S. Air Force fact sheet, May 24, 2010, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104612/agm-86bcd-missiles.aspx>.

⁸³ “B-2 Spirit,” U.S. Air Force fact sheet, December 16, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104482/b-2-spirit.aspx>.

⁸⁴ OASD (NCB/NM), *The Nuclear Matters Handbook—2016*, op. cit., p. 25.

⁸⁵ *U.S. Air Force Long-Range Strike Aircraft White Paper* (Washington, D.C.: Department of the Air Force, November 2001), p. A-1, available at <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=GetTRDoc&docName=a433970.pdf>.

⁸⁶ The unrefueled range for the B-1B is from “Airpower Classics: B-1,” *Air Force Magazine*, vol. 98, no. 9 (September 2015), p. 116.

⁸⁷ Maj. Gen. Richard M. Clark, USAF, commander, 8th Air Force, in House Armed Services Committee (HASC), *Update on Findings and Recommendations of the 2014 Department of Defense Nuclear Enterprise Review*, HASC No. 114-44, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2016), p. 63.

⁸⁸ The range for the Advanced Cruise Missile is from “AGM-129A Advanced Cruise Missile,” U.S. Air Force fact sheet, May 24, 2010, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104543/agm-129a-advanced-cruise-missile.aspx>.

⁸⁹ Boeing Company, “F-15 Strike Eagle,” available at <http://www.boeing.com/defense/f-15-strike-eagle/>; and Lockheed Martin Aeronautics Company, *F-16 Fighting Falcon: The Most Technologically Advanced 4th Generation Fighter in the World* (Fort Worth, Tex.: Lockheed Martin Aeronautics Company, n.d.), p. 2, available at http://www.lockheedmartin.com/content/dam/lockheed/data/aero/documents/f16/f16_brochure_a11-34324h001.pdf.

⁹⁰ Rebecca Grant, “Victor Alert,” *Air Force Magazine*, Vol. 94, No. 3 (March 2011), pp. 58-62; and text and related declassified sources cited in Hans M. Kristensen, Robert S. Norris, and Matthew G. McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Washington, D.C.: Federation of American Scientists and Natural Resources Defense Council, November 2006), pp. 134-135, 234.

⁹¹ “F-35A Lightning II Conventional Takeoff and Landing Variant,” U.S. Air Force fact sheet, April 11, 2014, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/478441/f-35a-lightning-ii-conventional-takeoff-and-landing-variant.aspx>.

⁹² OASD (NCB/NM), *The Nuclear Matters Handbook—2016*, op. cit., p. 25.

⁹³ Maj. Gen. Scott W. Jansson, USAF, commander, Air Force Nuclear Weapons Center, “Air Force Nuclear Weapons Center Update,” briefing, National Defense Industrial Association Gulf Coast Chapter 41st Air Armament Symposium, November 4, 2015, slide titled “B61-12 Tailkit Assembly,” available at http://www.ndiafgulfcoast.com/events/archive/41st_Symposium/Day2AFNWCJansson.pdf; and John R. Harvey, principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, in House Armed Services Committee, *Fiscal Year 2014 Budget Request for Atomic Energy Defense Activities and Nuclear Forces Programs*, HASC 113-45, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2013), p. 101.

⁹⁴ Walton S. Moody, *Building a Strategic Air Force* (Bolling Air Force Base, Washington, D.C.: Air Force History and Museums Program, 1995), pp. 205-216.

⁹⁵ Gregg Herken, *The Winning Weapon: The Atomic Bomb in the Cold War, 1945-1950* (New York: Alfred A. Knopf, 1980), p. 262.

⁹⁶ Hopkins and Goldberg, *The Development of Strategic Air Command, 1946-1986*, op. cit., pp. 42, 45, 53, 55, 58, 63, 64, 66, 71, 74, 83, 89, 97, 117, 120, 125, 126, 130, 131, 132, 139.

⁹⁷ Office of the Historian, Headquarters Strategic Air Command, *Alert Operations and the Strategic Air Command, 1957-1991*, op. cit., pp. 2-3.

⁹⁸ U.S. Air Force Long-Range Strike Aircraft White Paper, op. cit., p. 23.

⁹⁹ Headquarters Air Force Global Strike Command/A3TO, *Air Force Instruction 11-2B-2, Vol. 1: Flying Operations—B-2 Aircrew Training*, February 25, 2010, p. 82, available at http://static.e-publishing.af.mil/production/1/af_a3_5/publication/afi11-2b-2v1/afi11-2b-2v1.pdf.

¹⁰⁰ Gen. Ronald R. Fogelman, USAF, chief of staff, Headquarters USAF, “The Contributions of Long-Range Bombers to America’s Deep Strike Capability,” presentation to the Alexis de Tocqueville Institution Deep Strike Conference, September 13, 1996; and *Air Force Posture Statement—1998* (Washington, D.C.: Department of the Air Force, 1998), p. 31.

¹⁰¹ Headquarters Pacific Air Forces Public Affairs, “B-2s Conduct Deployment to Indo-Asia-Pacific,” news article, August 9, 2016, available at <http://www.pacom.mil/Media/News/News-Article-View/Article/909485/b-2s-conduct-deployment-to-indo-asia-pacific/>.

¹⁰² Headquarters Pacific Air Forces Public Affairs, “All Global Strike Bombers Deploy to Andersen, Maintain Stability in Pacific Command Theater,” news article, August 11, 2016, available at <http://www.pacom.mil/Media/News/News-Article-View/Article/912080/all-global-strike-bombers-deploy-to-andersen-maintain-stability-in-pacific-comm/>.

¹⁰³ Prepared statement in House Armed Services Committee, *How Is DoD Responding to Emerging Security Challenges in Europe?* HASC No. 114-10, 114th Cong., 1st sess. (Washington, DC: GPO, 2016), p. 80.

¹⁰⁴ Clark, in House Armed Services Committee, *Update on Findings and Recommendations of the 2014 Department of Defense Nuclear Enterprise Review*, op. cit., p. 58.

¹⁰⁵ George Little, assistant to the secretary of defense for public affairs, quoted in James Garamore, “Bombers Show U.S. Resolve to Defend South Korea, Spokesman Says,” American Forces Press Service, March 18, 2013, available at <http://archive.defense.gov/news/newsarticle.aspx?id=119555>; Pacific Air Forces Public Affairs, “B-52 Flies Mission Over ROK,” news article, March 19, 2013, available at <http://www.pacaf.af.mil/News/ArticleDisplay/tabid/377/Article/592429/b-52-flies-mission-over-rok.aspx>; and United States Forces Korea, “U.S. B-2 Bombers Conduct Extended Deterrence Mission to the Republic of Korea,” news article, March 28, 2013, available at <http://www.afgsc.af.mil/News/ArticleDisplay/tabid/2612/Article/454647/us-b-2-bombers-conduct-extended-deterrence-mission-to-the-republic-of-korea.aspx>.

¹⁰⁶ Media Availability with Deputy Secretary Carter at the United States Embassy, Seoul, South Korea, March 18, 2013, Department of Defense transcript, available at <http://archive.defense.gov/Transcripts/Transcript.aspx?TranscriptID=5206>.

¹⁰⁷ U.S. Pacific Command Public Affairs, “In a Show of Resolve, U.S. Sends B-52, F-16s for Bilateral Overflight With South Korea,” news article, January 9, 2016, available at <http://www.pacom.mil/Media/News/News-Article-View/Article/642118/in-a-show-of-resolve-us-sends-b-52-f-16s-for-bilateral-overflight-with-south-ko/>; United States Forces Korea, “ROK-U.S. Alliance Aircraft Conduct Extended Deterrence Mission,” press release, January 9, 2016, available at <http://www.usfk.mil/Media/Press-Releases/Article/642120/rok-us-alliance-aircraft-conduct-extended-deterrence-mission/>; and DoD and NNSA, “B61-12 Life Extension Program,” op. cit., p. 73.

¹⁰⁸ Jim Miklaszewski and Courtney Kube, “U.S. Bombers Fly Over Disputed Island Chain Without Informing China,” NBC News, November 26, 2013, available at <http://www.nbcnews.com/news/other/u-s-bombers-fly-over-disputed-island-chain-without-informing-f2D11658767>; and Col. Steve Warren, USA, director of defense press operations, Office of the Secretary of Defense, quoted in Tim Kelly and Phil Stewart, “Defying China, U.S. Bombers and Japanese Planes Fly Through New Air Zone,” Reuters, November 27, 2013, available at <http://www.reuters.com/article/us-china-defense-usa-idUSBRE9AP0X320131127>.

¹⁰⁹ Unnamed official quoted in Thom Shanker, “U.S. Sends Two Bombers Into Air Zone Claimed by China,” *New York Times*, November 26, 2013, available at http://www.nytimes.com/2013/11/27/world/asia/us-flies-b-52s-into-chinas-expanded-air-defense-zone.html?_r=0.

¹¹⁰ Ian E. Rinehart and Bart Elias, *China’s Air Defense Identification Zone (ADIZ)*, R43894 (Washington, D.C.: Congressional Research Service, January 30, 2015), p. 19.

¹¹¹ Senior Airman Malia Jackson, USAF, Minot Air Force Base Public Affairs, “USSTRATCOM Bombers Practice Key Capabilities,” news article, June 9, 2015, available at <http://www.minot.af.mil/News/Article-Display/Article/806374/usstratcom-bombers-practice-key-capabilities>; and Tony Osborne, “Bombers in Britain,” Aviation Week Network, Ares blog, June 22, 2015, available at <http://aviationweek.com/blog/bombers-britain>.

¹¹² U.S. Air Forces in Europe and Air Forces Africa, "Dyess B-1s to Deploy to Europe for Ample Strike," news article, September 3, 2016, available at <http://www.usafe.af.mil/News/Article-Display/Article/932479/dyess-b-1s-deploy-to-europe-for-ample-strike/>; and NATO Allied Air Command, "JTAC Exercise Ample Strike 2016 to Start in Czech Republic," news article, August 30, 2016, available at <https://www.airn.nato.int/archive/2016/complex-jtac-exercise-ample-strike-to-start-in-czech-republic>.

¹¹³ Lt. Col. Brad Dyer, USAF, commander, 23rd Expeditionary Bomb Squadron, quoted in Osborne, "Bombers in Britain," op. cit.

¹¹⁴ Jacek Durkalec, *Nuclear-Backed "Little Green Men": Nuclear Messaging in the Ukraine Crisis* (Warsaw: Polish Institute of International Affairs, July 2015), p. 35, available at https://www.pism.pl/files/?id_plik=20165.

¹¹⁵ Rebecca Grant, "Bomber Diplomacy," *Air Force Magazine*, vol. 94, no. 12 (December 2011), pp. 30-33; and Amy McCullough, "Bombers on Guam," *Air Force Magazine*, vol. 98, no. 8 (August 2015), pp. 20-25.

¹¹⁶ Pacific Air Forces Public Affairs, "B-52 Flies Mission Over ROK," news article, March 19, 2013, available at <http://www.andersen.af.mil/News/tabid/1981/Article/414776/b-52-flies-mission-over-rok.aspx>.

¹¹⁷ See, for example, Pacific Air Forces Public Affairs, "U.S. Air Force B-52 Takes Part in Bilateral Training at RAAF Darwin," news article, January 28, 2014, available at <http://www.pacaf.af.mil/News/ArticleDisplay/tabid/377/Article/591686/us-air-force-b-52-takes-part-in-bilateral-training-at-raaf-darwin.aspx>; Chuck Oldham, "B-52 Lands at RAAF Base Darwin," Defense Media Network, December 11, 2014, available at <http://www.defensemedianetwork.com/stories/b-52-lands-at-raaf-base-darwin/>; Gen. Lori Robinson, USAF, commander, Pacific Air Forces, "PACAF Projects Power Throughout the Pacific," commentary, March 2, 2016, available at <http://www.pacaf.af.mil/News/ArticleDisplay/tabid/377/Article/683391/commentary-pacaf-projects-power-throughout-the-pacific.aspx>; and Capt. Raymond Geoffrey, USAF, Headquarters Pacific Air Forces Public Affairs, "Bombers Span 5K Miles, Demonstrate Capability During Busy Week of Operations," news article, June 24, 2016, available at <http://www.afgsc.af.mil/News/ArticleDisplay/tabid/2612/Article/813637/bombers-span-5k-miles-demonstrate-capability-during-busy-week-of-operations.aspx>.

¹¹⁸ Gen. Lori Robinson, USAF, commander, Pacific Air Forces, meeting with Defense Writers Group, transcript, November 18, 2015, p. 12, available at <http://www.airforcemag.com/DWG/Documents/2015/111815Robinson.pdf>. See also Andrew Greene, "Long-Range Heavy Bombers Could be Based in Australia, U.S. General Reveals," Australian Broadcasting Corporation, March 8, 2016, available at <http://www.abc.net.au/news/2016-03-08/long-range-bombers-could-rotate-through-nt-general-says/7231098>; and Jonathan Pearlman and Neil Conner, "US to Rotate Long-Range Bombers Through Australia," *The Telegraph* (London), March 9, 2016, available at <http://www.telegraph.co.uk/news/worldnews/australiaandthepacific/australia/12189054/US-to-rotate-long-range-bombers-through-Australia.html>.

¹¹⁹ Air Force Central Command Public Affairs, "B-52 Stratofortress Joins Coalition Team," news article, April 9, 2016, available at <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/717091/b-52-stratofortress-joins-coalition-team.aspx>; Gen. David Goldfein, USAF, chief of staff, Headquarters USAF, Department of Defense press briefing with Secretary of the Air Force Deborah Lee James, August 10, 2016, Department of Defense transcript, available at <https://www.defense.gov/News/Transcripts/Transcript-View/Article/911083/department-of-defense-press-briefing-by-secretary-james-and-gen-goldfein-on-the>; and Brian W. Everstine, "Continuous Sandbox Presence," *Air Force Magazine*, vol. 100, no. 4 (April-May 2017), pp. 30-35, available at http://www.airforcemag.com/MagazineArchive/Documents/2017/April%202017/0417_Everstine_Bomber.pdf.

¹²⁰ Philip Nash, *The Other Missiles of October: Eisenhower, Kennedy, and the Jupiters, 1957-1963* (Chapel Hill, N.C.: University of North Carolina Press, 1997), pp. 163-166. See also Department of State, *Foreign Relations of the United States, 1961-1963, Vol. XVI: Eastern Europe; Cyprus; Greece; Turkey* (Washington, D.C.: GPO, 1994), Documents 380, 382-387, 389-394.

¹²¹ Hans M. Kristensen, "When the Boomers Went To South Korea," *Federation of American Scientists Strategic Security Blog*, October 4, 2011, available at <https://fas.org/blogs/security/2011/10/ssbnrok/>.

¹²² Kristensen and Norris, "Nuclear Notebook: United States Nuclear Forces, 2016," op. cit., p. 68.

¹²³ Michael Melia, "Port Visits Resume for Nuclear-Armed Navy Subs," Associated Press, December 21, 2015, available at <http://www.usnews.com/news/us/articles/2015-12-21/apnewsbreak-port-visits-resume-for-nuclear-armed-navy-subs>. The former Submarine Forces commander cited is Vice Adm. Michael Connor.

¹²⁴ Capt. Andy Hale, USN, quoted in "USS Ohio Arrives in Busan, Republic of Korea," Commander, Submarine Group 7 Public Affairs, February 20, 2008.

¹²⁵ U.S. Strategic Command Public Affairs, "SSBN Arrives at Her Majesty's Naval Base Clyde for Port Visit," September 16, 2015, available at https://www.stratcom.mil/news/2015/577/SSBN_Arrives_at_Her_Majestys_Naval_Base_Clyde_for_Port_Visit/.

¹²⁶ Unnamed official quoted in James Moncur, "US Defence Send Warning to Putin as Trident Sub Docks on Clyde Armed with Ballistic Missiles," *Daily Record and Sunday Mail*, September 19, 2015, available at <http://www.dailyrecord.co.uk/news/scottish-news/defence-send-warning-putin-trident-6473095>.

¹²⁷ Vice Adm. Joe Tofalo, USN, commander, Submarine Forces, "Commander's Intent for the United States Submarine Force and Supporting Organizations," *Submarine Review*, June 2016, p. 82.

¹²⁸ Keynote speech at Strategic Systems Programs (SSP) Historical, Educational and Recognition Organization (HERO) Fleet Ballistic Missile Program's 60th Anniversary event, October 2, 2015, quoted in Amaani Lyle, "Work Chronicles History at Fleet Ballistic Missile Program Event," Department of Defense news article, October 3, 2015, available at <http://www.defense.gov/News/Article/Article/621748/work-chronicles-history-at-fleet-ballistic-missile-program-event>.

¹²⁹ "US Defence Send Warning to Putin as Trident Sub Docks on Clyde Armed with Ballistic Missiles," op. cit.

¹³⁰ U.S. Strategic Command Public Affairs, "USS Tennessee Arrives in Scotland for Port Visit," October 7, 2016, available at <http://www.stratcom.mil/Media/News/News-Article-View/Article/997925/uss-tennessee-arrives-in-scotland-for-port-visit/>.

¹³¹ Submarine Force, U.S. Pacific Public Affairs, "Ballistic Missile Submarine Pennsylvania Visits Guam," October 31, 2016, available at <http://www.cpf.navy.mil/news.aspx/110155>.

¹³² Mass Communications Specialist 1st Class Amanda R. Gray, USN, "USS Pennsylvania (B) Returns to NBK-Bangor," Navy News Service, NNS161227-01, December 27, 2016, available at http://www.navy.mil/submit/display.asp?story_id=98288#.

¹³³ Cdr. Tommy Crosby, USN, force public affairs officer for commander, Submarine Forces, cited in Melia, "Port Visits Resume for Nuclear-Armed Subs," op. cit.

¹³⁴ "Warsaw Summit Communiqué: Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Warsaw 8-9 July 2016," NATO Press Release (2016) 100, July 9, 2016, available at http://www.nato.int/cps/en/natohq/official_texts_133169.htm.

¹³⁵ Madelyn R. Creedon, assistant secretary of defense for global strategic affairs, in House Armed Services Committee (HASC), *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), p.117; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the Nuclear Mission* (Washington, D.C.: Department of Defense, December 2008), p. 15; Michael Rühle, *The Broader Context of NATO's Nuclear Policy and Posture*, Research Paper No. 89 (Rome: Research Division, NATO Defense College, January 2013), p. 6; Guy B. Roberts, deputy assistant secretary general for WMD policy, and director, nuclear policy, defense and policy planning division, NATO, "NATO's New Strategic Concept: Implications for the Extended Deterrent and Ways Ahead," briefing, December 14, 2010, slide titled "Burden Sharing"; Roberts, "The Present and Future of NATO's Deterrence and Defense Posture," lecture to the Defense and Strategic Studies Program, Missouri State University, Washington, D.C., February 14, 2013; and Susi Snyder and Wilbert van der Zeijden, *Withdrawal Issues: What NATO Countries Say About the Future of Tactical Nuclear Weapons in Europe* (Utrecht, The Netherlands: IKV Pax Christi, March 2011), p. 17.

¹³⁶ DoD, *Nuclear Posture Review Report*, op. cit., p. xiii; DoD and NNSA, "B61-12 Life Extension Program," op. cit.; and Lt. Gen. Frank G. Klotz, USAF (ret.), administrator, National Nuclear Security Administration, written response for the record, in House Appropriations Committee (HAC), *Energy and Water Development Appropriations for 2016*, Part 8, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2015), p. 55.

¹³⁷ Keith B. Payne and Thomas Scheber, "Appendix E. An Adaptable Nuclear Force for the 2030+ Security Environment," in Clark Murdock et al., *Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025-2050* (Washington, D.C.: Center for Strategic and International Studies, May 2015), p. 78.

¹³⁸ Robert S. Dudney with Walter J. Boyne, "Airpower Classics: F-16 Fighting Falcon," *Air Force Magazine*, vol. 98, no. 10 (October 2015), p. 76; Dudney with Boyne, "Airpower Classics: F-15 Eagle/Strike Eagle," *Air Force Magazine*, vol. 98, no. 12 (December 2015), p. 76; and Dudney with Boyne, "Airpower Classics: F-35 Lightning II," *Air Force Magazine*, vol. 99, no. 7 (July 2016), p. 88.

¹³⁹ Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., pp. 44, 48-49, 52-54, 57-58, 61-62, 64-68, 69-70; Department of Energy (DOE), National Nuclear Security Administration (NNSA), *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), p. 1-3; and Office of the Historian, Headquarters Strategic Air Command, *From Snark to Peacekeeper: A Pictorial History of Strategic Air Command Missiles* (Offutt Air Force Base, Neb.: Office of the Historian, Headquarters Strategic Air Command, May 1, 1990), pp. 60-71.

¹⁴⁰ DOE/NNSA, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, op. cit., pp. 2-4, 2-5, 2-8, 4-34—4-36.

¹⁴¹ Office of the Historian, Headquarters Strategic Air Command, *Alert Operations and the Strategic Air Command, 1957-1991*, op. cit., pp. 48-50; and DoD, *Nuclear Posture Review Report*, op. cit., pp. 22, 25.

¹⁴² Rand, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, op. cit., p. 4; Bureau of Arms Control, Verification, and Compliance, Department of State, “New START Aggregate Numbers of Strategic Offensive Arms,” op. cit.; and Woolf, *U.S. Strategic Nuclear Forces*, op. cit., p. 21.

¹⁴³ Maj. Gen. Garrett Harencak, USAF, assistant chief of staff for strategic deterrence and nuclear integration, Headquarters U.S. Air Force, written response for the record, in House Armed Services Committee (HASC), *Fiscal Year 2016 Budget Request for Nuclear Forces*, HASC No. 114-38, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2015), p. 88; and Benedict, in SASC, *Department of Defense Authorization for Appropriations for Fiscal Year 2015 and the Future Years Defense Program*, Part 7, op. cit., p. 46.

¹⁴⁴ *U.S. Air Force Long-Range Strike Aircraft White Paper*, op. cit., p. A-1.

¹⁴⁵ Memorandum of Understanding on the Establishment of the Data Base Relating to the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms, in Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements: START* (Washington, D.C.: Arm Control and Disarmament Agency, 1991), p. 120. Throw-weight is the useful weight—reentry vehicles, postboost vehicle, penetration aids—carried by the boost stages of a ballistic missile.

¹⁴⁶ Maj. Melissa Milner, USAF, media operations officer, quoted in Kingston Reif, “Air Force Drafts Plan for Follow-On ICBM,” *Arms Control Today*, July/August 2015, available at https://www.armscontrol.org/ACT/2015_0708/News/Air-Force-Drafts-Plan-for-Follow-on-ICBM; and “Request for Information (RFI) #1, Ground Based Strategic Deterrent,” op. cit., p. 1.

¹⁴⁷ Hans M. Kristensen and Robert S. Norris, “United States Nuclear Forces, 2017,” *Bulletin of the Atomic Scientists*, vol. 73, no. 1 (January 2017), pp. 50, 51.

¹⁴⁸ On the diameter and length of the launch tubes on the *Columbia*-class SSBN, see O’Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program*, op. cit., p. 7.

¹⁴⁹ National Nuclear Security Administration, Document #2, “B61-12 LEP Enables Stockpile Reductions,” and Madelyn R. Creedon, assistant secretary of defense for global strategic affairs, written responses for the record, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), pp. 75, 135.

¹⁵⁰ Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, National Research Council, *Effects of Nuclear Earth-Penetrator and Other Weapons* (Washington, D.C.: National Academies Press, 2005), pp. 26-27.

¹⁵¹ Lt. Gen. Michael T. Flynn, USA, director, Defense Intelligence Agency, in Senate Armed Services Committee, *Current and Future Threats to the National Security of the United States*, S. Hrg. 113-571, 113th Cong., 2d sess. (Washington, D.C.: GPO, 2015), p. 35.

¹⁵² Secretary of Defense Chuck Hagel and Secretary of Energy Ernest J. Moniz, letter to Sen. Diane Feinstein, chairwoman, Energy and Water Development Subcommittee, Senate Appropriations Committee, November 6, 2013.

¹⁵³ Department of Defense, “Declassification of Formerly Restricted Data,” n.d., available at <http://open.defense.gov/Initiatives/FRD-Declassification/>; Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, *Effects of Nuclear Earth-Penetrator and Other Weapons*, op. cit., p. 26; and National Nuclear Security Administration, “B53 Nuclear Bomb,” October 25, 2011, available at <http://nnsa.energy.gov/mediaroom/factsheets/b53factsheet>.

¹⁵⁴ Scher, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, op. cit., p. 3. On the problems with the ALCM-B, see the assessments of STRATCOM commander Adm. Haney, written response for the record in HASC, *Fiscal Year 2016 Budget Request for Strategic Forces*, op. cit., p. 74; and John R. Harvey, former principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, “Sustaining Consensus on Triad Modernization: Transition to the Next Administration,” presented to the AFA-Peter Huessy Breakfast Seminar Series, July 29, 2016, p. 5, available at http://media.wix.com/ugd/a2dd91_34f718a66a044299a1bc968d8fb3699a.pdf.

¹⁵⁵ Northrop Grumman Corporation, “Intercontinental Ballistic Missile,” data sheet, 2016, available at http://www.northropgrumman.com/Capabilities/ICBM/Documents/ICBM_Datasheet.pdf; and Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., pp. 62, 69.

¹⁵⁶ On arms control, downloading, and uploading, see John M. Deutch, deputy secretary of defense, in Senate Armed Services Committee, *Briefing on Results of the Nuclear Posture Review*, S. Hrg. 103-870, 103d Cong., 2d sess. (Washington, D.C.: GPO, 1994), pp. 11-14; Gen. Richard B. Myers, USAF, chairman, Joint Chiefs of Staff, in Senate Foreign Relations Committee, *Treaty on Strategic Offensive Reduction: The Moscow Treaty*, S. Hrg. 107-622, 107th Cong., 2d sess. (Washington, D.C.: GPO, 2002), pp. 90-91; and James N. Miller, deputy under secretary of defense for policy, in Senate Foreign Relations Committee, *The New START Treaty (Treaty Doc. 11-5)*, S. Hrg. 111-738, 111th Cong., 2d sess. (Washington, D.C.: GPO, 2010), p. 274. For the sources of the quoted phrases, see, in order, William J. Perry, secretary of defense, *Department of Defense Annual Report to the President and the Congress* (Washington, D.C.: GPO, February 1995), p. 10 (and pp. 85-86); Donald H. Rumsfeld, secretary of defense, *Department of Defense Annual Report to the President and the Congress* (Washington, D.C.: GPO, 2002), p. 89; and DoD, *Nuclear Posture Review Report*, op. cit., p. 25.

¹⁵⁷ U.S. Department of State, “New START Aggregate Numbers of Strategic Offensive Arms,” *State.gov*, July 1, 2016, available at [https://2009-2017.state.gov/t/avc/rts/2016/259273.htm.](https://2009-2017.state.gov/t/avc/rts/2016/259273.htm;); and, U.S. Department of State, *Report of the United States of America Pursuant to Actions 5, 20, 21, of the 2010 Nuclear Non-Proliferation Treaty Review Conference Final Document, Updated 2015 Report* (Washington, D.C.: Department of State, April 27, 2015), p. 3, available at <https://www.state.gov/documents/organization/241363.pdf>.

¹⁵⁸ This calculation can be found with greater detail and supporting references in Payne and Foster et al., *Nuclear Force Adaptability for Deterrence and Assurance: A Prudent Alternative to Minimum Deterrence*, op. cit., p. 27, available at <http://www.nipp.org/wp-content/uploads/2014/12/MD-II-for-web.pdf>.

¹⁵⁹ “The Prague Nuclear Agenda,” White House fact sheet, January 11, 2017, available at <https://www.whitehouse.gov/the-press-office/2017/01/11/fact-sheet-prague-nuclear-agenda>; Gary Samore, coordinator for arms control and weapons of mass destruction terrorism, National Security Council, quoted in “Obama Adviser Gary Samore: ‘The Ball Is Very Much in Tehran’s Court’” (interview), Radio Free Europe/Radio Liberty, April 14, 2011, available at http://www.rferl.org/content/interview_samore_russia_iran_us_policy/3557326.html; and Guy Roberts, NATO deputy assistant secretary general for weapons of mass destruction policy, quoted in Oliver Meier, “U.S. Cuts Tactical Nuclear Weapons in Europe,” *Arms Control Today*, vol. 37, no. 7 (September 2007), available at http://www.armscontrol.org/act/2007_09/TacticalNuclearEurope; and OASD (NCB/NM), *The Nuclear Matters Handbook—2016*, op. cit., pp. 25, 39-41.

¹⁶⁰ Ibid.

¹⁶¹ In October 2006, Secretary of Defense Donald Rumsfeld directed the Air Force to reduce the number of ALCM-Bs to 528 missiles. All “excess ALCM missile bodies” were to be destroyed. See Maj. Gen. Roger Burg, USAF, director of strategic security, Office of the Deputy Chief of Staff for Operations, Plans, and Requirements, Headquarters U.S. Air Force, prepared statement in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2008*, Part 7, S. Hrg. 110-201, Pt. 7, 110th Cong., 1st sess. (Washington, D.C.: GPO, 2008), p. 56. Unless some number of ALCM-Bs beyond 528 have been retained for testing purposes, flight tests since the 2006 decision have reduced the size of the ALCM-B fleet available for wartime use. According to one source, ALCM-B flight tests for the Nuclear Weapon System Evaluation Program are conducted “six or seven times per year depending on available funds.” See “Official: ALCM Remains Accurate, Reliable Strategic Deterrent,” *InsideDefense.com*, October 17, 2014, available at <https://nukewatch.org/media2/postData.php?id=3175>. (Note that this source gives the number of ALCM-Bs at that time as 560.) The cruise missile-carrying capacity of the B-52H can be found in *U.S. Air Force Long-Range Strike Aircraft White Paper*, op. cit., p. A-1.

¹⁶² GAO, *ICBM Modernization: Approaches to Basing Options and Interoperable Warhead Designs Need Better Planning and Synchronization*, op. cit., pp. 7, 18.

¹⁶³ Undersea Warfare Division (OPNAV N97), *Ohio Replacement SSBN: 21st Century Capability in an Affordable Platform at Responsible Cost*, op. cit.

¹⁶⁴ Thomas Lee, “The History of America’s Undersea Strategic Deterrence: From V-1 to D5,” *Undersea Warfare*, issue no. 60 (Winter 2016), p. 17.

¹⁶⁵ Adm. Kirkland H. Donald, USN, deputy administrator for naval reactors, and director, naval nuclear propulsion, National Nuclear Security Administration, in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2012 and the Future Years Defense Program*, Part 7, S. Hrg. 112-80, Pt. 7, 112th Cong., 1st sess. (Washington, D.C.: GPO, 2012), p. 71: “[For the Columbia-class SSBN] we were challenged to drive the cost of that ship down. As far as our part was concerned, one of the key decisions that was made, that helped us in that regard, was the decision to go from 20 missile tubes to 16 missile tubes. Because, what that allowed us to do was to downrate the propulsion power that was needed. So, obviously, it’s a smaller reactor that you would need. But, what it also allowed us to do was to go back—the size fell into the envelope where we could go back and use components that we had already designed for the Virginia-class [SSN] and bring those into this design—not to have to do it over again, but, several mechanical components, to use those over again. It enabled

us to drive the costs of that propulsion plant down and rely on proven technology that's—pumps and valves and things like that don't change like electronics do. So, we're pretty comfortable putting that in a ship that will be around til 2080. But, we were allowed to do that."

¹⁶⁶ Harencak, in HASC, *Fiscal Year 2016 Budget Request for Nuclear Forces*, op. cit., p. 88.

¹⁶⁷ Department of Defense, *Report on Nuclear Employment Strategy of the United States Specified in Section 491 of 10 U.S.C.*, op. cit., pp. 6-7; and Klotz, written response for the record, in HAC, *Energy and Water Development Appropriations for 2016*, Part 8, op. cit., p. 55.

¹⁶⁸ Lt. Gen. Frank Klotz, USAF (ret.), administrator, National Nuclear Security Administration, prepared statement before Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, p. 3, available at <http://docs.house.gov/meetings/AS/AS29/20160714/105199/HHRG-114-AS29-Wstate-KlotzF-20160714.pdf>; Elizabeth Sherwood-Randall, deputy secretary of energy, in House Armed Services Committee, *Nuclear Deterrence in the 21st Century*, HASC No. 114-43, 114th Cong., 1st sess. (Washington, DC: GPO, 2016), p. 54; Department of Energy (DOE), National Nuclear Security Administration (NNSA), *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: DOE/NNSA, March 2015), p. 1-7; Thomas Scheber, *Reliable Replacement Warheads: Perspectives and Issues*, United States Nuclear Strategy Forum Publication No. 0005 (Fairfax, Va.: National Institute Press, August 2007), p. 9; and John R. Harvey, former principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, January 26, 2016, p. 6, available at http://www.armed-services.senate.gov/imo/media/doc/Harvey_01-27-16.pdf.

¹⁶⁹ DoD and NNSA, "B61-12 Life Extension Program," op. cit., p. 73; and Klotz, prepared statement before Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, op. cit., p. 3.

¹⁷⁰ DOE/NNSA, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, op. cit., p. 1-6.

¹⁷¹ "B-52 Stratofortress," U.S. Air Force fact sheet, op. cit.

¹⁷² "LGM-30 Minuteman III," U.S. Air Force fact sheet, op. cit.

¹⁷³ "AGM-86B/C/D Missiles," U.S. Air Force fact sheet, op. cit.

¹⁷⁴ "B-1B Lancer," U.S. Air Force fact sheet, December 16, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104500/b-1b-lancer.aspx>.

¹⁷⁵ O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program*, op. cit., p. 3; Bill Sweetman, *Inside the Stealth Bomber* (Osceola, Wis.: MBI Publishing Co., 1999), p. 126; and Northrop Grumman Corporation, "The B-2 Spirit Stealth Bomber Turns 25," fact sheet, July 9, 2014, p. 2, available at http://www.northropgrumman.com/Capabilities/B2SpiritBomber/Documents/pageDocuments/B-2_25th_Anniversary_Fact_Sheet.pdf.

¹⁷⁶ "U.S. Nuclear Modernization Programs," Arms Control Association fact sheet, October 2016, available at <https://www.armscontrol.org/factsheets/USNuclearModernization>; Vice Adm. Terry J. Benedict, USN, director, Strategic Systems Programs, U.S. Navy, in House Armed Services Committee, *Fiscal Year 2015 Budget Request for Atomic Energy Defense Activities and Nuclear Force Programs*, HASC 113-107, 113th Cong., 2d sess. (Washington, D.C.: GPO, 2015), p. 16; and Benedict, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, March 2, 2016, op. cit., p. 9.

¹⁷⁷ U.S. Government Accountability Office, "DOE Project Management: NNSA Needs to Clarify Requirements for Its Plutonium Analysis Project at Los Alamos" (Washington, D.C.: Government Accountability Office, August 9, 2016), p. 9, available at <https://www.gao.gov/assets/680/678941.pdf>; Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., p. 70; and Government Accountability Office, *DOE Project Management: NNSA Needs to Clarify Requirements for Its Plutonium Analysis Project at Los Alamos*, GAO-16-585 (Washington, D.C.: GAO, August 2016), p. 9 (quote and Rocky Flats production).

¹⁷⁸ See National Institute for Public Policy, *Foreign Nuclear Developments: A Gathering Storm* (Fairfax, Va.: National Institute for Public Policy, 2015).

¹⁷⁹ Gen. C. Robert Kehler, USAF, commander, U.S. Strategic Command, written response for the record, in House Armed Services Committee, *The Status of United States Strategic Forces*, HASC No. 112-12, 112th Cong., 1st sess. (Washington, D.C.: GPO, 2011), p. 122.

¹⁸⁰ Jabaley, remarks at Naval Submarine League 2016 Corporate Member Recognition Days, op. cit., pp. 105, 120.

¹⁸¹ Adm. James F. Caldwell, Jr., USN, director, Naval Nuclear Propulsion Program, address to the Naval Submarine League, October 26, 2016, summarized in Richard R. Burgess, "Admirals Address Submarine League Symposium,"

Seapower Magazine (online), October 27, 2016, available at <http://seapowermagazine.org/stories/20161027-subs.html>.

¹⁸² Woolf, *U.S. Strategic Nuclear Forces*, op. cit., p. 18.

¹⁸³ Collins, cited in Drew, “USAF Bars Exclusive Teaming with Rocket Shops for New ICBM,” op. cit.

¹⁸⁴ Rand, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, op. cit., p. 4. See also Bunn, in HASC, *Fiscal Year 2015 Budget Request for Atomic Energy Defense Activities and Nuclear Forces Programs*, op. cit., p. 4.

¹⁸⁵ Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, p. 9, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>; Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, “The Land and Air Based Deterrent,” remarks at the AFA-NDIA-ROA Capitol Hill Breakfast Forum, July 28, 2016, transcript, p. 13, available at http://media.wix.com/ugd/a2dd91_157e0d555bf2402590109ee20b6323d3.pdf; unnamed Air Force spokeswoman, quoted in James Drew, “USAF Basing Revised Bomber Count on ‘Minimum’ of 100 B-21s,” *FlightGlobal*, April 20, 2016, available at <https://www.flighthglobal.com/news/articles/usaf-basing-revised-bomber-count-on-minimum-of-100-424433/>; and John A. Tirpak, “It’s Official: Minimum of 100 B-21s,” *Air Force Magazine Daily Report*, March 15, 2017, available at <http://www.airforcemag.com/DRArchive/Pages/2017/March%202017/March%202015%202017/It%E2%80%99s-Official-Minimum-of-100-B-21s.aspx>. See also the discussion in Moeller, *US Bomber Force: Sustaining an Asymmetric Advantage for America*, op. cit., pp. 16-18.

¹⁸⁶ John A. Tirpak, “Buying the Future” (interview with Walter A. LaPlante, assistant secretary of the Air Force for acquisition), *Air Force Magazine*, vol. 98, no. 9 (September 2015), p. 42; and Gen. Mark A. Welsh III, USAF, chief of staff, Headquarters USAF, along with an unnamed Air Force spokesman, cited in John A. Tirpak, “The Future of Long-Range Strike, *Air Force Magazine*, vol. 98, no. 10 (October 2015), p. 21.

¹⁸⁷ Arthur T. Hopkins, principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 45.

¹⁸⁸ Scher prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, op. cit., p. 1 (“far lower” number); and Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Report to Congress on the Number of Long-Range Standoff Weapons as Specified by Section 1657 of the National Defense Authorization Act for Fiscal Year 2016* (Washington, D.C.: Department of Defense, March 2016), pp. 1-2 (“operational availability requirements”), available at <http://www.ucsusa.org/sites/default/files/attach/2016/04/FY16-LRSO-cost-reporting-requirement.pdf>.

¹⁸⁹ DOE/NNSA, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, op. cit., p. 5-2.

¹⁹⁰ Winston Churchill, radio broadcast, London, October 8, 1951, in Robert Rhodes James, ed., *Winston S. Churchill: His Complete Speeches, 1897-1963*, vol. 8 (New York: Chelsea House Publishers, 1974), p. 8257. “Kennedy never tired of quoting Winston Churchill: ‘We arm to parley.’” Arthur M. Schlesinger, Jr., *Robert Kennedy and His Times* (Boston: Houghton Mifflin, 1978), p. 427.

¹⁹¹ Gen. John A. Gordon, USAF (ret.), administrator, National Nuclear Security Administration, written response for the record, in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2003*, Part 1, S. Hrg. 107-696, Pt. 1, 107th Cong., 2d sess. (Washington, D.C.: GPO, 2003), p. 378; J.D. Crouch II, assistant secretary of defense for international security policy, “Challenges of a New Capability-Based Defense Strategy: ‘Transforming US Strategic Forces,’” briefing, National Defense Industrial Association 2003 Science & Engineering Technology Conference, March 5, 2003, slide 21, available at <http://www.dtic.mil/ndia/2003science/crouch.pdf>; and comments by Gen. Larry D. Welch, USAF (ret.), former chief of staff, Headquarters U.S. Air Force, December 5, 2016, and John R. Harvey, former principal deputy assistant secretary of defense for nuclear, chemical, and biological programs, December 8, 2016.

¹⁹² Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., pp. 123, 124.

¹⁹³ Ibid., p. 61; and OASD (NCB/NM), *The Nuclear Matters Handbook—2016*, op. cit., p. 25.

¹⁹⁴ National Nuclear Security Administration, Document #2, “B61-12 LEP Enables Stockpile Reductions,” and Creedon, written responses for the record, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, op. cit. pp. 75, 135.

¹⁹⁵ Harencak, "United States Strategic Interests and Current Triad Requirements," op. cit., slide 13; and Department of the Air Force, *Department of Defense Fiscal Year (FY) 2017 President's Budget Submission, Air Force, Research, Development, Test & Evaluation, Air Force*, Vol. III, Part 1 (Washington, D.C.: Department of the Air Force, February 2016), p. 435, available at <http://www.saffm.hq.af.mil/Portals/84/documents/FY17/AFD-160208-052.pdf?ver=2016-08-24-102137-043>.

¹⁹⁶ The Department of Defense categorizes yields as very low—less than 1 kiloton, low—1 kiloton to 10 kilotons, medium—over 10 to 50 kilotons, high—over 50 kilotons to 500 kilotons, and very high—over 500 kilotons. OASD (NCB/NM), *The Nuclear Matters Handbook—2016*, op. cit., p. 269. Past editions of Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms*, used the same categorizations.

¹⁹⁷ Scher, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, op. cit., p. 3; Harvey, "Sustaining Consensus on Triad Modernization: Transition to the Next Administration," op. cit., p. 4; *Report of the Defense Science Board Task Force on Future Strategic Strike Forces* (Washington, D.C.: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, February 2004), p. 5-10; and Kurt Guthe, "Deterrence, the Triad, and Dyads," in Barry R. Schneider and Patrick D. Ellis, eds., *Tailored Deterrence: Influencing States and Groups of Concern* (Maxwell Air Force Base, Ala.: USAF Counterproliferation Center, May 2011), pp. 332, 337.

¹⁹⁸ See Table 1: U.S. Nuclear Forces, 2018, Table 4: Future U.S. Nuclear Forces, and the sources for the tables found in the Appendix.

¹⁹⁹ *Report of the Defense Science Board Task Force on Future Strategic Strike Forces*, op. cit., p. 7-11.

²⁰⁰ Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, *Nuclear Matters: A Practical Guide* (Washington, D.C.: Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, 2008), pp. 38-39.

²⁰¹ Donald L. Cook, deputy administrator for defense programs, National Nuclear Security Administration, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), p. 14.

²⁰² Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., p. 61.

²⁰³ Gen. C. Robert Kehler, USAF, commander, U.S. Strategic Command, and Paul J. Hommert, president and laboratories director, Sandia National Laboratories, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), pp. 13-14.

²⁰⁴ Jeremiah Gertler, *U.S. Air Force Bomber Sustainment and Modernization: Background and Issues for Congress*, R43049 (Washington, D.C.: Congressional Research Service, June 4, 2014), p. 31.

²⁰⁵ Government Accountability Office, *Nuclear Weapons: DOD and NNSA Need to Better Manage Scope of Future Refurbishments and Risks to Maintaining U.S. Commitments to NATO*, op. cit., p. 11; and Cook, prepared statement for the record, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, op. cit., p. 55.

²⁰⁶ DoD and NNSA "B61-12 Life Extension Program," fact sheet, reprinted in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, op. cit., p. 73.

²⁰⁷ Creedon, prepared statement, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, op. cit., p. 38.

²⁰⁸ Cook, prepared statement for the record, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, op. cit., p. 53.

²⁰⁹ Clark, prepared statement, in HASC, *Update on Findings and Recommendations of the 2014 Department of Defense Nuclear Enterprise Review*, op. cit., p. 63. See also Government Accountability Office, *Nuclear Weapons: NNSA Has A New Approach to Managing the B61-12 Life Extension, but a Constrained Schedule and Other Risks Remain*, GAO-16-218 (Washington, D.C.: GAO, February 2016), p. 2.

²¹⁰ Haney, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, op. cit., p. 12.

²¹¹ Scher, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, op. cit., p. 4.

²¹² Unclassified estimates of missile accuracies can be found in Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., pp. 173, 199; and Lauren Caston et al., *The Future of the U.S. Intercontinental Ballistic Missile Force*, MG-1210-AF (Santa Monica, Calif.: RAND Corp., 2014), pp. 64, 67.

²¹³ The ALCM-B guidance system uses an inertial navigation element with terrain-contour matching updates. “AGM-86B/C/D Missiles,” U.S. Air Force fact sheet, op. cit. For an unclassified estimate of the ALCM-B CEP, see Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., p. 202.

²¹⁴ Kristensen and Norris, “Nuclear Notebook: United States Nuclear Forces, 2016,” op. cit., p. 68; Northrop Grumman, “Ground-Based Strategic Deterrent (GBSD),” data sheet, August 2016, available at http://www.northropgrumman.com/Capabilities/gbsd/Documents/GBSD_Data_Sheet.pdf; and Reif, “New Cruise Missile Capability Debated,” op. cit.

²¹⁵ Reif, “New Cruise Missile Capability Debated,” op. cit.

²¹⁶ Scher, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, op. cit., pp. 1-2.

²¹⁷ Drew, “USAF Bars Exclusive Teaming with Rocket Shops for New ICBM,” op. cit.

²¹⁸ National Nuclear Security Administration, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: NNSA, March 2015), pp. 1-4, 1-6, available at https://nnsa.energy.gov/sites/default/files/FY16SSMP_FINAL%203_16_2015_reducedsize.pdf.

²¹⁹ Government Accountability Office, *Nuclear Weapons: DoD and NNSA Need to Better Manage Scope of Future Refurbishments and Risks to Maintaining U.S. Commitments to NATO*, op. cit., p. 11; and Polmar and Norris, *The U.S. Nuclear Arsenal*, op. cit., p. 61.

²²⁰ Jerry A. Krill and J. Paul Reason, Co-chairs, Committee on Capability Surprise on U.S. Naval Forces, “Responding to Capability Surprise: A Strategy for U.S. Naval Forces, Report of the Committee on Capability Surprise on U.S. Naval Forces,” Naval Studies Board, Division on Engineering and Physical Sciences (Washington, DC: The National Academy Press, 2013) , pp. 3, and 72-73.

²²¹ Sydney J. Freedberg, Jr., “We’ve Got To Wake Up: Frank Kendall Calls For Defense Innovation,” <http://breakingdefense.com/2014/08/weve-got-to-wake-up-frank-kendall-calls-for-defense-innovation/>.

²²² Secretary of Defense Memorandum, Subject: The Defense Innovation Initiative, November 15, 2014, available at <http://www.defense.gov/Portals/1/Documents/pubs/OSD013411-14.pdf>.

²²³ “Amazon Chairman to Join Google Chief on US Defense Innovation Board,” *Sputnik News*, July 26, 2016, available at <https://sputniknews.com/us/201607261043652444-amazon-jeff-bezos-google-usa-defence-board/>.

²²⁴ Mackenzie Eaglen, “What is the Third Offset Strategy?” February 16, 2016, available at http://www.realcleardefense.com/articles/2016/02/16/what_is_the_third_offset_strategy_109034.htm

²²⁵ Lisbeth Gronlund, *Bad Math on New Nuclear Weapons: The Costs of the 3+2 Plan Outweigh Its Benefits* (Washington, DC: Union of Concerned Scientists, October 2015), available at <http://www.ucsusa.org/sites/default/files/attach/2015/11/Bad-Math-Nuclear-Weapons-3-Plus-2.pdf>.

²²⁶ William J. Perry and Andy Weber, “Kill the new cruise missile,” *Washington Post*, October 16, 2015, p. A21. Other references include: Gen. (Ret.) James Cartwright et al., “Global Zero U.S. Nuclear Policy Commission Report: Modernizing U.S. Nuclear Strategy, Force Structure and Posture,” *Global Zero*, May 2012, p. 18. Hans M. Kristensen and Robert S. Norris, “Reviewing Nuclear Guidance: Putting Obama’s Words into Action,” *Arms Control Association*, November 2011, available at: http://www.armscontrol.org/act/2011_11/Reviewing_Nuclear_Guidance_Putting_Obama_Words_Into_Action.

²²⁷ The Secretary of State, the Secretary of Defense, and the Secretary of Energy, *Report to Congress on: An Assessment of the Impact of Repeal of the Prohibition on Low Yield Warhead Development on the Ability of the United States to Achieve Its Nonproliferation Objectives*, March 2004, p. 1.

²²⁸ Ibid, p. 2. (Emphasis as in the original.)

²²⁹ Ibid.

²³⁰ Ibid, p. 3.

²³¹ Terri Moon Cronk, “McKeon: Budget Request Provides ‘Robust’ Nuclear Deterrent,” *DoD News*, February 27, 2015, available at: <http://archive.defense.gov/news/newsarticle.aspx?id=128267>.

²³² Don Cook, "An Insider's View of Nuclear Weapon Modernization," *Arms Control Today*, October 2016, available at https://www.armscontrol.org/ACT/2016_10/Features/An-Insiders-View-of-Nuclear-Weapons-Modernization.

²³³ Robert J. Joseph, "Second to One," *National Review*, July 2, 2012, available at <http://www.nationalreview.com/article/304310/second-one-robert-g-joseph>.

²³⁴ Jenifer Hlad, "Replacing Minutemen III," *Air Force Magazine*, March 3, 2016, available at: <http://www.airforcemag.com/DRArchive/Pages/2016/March%202016/March%2003%202016/Replacing-Minuteman-III.aspx>.

²³⁵ Ibid.

²³⁶ Defense Science Board, *Report of the Defense Science Board Task Force on Nuclear Capabilities: Report Summary* (Washington, DC: Defense Science Board, December 2006), p. 37, available at <http://www.acq.osd.mil/dsb/reports/2000s/ADA459527.pdf>.

²³⁷ Robert M. Gates, Secretary of Defense, and Samuel W. Bodman, Secretary of Energy, *National Security and Nuclear Weapons in the 21st Century* (Washington, DC: Department of Defense, September 2008, p. 19, available at <http://archive.defense.gov/news/nuclearweaponspolicy.pdf>.

²³⁸ William J. Perry, Chairman, and James R. Schlesinger, Vice Chairman, et al., *America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Washington, DC: United States Institute of Peace Press, 2009), pp. 47-51.

²³⁹ For a more in depth analysis, see Thomas Scheber and John R. Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps* (Fairfax, VA: National Institute Press, 2015) pp. 7-15. Available at: <http://www.nipp.org/wp-content/uploads/2015/10/Assessment-of-US-Readiness-for-web.pdf>.

²⁴⁰ For example see: ADM Henry G. Chiles, Jr., USN (ret.), Chairman, *Report of the Commission On Maintaining United States Nuclear Weapons Expertise*, Report to the Congress and the Secretary of Energy, March 1, 1999; *Nuclear Deterrence Issues and Options Study: A Baseline Assessment of DoD Staff Nuclear Expertise*, Advanced Systems and Concepts Office, Defense Threat Reduction Agency, December 21, 2001; *The Comprehensive Nuclear Test Ban Treaty—Technical Issues for the United States* (Washington, DC: The National Academies Press, 2012); Report of the Defense Science Board Task Force on Nuclear Deterrence Skills, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2008; ADM C. D. Haney, U.S. Navy, Commander, United States Strategic Command, *Report to Congressional Committees: Report on Balance in Nuclear Weapons Program*, United States Strategic Command, January 2015.

²⁴¹ ADM Henry G. Chiles, Jr., USN (ret.), Chairman, *Report of the Commission On Maintaining United States Nuclear Weapons Expertise*, Report to the Congress and the Secretary of Energy, March 1, 1999, pp. 20-22.

²⁴² Perry-Schlesinger Commission Report, op. cit., p. 51.

²⁴³ U.S. Code, Title 50, Chapter 42, Subchapter II, Part A, paragraph 2538b.

²⁴⁴ *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Department of Energy Report to Congress, March 2016, pp. 3-1 and 3-2.

²⁴⁵ These and other recommended actions were the result of a study conducted by National Institute for Public Policy in 2015. The report from that study is: Thomas Scheber and John R. Harvey, "Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps," (Fairfax, VA: National Institute Press, 2015), available at: <http://www.nipp.org/wp-content/uploads/2015/10/Assessment-of-US-Readiness-for-web.pdf>.

²⁴⁶ Perry-Schlesinger Commission Report, op. cit., pp. 47-51.

²⁴⁷ Ibid., p. 8.

²⁴⁸ Ibid., p. 50.

²⁴⁹ "November 2010 Update to the National Defense Authorization Act of FY 2010, Section 1251 Report: New START Treaty Framework and Nuclear Force Structure Plans," The White House, November 17, 2010, pp.5-6.

²⁵⁰ Aaron Mehta, "NNSA, Pentagon Tracking Nuclear Infrastructure Bills," *Defense News*, October 21, 2016, available at <http://www.defensenews.com/articles/nnsa-pentagon-tracking-nuclear-infrastructure-bills>.

²⁵¹ National Research Council, *The Comprehensive Nuclear Test Ban Treaty—Technical Issues for the United States, Report of the National Research Council of the National Academies* (Washington, DC: The National

Academies Press, 2012), p. 80, available at <https://www.nap.edu/catalog/12849/the-comprehensive-nuclear-test-ban-treaty-technical-issues-for-the>.

²⁵² National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary* (Washington, DC: Department of Energy Report to Congress, March 2016), p. 5-2, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf.

²⁵³ Ibid.

²⁵⁴ National Nuclear Security Administration, *Fiscal Year 2014 Stockpile Stewardship and Management Plan—Biennial Plan Summary* (Washington, DC: Department of Energy Report to Congress, March 2013, pp. 4-1 and 4-2.

²⁵⁵ John C. Hopkins, “Nuclear Test Readiness: What is Needed? Why?,” *National Security Science*, December 2016, p. 9, available at https://www.lanl.gov/discover/publications/national-security-science/2016-december/_assets/docs/NSS-dec2016_nuclear-test-readiness.pdf.

²⁵⁶ Ibid.

²⁵⁷ Perry-Schlesinger Commission Report, op. cit., pp. 51, 63.

²⁵⁸ John E. Hyten, “Statement of John E. Hyten, Commander, United States Strategic Command,” *115th U.S. Congress*, House Armed Services Committee, March 8, 2017, p. 6, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-HytenUSAFJ-20170308.pdf>.

²⁵⁹ Paul Selva, “Statement of General Paul Selva, USAF, Vice Chairman of the Joint Chiefs of Staff, *115th U.S. Congress*, House Armed Services Committee, March 8, 2017, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-SelvaUSAFFP-20170308.pdf>.

²⁶⁰ Hyten, “Statement of John E. Hyten, Commander, United States Strategic Command,” op. cit., p. 6.

²⁶¹ Statement of Admiral C. D. Haney, Commander, United States Strategic Command, in testimony before the Senate Committee on Armed Services, March 10, 2016, pp. 13-14. See also Admiral Haney’s Statement before the Senate Committee on Armed Services, March 19, 2015, pp. 9-10.

Section VII. Missile Defense: Critical Element of US and Allied Security

Introduction

Missile defense is widely recognized as a critical component of national and regional security, and holds the potential to contribute more to deterrence, assurance and, if necessary, damage limitation by supporting flexibility and resilience amidst a highly-dynamic strategic environment. One of President Trump's first executive orders directed "a new Ballistic Missile Defense Review to identify ways to strengthen missile defense capabilities, rebalance homeland and theater defense priorities, and highlight priority funding areas."¹

Strategic missile defenses were severely restricted by treaty for 30 years on the assumption that defenses were of little potential value and would undermine "stable" mutual deterrence. But with expanding missile threats facing the United States and its allies, homeland and regional missile defenses are now accepted as essential components for US and allied security. This prominence is reflected by major national and military strategy documents across several administrations.² A capstone JCS document from 2012, for example, singles out missile proliferation as a challenge to US military strategy, and notes that a strategic "concept predicated on global agility requires the ability to protect against such a threat."³

US Ballistic Missile Defense (BMD) Consideration: Shifting Parameters

Over the course of decades, various US Ballistic Missile Defense policies and programs have come and gone, and their consideration has taken place within the policy framework prevailing at the time.⁴

The Johnson Administration's Sentinel BMD program of the late 1960s, for example, focused on particular roles judged valuable for a time, including protection of US society against a then-expected Chinese missile threat. By 1969, that policy framework had shifted and the Nixon Administration replaced the Sentinel program with the Safeguard BMD program. The focus of Safeguard was to serve different purposes, supporting deterrence by protecting US nuclear retaliatory capabilities against Soviet ballistic missile attacks.

Yet, within a matter of three years, the policy framework for considering BMD once again shifted. The Nixon Administration effectively canceled the Safeguard program in 1972 with the signing of the Anti-Ballistic Missile (ABM) Treaty, which prohibited any serious strategic BMD deployment, and severely limited BMD development and testing options. In approximately five years, the US policy framework for considering BMD shifted significantly three times, from Sentinel to Safeguard to the ABM Treaty.

Eleven years later, in 1983, President Reagan famously announced the new US goal of a comprehensive defense of US society against even a large-scale Soviet attack. He initiated the

Strategic Defense Initiative (SDI) for this declared purpose. This was a dramatic turnabout from the then-extant policy framework favoring the absence of BMD. Yet, within five years, the US SDI goal shifted, at least for the near-term “Phase 1,” from the direct and comprehensive protection of society to creating uncertainties for Soviet counterforce target planning, that is, to support deterrence.

In early 1991, President George H.W. Bush redirected the SDI goal and program once more to Global Protection Against Limited Strikes (GPALS).⁵ This program, which included plans for ground- and space-based interceptors, was intended to provide direct area protection on a global basis against limited missile strikes, including protection against missiles of less than intercontinental ballistic missile (ICBM) range.

The point here is that the policy framework for considering BMD is not static. It is shaped by shifting beliefs and judgments regarding the security context—for example, US security goals and their priorities, the threat context confronting the United States and its allies, and preferred US strategies for achieving its priority goals in light of threats. As the security context changes and US goals shift accordingly, so too does the policy framework for considering BMD. As is well-illustrated by the multiple transitions from the Sentinel program to GPALS, the US BMD roles and goals deemed worthy given perceptions of the security environment drive the consideration of programs that, in turn, lose or gain favor as the measures of merit for judging BMD shift with those transitions.

As beliefs and judgments shift regarding US security goals and their priorities, the threat context, and preferred US strategies, so too do views about what BMD might usefully do for the United States, how important that role might be and, correspondingly, the metrics for judging BMD. Beliefs and judgments about these fundamental factors can shift quite rapidly and unevenly, and the history of US BMD since the 1960s has seen only occasional periods of general consensus regarding the BMD policy framework and the related metrics for judging the potential roles and value of BMD—whether favorably or unfavorably.

The Contemporary Context and Missile Defense for Deterrence, Assurance and Damage Limitation

The term “missile defense” appeared over 20 times in the 65-page 2010 NPR, or about once every three pages of text. Given the advance of US capabilities and the increasing global demand for means to counter missile threats, the role of missile defense merits continued attention in the 2017 NPR.

The 2001 NPR proposed a “new triad” in which defenses, including BMD, represented one leg, responsive infrastructure the second, and nuclear and advanced conventional strike forces the third. Although the 2010 NPR did not retain the “new triad” vocabulary, the concepts behind each of those three “legs” persisted. All three traditional triad legs continue to be valuable, as are both conventional strike and missile defense.

Just as the US nuclear posture supports a range of strategic goals, so do related non-nuclear capabilities. Measures to defend against missile delivery systems support the three priority goals:

- Deter attack
- Assure allies and partners
- Limit damage in the event of deterrence failure

The National Defense Authorization Act (NDAA), signed into law in December 2016, contains several provisions bearing directly on the relationship of missile defenses to larger strategic objectives, especially including flexibility and resilience. The 1999 National Missile Defense Act was replaced with a policy statement broadening the policy objectives for missile defense. These changes include the description of missile defenses as “effective, robust and layered,” emphasizing the importance of these attributes and eliminating the word “limited” from the 1999 language that had served as a qualifier for the level of ballistic missile attack against which the United States should defend. This change occurred because rogue states like North Korea and Iran have begun steadily to improve their missile capabilities, thereby narrowing the gap between what was once considered “limited” and increasingly complex threats. Striking the word “limited” is significant; it establishes a policy basis for the United States to build defenses to defend “the territory of the United States, allies, deployed forces, and capabilities” from missile threats regardless of the origin of their launch. In addition, broadening the defensive objectives to include “capabilities,” suggests, importantly, that the United States can expand its missile defense system to include defense of non-terrestrial assets.

Strategic Environment

Missile defenses must be adaptable as well as support strategic force adaptability in the face of an increasingly complex and highly-dynamic strategic environment. Today, the United States and others face threats from missiles carrying WMD or conventional payloads. Despite various nonproliferation and counterproliferation efforts, the spread and evolution of such technologies are producing what might be called a “missile renaissance.”

This new missile age is characterized by technological, commercial, and geopolitical trends contributing to a surge in the global supply and demand for a spectrum of unmanned, high-precision, and high-velocity delivery systems, including:

- Guided and unguided rockets, artillery, and mortars;
- Supersonic and long-range subsonic cruise missiles with improved guidance and evasion;
- Guided and maneuvering reentry vehicles;
- Depressed trajectory ballistic missiles;
- Ballistic missile improvement in range, survivability, and mobility;
- Anti-ship missiles of various kinds;
- Missile-boosted hypersonic glide vehicles; and,
- Missile-boosted anti-satellite weapons.

In sum, this missile renaissance represents “a complex and nearly continuous threat spectrum across the characteristics of altitude, speed, propulsion type, and range.”⁶ As such, it has

generated increased global supply and demand for missile counters, both strike capabilities and air and missile defenses.

Missiles have been used in numerous conflicts, sometimes with significant effect. The single greatest loss of American life during Operation Desert Storm came when a single Scud missile hit a US barracks, killing 27 and wounding 98.⁷ In the recent Yemen conflict, non-state or quasi-state actors have successfully attacked an Emirati ship, and a single missile strike reportedly killed 60 Saudi and Emirati military personnel.⁸ Precision-guided cruise and ballistic missiles have now become a significant means of denying access to a particular defended area.⁹

These and related trends contribute to the growing recognition that missile defenses are essential to support deterrence rather than undermine it. Unlike the Cold War era, when the United States codified virtually unmitigated vulnerability to Soviet missiles with the 1972 ABM Treaty, today there are simply too many missile-armed actors and too much uncertainty to forego defenses. North Korea, Russia and China are all rapidly expanding their offensive missile capabilities. Indeed, over 28 nations now possess ballistic missiles, and virtually no intelligence assessment suggests the threat is declining.¹⁰

The quantity and quality of adversary missiles that can threaten the US homeland and its allies is growing at a rapid pace. The JCS recently released its *Joint Operating Environment 2035* report which stated:

Over the next two decades, there will be a significant evolution in long-range strike weapons capable of ranging the U.S. homeland... The purpose of state adversary investments in global strike assets capable of reaching North America is to threaten key targets within the United States during a conflict... Adversaries will threaten the homeland not to physically destroy the United States, or even in anticipation of materially hindering its economic or military potential, but rather to change the decision calculus of leaders or the public's appetite for foreign military operations.¹¹

Demand for hit-to-kill interceptors and other means to counter missiles has likewise grown. Recent years have seen demonstrated successes across all four families of systems currently deployed by the United States today: Patriot, the Aegis Ballistic Missile Defense Weapon System (at sea and ashore), Terminal High Altitude Area Defense (THAAD), and Ground-based Midcourse Defense. Systems abroad include Israel's Iron Dome, David's Sling, and Arrow programs; France's SAMP/T; and the nascent MEADS program being developed and under consideration by Germany. THAAD is also now operated by United Arab Emirates (UAE), and the Aegis weapons system has expanded to a number of partners. Russia (and through it, Iran) likewise deploys the evolving S-300/S-400 family, and China the HQ-family.

Deterrence

The first and perhaps primary contribution of missile defense is to support the priority national goal of deterrence. The advance of missile capabilities in the hands of potential adversaries creates real challenges for deterring attack. The 2001 NPR observed that “offensive capabilities alone may not deter aggression in the new security environment of the 21st century.” This concern appears to have been a critical part of the rationale for the withdrawal from the 1972 ABM Treaty. And, the 2010 NPR cited “conventional military preeminence and continued improvements in U.S.

missile defenses” as means to reduce reliance upon nuclear weapons to deter non-nuclear attacks.¹²

While not substituting for nuclear forces, missile defenses can contribute to deterrence in several ways:

- Providing a defensive alternative option to offensive strikes;
- Raising the threshold for attack; and,
- Supporting military operations.

Defensive Alternatives

Missile defenses may improve “crisis stability” by providing the United States courses of action other than preemption or retaliation. In the days prior to North Korea’s 2006 Taepodong-2 launch, some former senior officials recommended a preemptive US strike against the North Korean missile site;¹³ this option continues to be discussed publicly.¹⁴ However, the deployment of a limited US homeland missile defense capability provided President Bush with an alternative to striking North Korea’s launch facilities preemptively. Such a US posture creates additional options for decision makers that can contribute substantially to reducing escalation pressures in crises.

A more recent example of this value of missile defense occurred in October 2016, when two or more anti-ship cruise missiles were reportedly fired at the *USS Mason* as it sailed off the coast of Yemen. Instead of being hit, the ship employed defensive systems and was unharmed.¹⁵ Absent these active defenses, the United States could have been drawn further into the conflict. Instead, the United States was able to assess what had taken place and limit its response.¹⁶

Missile defense also buys time and creates options for decision makers that could otherwise be unavailable. Even limited and imperfect defenses create time and space for diplomacy or to attrite adversary missile forces with other means.¹⁷ In so doing, pressure to strike adversary launchers prior to launch is thereby relaxed.¹⁸ Reported difficulties of Scud hunting during the Gulf War demonstrate that relying on preemption alone, in addition to potentially creating instabilities, may be unreliable, especially as potential adversaries deploy mobile missiles.¹⁹

Raising the Threshold for Attack

Missile defenses also serve the purpose of raising the threshold for aggression for an adversary wishing to pursue coercive escalatory threats or actual strikes against the United States or allies. Denying adversaries limited strike options against the American homeland or military forces is an important approach to deterring them from taking such actions. Missile defenses can change the calculus of potential adversaries by countering escalatory threats or attacks and thereby helping deter escalation strategies.

Supporting Operations

While deterrence rests in part upon the perception and the credibility of threats, it also requires the perceived technical ability to execute deterrent threats. Point defense for military assets like air bases and aircraft carriers or points of debarkation can ensure the possible introduction and surging of forces into a theater.²⁰ The 2010 Ballistic Missile Defense Review (BMDR) notes this

more tactical quality by observing that missile defenses support “military freedom of maneuver, by helping to negate the coercive potential of regional actors intent on inhibiting and disrupting U.S. military access in their regions.” An adversary’s recognition that defenses can help the United States in this manner can also help deter conflict. In the words of Herman Kahn, “Usually the most convincing way to look willing [for deterrence] is to be willing.”²¹

Additional Contributions to Deterrence

In terms of more specific deterrence goals, decision makers will have to select between a set of options for both smaller powers like North Korea and Iran, and larger powers like Russia and China. For both sets, objects of defense might be either broader territorial defense in the interest of avoiding coercion, or more targeted point or preferential defenses for military bases, strategic forces, or other assets of value.

One possible path would be to retain a bifurcated strategy and posture similar to that currently in force. This involves near-complete vulnerability of US territory and military forces to Russian and Chinese missiles, even of limited quantity, and reliance upon an offense-dominant posture to deter, while simultaneously working to outpace Iranian and North Korean threats with missile defense, and retaining an advantageous and relatively defense-dominant position relative to their short- and long-range missiles.

Alternatively, the objects of US missile defense efforts could be revised to include protection against not only attacks from North Korea and Iran, but also select missile threats from whatever source, including Russia and China. This level of protection, as noted above, could contribute to the deterrence of coercive escalatory threats and protection against limited attacks—whatever the source. The 1980s SDI Phase I goal of denying the Soviet Union confidence in counterforce nuclear strike strategies is one example of this alternative.

Such a posture would prioritize increased protection for US population centers and possibly for nuclear and other strategic forces so as to enhance US deterrence credibility. The objectives of homeland defense might also be expanded to include non-ballistic missiles, such as cruise missiles, against which there reportedly is no significant capability to defend the National Capital Region from attack.

Options to expand the deterrence goals of missile defense efforts could include:

1. *Increased protection of US territory and population against a limited attack from whatever source*, thereby providing plausible damage limitation in some scenarios and strengthening deterrence by raising the threshold for attack, coercion, or blackmail. Indeed, previous US missile defense architectures have focused on limited territorial defenses or point defenses to support US deterrence and/or damage-limitation goals, such as Sentinel and GPALS.
2. *Increased defense for NATO and other alliance territory, or perhaps preferential defense of military forces, against cruise missile and short-range ballistic missile attack*—what is sometimes called “theater” missile defense. One state’s theater missile defense is another’s national missile defense, however, and “non-strategic” defenses could support the strategic defense of NATO or other allies. Such an architecture might prioritize air or

- sea ports of debarkation/embarkation to enhance deterrence by making more credible the surging of allied forces in the face of Russian aggression.²²
3. *Defense of US nuclear and other strategic forces against ballistic, cruise, and maneuvering glide vehicles* in the interest of improving survivability and thereby enhancing deterrence. This might include additional air and missile defense protection of SSBN ports, bomber bases within the United States and abroad, or ICBM fields. Previous US missile defense architectures have focused on this limited defensive goal for deterrence purposes, including Safeguard and the later Low-Altitude Defense Systems (LoADs).

Assurance

The second strategic goal in which missile defense supports the US nuclear posture is the assurance of allies. The viability of US security commitments presupposes that the United States will remain willing and able to come to the defense of its allies and avoid becoming decoupled from them. In this respect, defenses of the American homeland and regional defenses can work together to support assurance. In the absence of defenses, the United States might have to face the proverbial choice between trading New York for Berlin, or Los Angeles for Taipei. Military action against regional threats from Libya and Iraq, for instance, might have carried a significantly greater degree of risk had they possessed intercontinental-range missiles. Protection of the United States against long-range, coercive missile threats could increase the perception of American resolve that is essential for extended deterrence, and thus assurance. By reducing US vulnerability to the coercive threats of ICBM-capable adversaries, homeland missile defenses can improve the credibility of US security guarantees to allies.²³

Regional defenses likewise can support the assurance of allies facing significant threats from states armed with missiles. The 2010 NPR noted that missile defenses reinforce regional security architectures by assuring non-nuclear allies and partners of US security commitments, thereby helping to dissuade them from acquiring nuclear capabilities of their own, a point also made in the 2010 BMDR.²⁴ NATO's Lisbon Summit Declaration that same year established missile defense as a core alliance mission, "to provide full coverage and protection of all NATO European populations, territory and forces against the increasing threats posed by the proliferation of ballistic missiles."²⁵ Defenses for NATO territory as well as other US forces deployed abroad can directly support allied confidence in the seriousness of US presence in a militarily credible way.

The deployment of THAAD to South Korea, for instance, will help protect the survivability and credibility of US and ROK retaliatory forces. In a similar manner, increased air defenses in Europe as part of the European Reassurance Initiative raise the cost of attack on alliance forces. The expense, military significance, and even symbolism of such systems may even serve, along with other presence, as a tripwire to help deter aggression.²⁶ Increased defenses for Saudi Arabia, the UAE, and others in the Gulf may similarly provide assurance in the face of Iranian missiles.

Greater assurance and protection of allies through missile defense also contribute to US nonproliferation goals by helping to reduce the incentive for friends and allies to seek an independent nuclear deterrent. This effect may become increasingly important in the context of continued proliferation and Russian and Chinese expansionism.

Restrictions on the numbers, locations, and capabilities of missile defenses in Europe are sometimes floated as a possible incentive for Russian cooperation on arms control, but the Bush

and Obama Administrations have carefully avoided formally including restrictions on missile defense in such agreements. The 2010 NPR specifically observed that the exclusion of missile defense from arms control negotiations contributed to preserving the value of missile defense to regional deterrence and assurance.

Furthermore, the cooperative process of developing and deploying missile defense systems helps build stronger alliance relationships, and gives the United States a larger perceived stake in the security of allies.²⁷ Stronger relationships can in turn contribute to a sense that strategies to split regional coalitions are likely to fail, deterring their use. These benefits are increasingly recognized by allies and combatant commands, and demand for US missile defense forces is outstripping their supply. One trend alleviating some of the strain on US missile defense assets is the increasing purchase of such assets by allies and partners. Japan has purchased its own Aegis BMD capability. The UAE became the first country other than the United States to deploy THAAD. Besides the United States, Patriot is deployed by 12 other countries. All of these capabilities serve to augment joint force projection while demonstrating alliance solidarity, making it more difficult to fracture.

Damage Limitation

A third goal served by missile defense is damage limitation in the event that deterrence should fail.²⁸ Escalation by means of missile attack could occur against forces or allies within a region, or against the US homeland. Missile defenses can simultaneously discourage an adversary from escalating a conflict and provide a degree of protection against such an attack. By definition, missile attacks occur with considerable speed, and other means of limiting damage may be unavailable. Should an adversary believe it can escalate its way out of a conventional conflict by nuclear or other means, missile defenses can buy protection for societal targets in some scenarios and time for other US forces to be brought to bear. Even while declining to deploy national missile defense in 2000, President Clinton noted its defensive potential: “such a system, if it worked properly, could give us an extra dimension of insurance in a world where proliferation has complicated the task of preserving the peace.”²⁹

Missile defense can also provide protection in the event of an accidental or unauthorized missile attack. In the 1999 National Missile Defense Act the United States declared its policy to defend US territory against limited ballistic missile attack, whether “accidental, unauthorized, or deliberate.”³⁰ Such concerns emanated in part from the prospect of a rogue commander after the dissolution of the Soviet Union, but a similar prospect could recur with another unstable or failing regime, perhaps with the delegation of launch authority down to field commanders. While the recent NDAA revision dropped the reference to “whether accidental, unauthorized, or deliberate,” a policy of missile defense adaptability should presuppose it within the pursuit of effective and layered homeland and regional defenses.

To be sure, the purpose of missile defense is not simply to sit and play catch, but rather to support the larger strategic objectives of the United States. On this topic, the December 2016 NDAA includes a provision for a “missile defeat review” (MDR) report by the Department of Defense and the JCS, to include a new review of the missile defeat capability, policy, and strategy of the United States with respect to:

- (1) left- and right-of-launch ballistic missile defense for:

- (a) both regional and homeland purposes; and
 - (b) the full range of active, passive, kinetic, and nonkinetic defense measures across the full spectrum of land-, air-, sea-, and space-based platforms;
- (2) the integration of offensive and defensive forces for the defeat of ballistic missiles, including against weapons initially deployed on ballistic missiles, such as hypersonic glide vehicles; and,
- (3) cruise missile defense of the homeland.³¹

This report may serve to encourage better integration of missile defense into operational planning, and in turn inform future missile defense requirements.

Missile defenses do not exist in a vacuum; they should be integrated with the growing spectrum of US military force, including offensive capabilities to counter missile threats prior to launch. Defeating missile threats prior to launch may be one method of countering missile threats, but is not a substitute for active and passive defenses.³²

As then-Vice Chair of the JCS Admiral Winnefeld noted in 2015, “While we would obviously prefer to take a threat missile out while it’s still on the ground, what we would call left-of-launch, we won’t always have the luxury of doing so. And because it’s our policy to stay ahead of the threat, we don’t want there to be any doubt about our commitment to having a solid right-of-launch [defensive] capability.”³³

In 2013, then-Chairman of the JCS Gen. Martin Dempsey made a similar point in *Vision 2020*: “While these offensive actions can attrite portions of the air and missile threat, they cannot assure complete negation,” and as such “Both active and passive defenses and offensive actions against air and missile threats should be part of the initial focus of every war plan.”³⁴

“Active and passive defenses will not be perfect,” noted the 2001 NPR. Nor can defenses alone prevail; yet even imperfect defenses increase flexibility, help manage and mitigate risk, and support the overall effectiveness and credibility of military operations.³⁵

Related to deterrence and damage-limitation goals is the goal of dissuading adversaries from acquiring or fielding certain missile capabilities, a form of threat reduction. Such a strategy is intended to impose more costs upon the missile attacker than on the defender. The prospect of a relatively advantageous defensive posture position against long-range ICBMs from North Korea or Iran could, in principle, discourage their investment of scarce resources in such capabilities. Defenses for NATO, Gulf Cooperation Council (GCC) partners, and other Asia-Pacific allies might likewise discourage investment in short- or intermediate-range missiles.

The effectiveness of dissuasion, however, is uncertain in some difficult cases. Despite the success record of Israel’s Iron Dome defenses against rockets and mortars from Hamas and Hezbollah, for instance, these groups continue to expend considerable effort to stockpile, improve, and employ these relatively unsophisticated forces. Without greater insight into Iranian or North Korean deliberation on resource allocation, the potential dissuasive effect of missile defenses is difficult to assess. North Korea and Iran continue to advance their missile programs, and thus far the cost imposition has weighed just as heavily upon their neighbors to acquire missile defenses. Despite considerable progress, missile defenses appear not to have yet persuaded proliferators that missiles are, or will become, ineffective instruments. At this relatively

late stage in their missile programs, the proliferation of defenses may not dissuade Iran and North Korea from further missile efforts, but could discourage other states from following a similar path.

Countering the Emerging North Korean Missile Threat to the US Homeland

The emerging North Korean ICBM threat to the United States represents a contemporary illustration of the need for adaptability and the contribution of US missile defense programs to that requirement.³⁶ North Korea regularly threatens to turn the United States and neighboring states into “a sea of fire,” and reportedly has the capability now to launch nuclear weapons at targets in South Korea and Japan.³⁷ In a televised address on New Year’s Day, North Korea’s eccentric leader, Kim Jong Un, claimed that preparations were nearly complete for testing an ICBM capable of striking the United States.³⁸ A former senior North Korean official, Thai Yong-ho, stated that Kim Jong Un’s priority is to complete the development of nuclear weapons in 2017 “at all costs.”³⁹

While some US officials maintain that North Korea does not yet have a nuclear ICBM,⁴⁰ former Deputy Secretary of State Antony Blinken recently acknowledged “unprecedented” North Korean nuclear and missile activity in 2016, and that the North Korean nuclear missile threat grows by the day.⁴¹ In April 2016, Admiral William Gortney, then-Commander of the United States Northern Command, reported to Congress that while the prospective North Korean ICBM, the KN08, “remains untested, modeling suggests it could deliver a nuclear payload to much of the Continental United States.”⁴² In September 2016, then-DNI Clapper stated that the United States must assume that North Korea can reach the United States with a nuclear missile,⁴³ and in October 2016, Clapper added that persuading North Korea to give up its nuclear weapons was “probably a lost cause.”⁴⁴

The Hawaiian Islands and West Coast may well be North Korea’s initial ICBM targets in the United States given their closer relative proximity to North Korean launch sites. Indeed, many years of international diplomacy, scolding and sanctions have failed to prevent apparent North Korean progress toward a nuclear ICBM. Moreover, a US offensive military strike against a threatening North Korean nuclear missile, although recommended in the past by some senior US civilian officials,⁴⁵ could initiate a devastating war on the Korean Peninsula that could also draw in China.

In principle, US ballistic missile defense offers a counter to a North Korean ICBM that may also reduce the risk of a new Korean conflict. The value of defensive capabilities has become obvious: Hawaii state lawmakers are now relooking at civil defense measures for this purpose.⁴⁶ The US Ground-based Midcourse Defense (GMD) system now protecting the United States against long-range missile attack reportedly has 36 defensive interceptors located in California and Alaska, with that number scheduled to grow quickly to 44.⁴⁷

This GMD system provides important but limited defense coverage for the entire United States, including Hawaii—limited in part because, for reliability reasons, more than one interceptor from the small GMD arsenal reportedly may have to be assigned to each attacking North Korean missile.⁴⁸ Other US BMD systems deployed in Europe and Asia, such as the well-known Patriot, THAAD and SM-3 systems, are intentionally capable of defending US allies and assets in those regions against shorter-range missile threats, not against ICBMs targeting the United States itself.

Given the emerging and possibly near-term North Korean threat, a possible option for consideration is to complement the existing GMD arsenal to provide added protection for Hawaii.

This option would employ BMD elements largely already deployed in the Pacific, including the proven mobile and long-range Sea-based X-Band (SBX) radar, a smaller, transportable THAAD radar, and well-tested SM-3 interceptors reportedly now deployed in the hundreds on numerous Navy Aegis BMD ships, including those Aegis ships homeported at Pearl Harbor.⁴⁹ Providing some operational capability to the existing Aegis Ashore Missile Defense Test Complex located in Kauai, Hawaii may be a near-term option that would further enhance the defense of Hawaii.⁵⁰

The Aegis SM-3 system, while not designed to defend against ICBM-range missile threats, reportedly could potentially help protect limited geographical areas if deployed to a region with suitable radar support.⁵¹ The Navy recently tested successfully the SM-3 IIA against a medium-range ballistic missile near Hawaii.⁵² It is planned for delivery in 2018 and apparently will have some additional capability to protect against long-range missile threats; it thus could strengthen this additional defensive step for Hawaii and possibly the West Coast.⁵³

Layering defenses provides the most effective and efficient protection against missile threats. Complementing existing GMD defenses with the BMD elements discussed here could provide a relatively inexpensive added layer of protection in the near term. This would involve expanding and possibly accelerating SM-3 capabilities. These layers functioning together could provide greater protection. Given the utter failure or extreme risks of alternative measures to stop North Korean nuclear ICBMs, the possible immediacy of the North Korean ICBM threat, and the “risk tolerant” and “impulsive” character of Kim Jong Un as described by Gen. Vincent Brooks, Commander of US Forces in Korea,⁵⁴ moving forward with the infrastructure needed for this layered defense could be a prudent step for President Trump.

Summary and Recommendations for Consideration

Limitations in the current BMD system reportedly include the absence of a space-based sensor layer for persistent birth-to-death tracking and discrimination of threats.⁵⁵ A space-based sensor layer for this purpose has been a feature of every missile defense architecture for the past five administrations—but to date, none actually has fielded them, with the exception of Space Tracking and Surveillance System (STSS) demonstration satellites. Richard Matlock of the Missile Defense Agency has recently remarked that “It’s so important that we make this broader shift from a terrestrial-based system to a system that primarily plays from space in the next couple of years.”⁵⁶ Fielding a space sensor layer and moving forward with a space test bed for eventual deployment of space-based interceptors could improve performance across the BMDS, and open new options for expanding interceptor coverage. Indeed, a space-based interceptor (SBI) capability may become necessary to augment US land- and sea-based capabilities and keep pace with the threats confronting the United States.

The global threat environment can shift rapidly and unexpectedly, while established policy thinking can be highly resistant to change. Moreover, BMD programs can take many years to move from concept, to development and testing, to deployment. Consequently, policy adjustments may not keep pace with changed circumstances, and US defense acquisition programs can lag behind changes in policy and the threat environment further still. To provide flexibility and resilience against emerging threats and changing conditions, the following additional steps should be considered for the purposes of sustaining existing initiatives from the 2010 BMDR, establishing important near-term priorities, or exploring longer-term options:

- Improve the flexibility, capability, and reliability of today's homeland missile defenses.
- Complete readiness efforts for an East Coast site, and explore alternative and more flexible fielding concepts such as transportable Ground Based Interceptors (GBIs) and alternative interceptors, including a non-GBI interceptor underlay.
- Expand and accelerate SM-3 capabilities.
- Create and field a space sensor layer for persistent "birth-to-death" missile tracking and discrimination, and improve redundancy and quality for ground-based radar sensors.
- Expand missile defense efforts to include capability for protecting US territory and military forces (whether comprehensively or not) against cruise missile or ballistic missile attacks from any source, whether accidental, unauthorized, or deliberate.
- Explore the potential of space-based sensors and interceptors to support the defense of the United States and its allies against complex and emerging ballistic missile threats; also, initiate a space-based test bed for interceptors.
- Create an integrated air and missile defense capability for US and allied forces in Europe, and potentially other regions, to protect against cruise missiles and other theater ballistic missile threats.
- Review the potential for using active and passive missile defenses to improve the survivability of nuclear forces and other strategic capabilities and thereby strengthen US deterrence strategies.
- Improve the survivability and graceful degradation of kill vehicles, interceptor sites, sensors, ground and support systems, and the broad missile defense enterprise to hostile environments and direct attack.
- Accelerate research and development efforts for compact lasers and other directed energy weapons for potential mounting aboard high altitude unmanned aerial vehicles (UAVs) flying within range of boosting ballistic missiles, for both tracking and boost phase intercept missions.
- Continue an evolutionary block development of all four families of interceptor capabilities—GMD, THAAD, Aegis BMD, and Patriot.
- Improve integration of left-of-launch missile defeat efforts with active and passive missile defenses.
- Improve the integration and interoperability of missile defense systems within the Joint Force and with those of allies and partners.
- Evaluate additional sensor options to improve tracking of missile threats to the United States from the Middle East, and to address any possible gaps for missiles traveling from southern trajectories or from sea-launched cruise or ballistic missiles.
- Maintain special acquisition authorities to maximize flexibility and responsiveness to changing and emerging missile threats.
- Devote significant research and development efforts to defend against emerging Russian and Chinese hypersonic boost glide vehicles.
- Provide operational capability to the Aegis Ashore Missile Defense Test Complex located in Kauai, Hawaii.

¹ Donald J. Trump, "Presidential Memorandum on Rebuilding the U.S. Armed Forces," *WhiteHouse.gov*, January 27, 2017, available at <https://www.whitehouse.gov/the-press-office/2017/01/27/presidential-memorandum-rebuilding-us-armed-forces>.

² See for example, *National Security Strategy of the United States* (Washington, DC: The White House, September 2002); *National Strategy to Combat Weapons of Mass Destruction* (Washington, DC: The White House, December 2002); U.S. Department of Defense, *Ballistic Missile Defense Review Report* (Washington, DC: Department of Defense, February 2010); U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, DC: Department of Defense, April 2010); Martin E. Dempsey, *Joint Integrated Air and Missile Defense: Vision 2020* (Washington, DC: Joint Chiefs of Staff, December 5, 2013); U.S. Department of Defense, *Strategy for Countering Weapons of Mass Destruction* (Washington, DC: Department of Defense, June 2014); U.S. Department of Defense, *Quadrennial Defense Review* (Washington, DC: Department of Defense, 2014); Barack Obama, *National Security Strategy of the United States* (Washington, DC: The White House, February 2015). U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: Department of Defense, December 2001).

³ Martin E. Dempsey, *Capstone Concept for Joint Operations* (Washington, DC: Joint Chiefs of Staff, September 10, 2012), p. 12.

⁴ This section is adapted in part from the chapter by Keith B. Payne, "A New Missile Defense Review," in Thomas Karako, Keith B. Payne, Brad Roberts, Henry A. Obering III, and Kenneth Todorov, *Missile Defense and Defeat: Consideration for the New Policy Review* (Washington, DC: CSIS, March 2017), available at https://csis-prod.s3.amazonaws.com/s3fs-public/publication/170228_Karako_MissileDefenseDefeat_Web.pdf?oYEFxIARU6HCqtRN3Zuq7mKljU3jllq.

⁵ See the Defense Department's announcement of GPALS: Office of the Assistant Secretary of Defense (Public Affairs), "New Strategic Defense Initiative Program Focus: Global Protection Against Limited Strikes (GPALS)," News Release, No. 54-91 (January 30, 1991), p. 1.

⁶ Edward Cashman, as cited in, "The Missile Defeat Posture and Strategy of the United States – the FY 17 President's Budget Request," *114th Congress*, House Armed Services Committee, April 14, 2016, available at <https://armedservices.house.gov/legislation/hearings/missile-defeat-posture-and-strategy-united-states-fy17-presidents-budget-0>.

⁷ R.W. Apple Jr., "War in the Gulf: Scud Attack, Scud Missile Hits a US Barracks, Killing 27," *The New York Times*, February 26, 1991, available at <http://www.nytimes.com/1991/02/26/world/war-in-the-gulf-scud-attack-scud-missile-hits-a-us-barracks-killing-27.html>.

⁸ Rory Jones and Ahmed al Omran, "Houthi Rebels Kill 60 Coalition Soldiers in Yemen," *The Wall Street Journal*, September 5, 2015, available at <http://www.wsj.com/articles/houthi-rebels-were-behind-attack-that-killed-45-u-a-e-soldiers-in-yemen-1441446816>.

⁹ Ralph Botton et al., "Russian cruise missiles target Syria," *Reuters*, August 20, 2016, available at <http://www.reuters.com/article/us-mideast-crisis-syria-aleppo-idUSKCN10U1EE>; Bilal Y. Saab and Michael Elleman, "Precision Fire: A Strategic Assessment of Iran's Conventional Missile Program," *Atlantic Council Issue Brief*, September 2016, available at http://www.atlanticcouncil.org/images/publications/Precision_Fire_web_0907.pdf.

¹⁰ Steven Lambakis, *The Future of Homeland Missile Defenses* (Fairfax, VA: National Institute Press, 2014), p. 2, available at <http://www.nipp.org/wp-content/uploads/2014/12/Future-of-Homeland-Missile-Defenses.pdf>.

¹¹ Joint Chiefs of Staff, *Joint Operating Environment 2035* (Washington, DC: Joint Chiefs of Staff, July 14, 2016), pp. 25, 27, available at http://www.dtic.mil/doctrine/concepts/joe/joe_2035_july16.pdf.

¹² U.S. Department of Defense, *Nuclear Posture Review Report* (2010), op. cit., p. vii.

¹³ Ashton Carter and William Perry, "If Necessary, Strike and Destroy," *Washington Post*, June 22, 2006, available at <http://www.washingtonpost.com/wp-dyn/content/article/2006/06/21/AR2006062101518.html>.

¹⁴ William M. Arkin, Cynthia McFadden, and Kenzi Abou-Sabe, "U.S. May Launch Strike If North Korea Reaches for Nuclear Trigger," *NBC News*, April 13, 2017, available at <http://www.nbcnews.com/news/world/u-s-may-launch-strike-if-north-korea-reaches-nuclear-n746366>.

¹⁵ "USS Mason Launches Three Interceptors to Defend Against Yemen Cruise Missile Attack," *Missile Threat*, October 13, 2016, available at <http://missilethreat.csis.org/uss-mason-launches-three-interceptors-defend-yemen-cruise>.

¹⁶ Ibid.

¹⁷ Martin E. Dempsey, *Joint Integrated Air and Missile Defense: Vision 2020* (Washington, DC: Joint Chiefs of Staff, December 5, 2013) p. 3, available at <http://www.jcs.mil/Portals/36/Documents/Publications/JointIAMDVision2020.pdf>.

¹⁸ Keith B. Payne, "Post-Cold War Deterrence and Missile Defense," *Orbis*, Vol. 39, No. 2 (Spring 1995).

¹⁹ William Rosenau, "Chapter 3: Coalition Scud Hunting in Iraq, 1991," in *Special Operations Forces and Elusive Enemy Ground Targets: Lessons from Vietnam and the Persian Gulf War* (Santa Monica, CA: RAND Corporation, 2002), pp. 29-44.; see also, Stephan Fröhling, "Managing escalation: missile defence, strategy and U.S. alliances," *International Affairs*, Vol. 92, No. 1 (2016), pp. 85, 87.

²⁰ Fröhling, "Managing escalation: missile defence, strategy and U.S. alliances," op. cit., p. 84.

²¹ Herman Kahn, *On Thermonuclear War* (New Brunswick, ME: Transaction Publishers, 2007), p. 287.

²² Thomas Karako, *Looking East: European Air and Missile Defense after Warsaw* (Washington, DC: Center for Strategic and International Studies, July 14, 2016).

²³ Peppi DeBiaso, "Proliferation, Missile Defense and the Conduct of Modern War," *Comparative Strategy*, Vol. 25, No. 3 (2006), p.163.

²⁴ U.S. Department of Defense, *Nuclear Posture Review Report*, 2010, p. iv.; U.S. Department of Defense, *Ballistic Missile Defense Review Report*, 2010, op. cit.

²⁵ North Atlantic Treaty Organization, "Lisbon Summit Declaration," *NATO.int*, November 20, 2010, available at http://www.nato.int/cps/en/natohq/official_texts_68828.htm.

²⁶ Fröhling, "Managing escalation: missile defence, strategy and U.S. alliances," op. cit., p. 87.

²⁷ Brad Roberts, "On the Strategic Value of Ballistic Missile Defense," *Institut Français des Relations Internationales Proliferation Papers*, No. 50 (June 2014), p. 23, available at <http://www.ifri.org/sites/default/files/atoms/files/pp50roberts.pdf>.

²⁸ Dempsey, *Joint Integrated Air and Missile Defense: Vision 2020*, op. cit., p. 3.

²⁹ William Clinton, "Remarks by President Bill Clinton on National Missile Defense" (speech, Georgetown University, Washington, DC, September 1, 2000), available at http://www.armscontrol.org/act/2000_09/clintonnmd.

³⁰ *National Missile Defense Act of 1999*, Public Law 106-38, 113 Stat. 205 (July 22, 1999).

³¹ National Defense Authorization Act for Fiscal Year 2017, *Conference Report to Accompany S.2943*, Sec. 1683, 114th Congress (2016), 1600-1601, available at <http://docs.house.gov/billsthisweek/20161128/CRPT-114HRPT-S2943.pdf>.

³² William E. Gortney, *Countering Air and Missile Threats* (Washington, DC: Joint Publication 3-01, March 23, 2012), p. xviii, available at http://www.dtic.mil/doctrine/new_pubs/jp3_01.pdf.

³³ James A. Winnefeld, "Adm. Winnefeld's Remarks at the Center for Strategic and International Studies," *JCS.mil*, May 19, 2015, available at <http://www.jcs.mil/Media/Speeches/Article/589289/adm-winnefelds-remarks-at-the-center-for-strategic-and-international-studies/>.

³⁴ Dempsey, *Joint Integrated Air and Missile Defense: Vision 2020*, op. cit., p. 3.

³⁵ U.S. Department of Defense, *Nuclear Posture Review*, 2001, p. iii.

³⁶ This discussion was adapted from, Keith B. Payne, "Preventing another Pearl Harbor—America must counter the North Korean missile threat," *The Washington Times*, January 22, 2017, available at <http://www.washingtontimes.com/news/2017/jan22/preventing-another-pearl-harbor>.

³⁷ Choe Sang-Hun, "North Korea IS Able to Mount Nuclear Warhead on Missile, South Says," *The New York Times*, April 5, 2016, available at <http://www.nytimes.com/2016/04/06/worl/asia/north-korean-nuclear-warhead-rodon-missile.html>.

³⁸ K.J. Kwon and Joshua Berlinger, "Kim Jong Un Says North Korea Close to Testing IBM," CNN, January 2, 2017, available at <http://www.cnn.com/2017/01/01/asia/north-korea-kim-jong-un-speech/>.

³⁹ Ibid.

⁴⁰ "North Korea Cannot 'Tip' Missile With Nuclear Warhead: U.S. State Department," *Reuters*, January 3, 2017, available at <http://www.reuters.com/article/us-northkorea-missiles-state-idUSKBN14N1Q9>. See also, "U.S. not aware North Korea Nuclear Capabilities Have Changed: White House," *Reuters*, January 3, 2017, available at <http://reuters.com/article/us-northkorea-missiles-whitehouse-idUSKBN14N1OF?il=0>.

⁴¹ Matthew Pennington, "US Sees 'Qualitative Improvement' in North Korea's Weapons Capabilities," *Bloomberg News*, January 5, 2017, available at <https://www.bloomberg.com/news/articles/2017-01-06/us-sees-qualitative-improvement-in-nkorea-capability>.

⁴² William E. Gortney, "Statement of Admiral William E. Gortney, United States Navy, Commander, United States Northern Command and North American Aerospace Defense Command," 114th U.S. Congress, Senate Armed Services Committee, April 13, 2016, p. 5, available at https://www.armed-services.senate.gov/imo/media/doc/Gortney_04-13-16.pdf.

⁴³ Reported in, Sam Kim, "Trump Has Four Main Options for Stopping North Korean Missiles," *Bloomberg*, January 2, 2017, available at <https://www.bloomberg.com/politics/articles/2017-01-03/trump-has-four-main-options-for-stopping-north-korean-missiles>.

⁴⁴ Quoted in Rick Gladstone, "North Korea Giving Up Nuclear Arms 'a Lost cause,' Official Says," *The New York Times*, October 25, 2016, available at <http://www.nytimes.com/2016/10/26/world/asia-korea-james-clapper.html>.

⁴⁵ Ashton Carter and William Perry, "If Necessary, Strike and Destroy," op. cit., available at <http://www.washingtonpost.com/wp-dyn/content/article/2006/06/21/AR2006062101518.html>.

⁴⁶ Associated Press, "Hawaii Panel Asks State to Prepare for North Korea Attack," *US News and World Report*, April 13, 2017, available at <https://www.usnews.com/news/best-states/hawaii/articles/2017-04-13/hawaii-panel-asks-state-to-prepare-for-north-korea-attack>.

⁴⁷ See Anthony Capaccio, "Stopping a N. Korean Missile No Sure Thing, U.S. Tester Says," *Bloomberg*, January 10, 2017, available at <https://www.bloomberg.com/politics/articles/2017-01-10/stopping-a-n-korean-missile-no-sure-thing-u-s-tester-says-ixr2dcu3>.

⁴⁸ See the discussion in J.D. Syring, "Vice Admiral J.D. Syring, USN, Director, Missile Defense Agency," 114th U.S. Congress, House Armed Services Committee, April 14, 2016, p. 5, available at https://www.armed-services.senate.gov/imo/media/doc/Syring_04-13-16.pdf.

⁴⁹ See, "How Many SM-3 Block IIA Missiles?" *MostlyMissileDefense*, January 25, 2016, available at <https://mostlymissileddefense.com/2016/01/25/how-many-sm-3-block-iiia-missiles-january-25-2016>. See also, Rikki Ellison, "Missile Defense In the News-The 'Pearls' of Pearl Harbor," available at <http://www.experts.com/Articles/Missile-Defense-In-The-News-The-Pearls-of-Pearl-Harbor-By-Rikki-Ellison>.

⁵⁰ Andrea Shalal, "Exclusive: U.S. weighs making Hawaii missile test site optional-sources," *Reuters*, January 22, 2016, available at www.reuters.com/article/us-usa-missile-defense-hawaii-idUSKCN0V0008.

⁵¹ See the discussion in, Amb. Hank Cooper, speech to the Explorer Club, New York City, April 10, 2014, available at <http://highfrontier.org/wp-content/uploads/2014/04/Defeat-the-NK-FOBS-140410.pdf>.

⁵² Missile Defense Agency, "US, Japan Successfully Conduct First SM-3 Block IIA Intercept Test," *Navy.mil*, February 4, 2017, available at http://www.navy.mil/submit/display.asp?story_id=98719.

⁵³ See Ronald O'Rourke, *Sea-Based Ballistic Missile Defense—Background and Issues for Congress* (Washington, DC: Congressional Research Service, December 22, 2009), p. 19, available at http://research.policyarchive.org/19898_Previous_Version_20090918.pdf.

⁵⁴ Quoted in, Chang Jae-soon, "Removal of U.S. Nuclear Umbrella Would Lead Seoul to Contemplate Nuclear Armament: Incoming USFK Commander," *Yonhap News*, April 20, 2016, available at <http://english.yonhapnews.co.kr/news/2016/04/20/0200000000AEN20160420000252315.html?a370fd80>.

⁵⁵ Thomas Karako, "A space sensor layer for missile defense," *Space News*, August 15, 2016, available at <https://www.spacenewsmag.com/commentary/a-space-sensor-layer-for-missile-defense/>.

⁵⁶ Phillip Swarts, "Missile Defense tracking systems need to move to orbit, leaders say," *Space News*, December 15, 2016, available at <http://spacenews.com/missile-defense-tracking-systems-need-to-move-to-orbit-leaders-say/>.

Section VIII. Adapting Western Policies and Capabilities for the NATO Region

Background

NATO has consistently relied on nuclear weapons for deterrence and assurance. Since the collapse of the Soviet Union, the alliance has reduced the role of nuclear weapons in its military strategy and deterrence posture. Nonetheless, NATO has maintained a posture and policy emphasizing that nuclear weapons continue to play a foundational role in its security. This role has been fulfilled both by the strategic forces of the United States and the United Kingdom (and, indirectly, France), as well as by US theater nuclear weapons deployed in Europe and deliverable in concert with allied nations contributing either directly through the provision of basing and/or delivery aircraft, or indirectly through participation in various aspects of the fulfillment of the nuclear mission. The alliance also has maintained internal mechanisms for consultation regarding nuclear strategy and deterrence such as the Nuclear Planning Group (NPG) and the High-Level Group (HLG).

The resurgent threat from Russia has refocused discussion on the role of nuclear weapons within NATO. As already noted, previous NPRs reflected considerable confidence in an increasingly cooperative US relationship with Russia. However, previous NPRs also called for hedging measures to facilitate US responses in the event that relations with Russia reverted to previous levels of hostility with the Soviet Union—with the attendant increased salience of nuclear weapons.

This concern, as noted earlier, was perhaps best expressed by former Defense Under Secretary for Policy Walter Slocombe:

Nuclear weapons will retain their fundamental role because, even if the transformation of the USSR follows a relatively optimistic path, there will be for many years an overhanging possibility not merely of transient ups and downs in Russian progress, but of fundamental relapse, an event which would again require active nuclear deterrence for world stability and US security.¹

Russia's blatant willingness now to use force, its expansion of conventional forces that can quickly threaten member states, especially in Eastern NATO, its repeated nuclear threats to NATO members and neutral states, and its apparent planning for limited nuclear first use have all contributed to the renewed salience of the alliance's nuclear forces and deterrent posture. These new realities illustrate the need for and value of the adaptability of US strategies and forces.

Moscow's ongoing nuclear modernization programs and evident emphasis on the option of nuclear first use, especially when coupled with capabilities to create *faits accomplis* in Central Europe, have stirred serious anxieties within NATO and resulted in alliance efforts to enhance deterrence. NATO's then-Deputy Supreme Allied Commander Sir Adrian Bradshaw described the current threat context in stark terms: "The threat from Russia is that through opportunism and

mistakes and a lack of clarity regarding our deterrence we find ourselves sliding into an unwanted conflict which has existential implications.”²

That said, the nuclear issue remains delicate within the alliance, with many populations and governments, particularly in Western Europe, fearful of or opposed to re-emphasizing nuclear weapons. This serves to make the issue of nuclear weapons particularly sensitive within alliance deliberations.

The Development of the Alliance’s Nuclear Policy and Posture

During the Cold War, nuclear weapons were the cornerstone of NATO’s deterrence posture and strategy. Because the Soviet Union and the Warsaw Pact held many advantages in conventional forces in Europe, at least into the mid- to late-1980s, the alliance emphasized nuclear weapons as the fundamental way of deterring Soviet aggression or coercion. This deterrent force included the strategic arsenal of the United States, based in silos and at airfields in the United States itself and on submarines at sea, and also a very large number of US theater-range nuclear weapons deployed within Europe, including thousands of short- and medium-range ballistic and cruise missiles, nuclear artillery shells, atomic demolition munitions, bombs, and other forms of nuclear weaponry.³ These weapons were intended to contribute to deterrence and, if necessary, for intra-theater use in the event of war with the USSR and its Warsaw Pact allies. Indeed, a primary role of these theater nuclear weapons was to “couple” the defense of Europe with the strategic deterrent forces of the United States—to ensure Soviet understanding that any attack against NATO could very well escalate to a general war between the superpowers, and thus deter Soviet aggression.

At the same time, the alliance emphasized a “dual track” approach to dealing with the threat from the East, captured most famously in the Harmel Report of 1967, which combined a strong deterrent and defense posture with a parallel approach to easing tensions with the Warsaw Pact. This dual track approach was perhaps most evident in the late 1970s and early 1980s with the US deployment, in concert with the alliance—particularly key basing allies like Germany, the United Kingdom, Belgium, Netherlands, and Italy—of ground-launched cruise missiles (GLCMs) and Pershing II medium-range ballistic missiles (MRBMs). At the same time, Washington negotiated with Moscow for a reduction and, ultimately, elimination through the 1987 Intermediate-Range Nuclear Forces (INF) Treaty of these weapons and the Soviet SS-20 intermediate range ballistic missile (IRBM) that had prompted their deployment in the first place.

With the end of the Cold War and the collapse of the Soviet Union, the main threat to NATO dramatically declined. In concert with this, the alliance sharply reduced its nuclear forces and its reliance on nuclear forces in its deterrent posture. This was a product both of a more benign security environment for the alliance and of the greatly-increased conventional advantages of the United States resulting from “Second Offset Strategy”-era technologies such as precision conventional strike and stealth. Thus, while the alliance and the United States during the 1990s continued to hedge against the unexpected possibility of a return to Cold War-era behavior by Russia, the alliance and its nuclear weapons state members sharply reduced their nuclear arsenals.

In the case of forces specifically allocated to the alliance, by the 2000s the remaining nuclear force reportedly consisted of several hundred US nuclear gravity bombs based at air bases in

several European countries and capable of being delivered by US and Allied F-16 or Tornado attack aircraft. During much of the 2000s, given the perception of a low level of threat from Russia and the focus of the alliance on Afghanistan (and, for some member states, on Iraq), most of the policy focus on this residual arsenal was on whether to retain it at all and, if so, whether it could be used as a bargaining chip for further nuclear reductions by Moscow. The cost of sustaining and modernizing the forces required to continue this nuclear deterrent posture also was an issue among NATO members. For European allies, the question largely focused on the issue of whether or not to move forward with a nuclear-capable replacement for the F-16 or Tornado aircraft. For the United States, and particularly the Air Force, the issue was whether sustaining the presence and capabilities for the deterrent were worth the cost in light of other priorities.

NATO's desire for and expectation of positive relations with Russia continued even after Russia's 2008 military operations against Georgia. The 2010 Strategic Concept characterized the NATO-Russia relationship, despite differences on particular issues, as a "strong and constructive partnership based on mutual confidence, transparency and predictability."⁴

Despite this expressed view, and a strong push by several member states to withdraw remaining US nuclear weapons from Europe in the late 2000s, NATO agreed in its 2012 *Deterrence and Defense Posture Review* (DDPR) effectively to sustain its strategy and posture regarding nuclear weapons. Concerns on the part of Eastern European states and Turkey about the potential threat from the East, as well as concerns among nuclear states about being politically "singularized," contributed to the sustained support for nuclear deterrence.

Specifically, the DPR reflected agreement among the allies that "[n]uclear weapons are a core component of NATO's overall capabilities for deterrence and defense... As long as nuclear weapons exist, NATO will remain a nuclear alliance."⁵ It also emphasized that "[t]he circumstances in which any use of nuclear weapons might have to be contemplated are extremely remote," and it committed to "seeking to create the conditions and considering options for further reductions of non-strategic nuclear weapons assigned to NATO." The alliance also specifically signaled its readiness, "to consider further reducing its requirement for non-strategic nuclear weapons assigned to the Alliance in the context of reciprocal steps by Russia." Thus, the DPR reflected the traditional dual track approach.

Member states agreed that the "Allies concerned will ensure that all components of NATO's nuclear deterrent remain safe, secure, and effective.... That requires sustained leadership focus and institutional excellence for the nuclear deterrence mission and planning guidance aligned with 21st Century requirements." NATO also committed to exploring "concepts for how to ensure the broadest possible participation of Allies concerned in their nuclear sharing arrangements."⁶

In effect, the alliance committed itself to the sustainment of its nuclear deterrent posture and strategy, but also to the reduction of those nuclear forces dedicated to the alliance if Russia cooperated. Alliance policy reflected a compromise situation that deferred a number of the hardest questions, including whether Russia would offer any serious proposals for reducing its own large non-strategic nuclear weapons (NSNW) arsenal and how to pay for the modernization of delivery aircraft for NATO's NSNW. At the same time, significant political divisions with the alliance—and within member states—about the appropriate role of nuclear weapons persisted.

2014 and After⁷

The 2014 Russian military annexation of Crimea and operations in Eastern Ukraine came as a shock to NATO, prompting the realization that the expected positive relationship with Russia was not to be and that the Euro-Atlantic security area was no longer at peace. In the words of former NATO Deputy Secretary General Alexander Vershbow, “For 20 years, the security of the Euro-Atlantic region has been based on the premise that we do not face an adversary to our east. That premise is now in doubt.”⁸ NATO’s then-Secretary General Anders Rasmussen was even more blunt, noting that Russia “has violated every principle and international commitment it has made.”⁹ He called Russia’s military aggression in Ukraine a “game changer,” and “the most serious crisis in Europe since the fall of the Berlin Wall,” further lamenting that “our vision of a Europe whole, free and at peace has been put into question.”¹⁰

In response, at the 2016 Warsaw Summit NATO declared that, “NATO has the capabilities and resolve” to impose on any adversary unacceptable costs, which would far outweigh expected benefits, and explicitly confirmed the important role and relevance of US nuclear weapons based in Europe.¹¹ The Ukraine Crisis, Russia’s seizure of Crimea, military exercises involving simulated nuclear first use, and the general deterioration in NATO-Russia relations have all contributed to a substantial increase in recognition by NATO members of the threat from Moscow. The cardinal assumption behind reducing NATO’s military posture in Europe—conventional and nuclear—was a vastly diminished sense of threat from Russia. This assumption no longer holds for member states in the East such as Poland and the Baltic states, and is increasingly questioned by countries farther north and west such as the United Kingdom, Norway, and Denmark. For example, Russia’s ambassador to Norway Teimuraz Ramishvili recently warned Norway that if it participated in NATO missile defense efforts, it must “understand that after becoming an outpost of NATO, it will have to face head-on Russia and the Russian military might.”¹²

These concerns have focused on the possibility that Russia may be prepared to use force against NATO states, and its increased ability to do so. To most NATO governments, Moscow appears to be interested in reestablishing its influence, if not suzerainty, over its “near abroad,” weakening and dividing NATO, and pursuing menacing ways of causing instability in the economic and political order in neighboring states. This intent is coupled with Moscow’s evident willingness to use force and its markedly improved conventional military capability, along with a large nuclear arsenal that is continually being modernized.

Together, these factors have led to a substantial increase in focus on strengthening NATO’s deterrence and defense posture broadly, particularly at the conventional level. Concerns about Russian military advantages in the Baltics, particularly if used in a *fait accompli* or *coup de main* manner, have led the alliance to form a Rapid Reaction Force and, more recently at the 2016 Warsaw Summit, to commit to the deployment of multinational battalions to the vulnerable Baltic states. At the same time, the United States has committed to strengthening its forces in Europe and focus on the alliance.

There also has been significant increased attention to and concern about the nuclear dimension of these developments. Russia has clearly intensified its expressions of nuclear threat in various ways since 2014, including through direct emphasis on nuclear weapons by senior Russian officials or those closely associated with the Kremlin (as well as a number of inflammatory

incidents) and a substantial uptick in operations by nuclear-capable forces throughout the Euro-Atlantic area.

Most worrisome, Western officials and analysts have grown increasingly concerned with Moscow's "escalate-to-de-escalate" strategy—effectively the threat or use of nuclear weapons in limited fashion to coerce NATO into backing down in the midst of a conventional war brought on by Russian expansionism. While Russia's formal, public doctrine states that Moscow would only use nuclear weapons in the event of a threat to the existence of the state, many—if not most—informal Western officials and analysts judge that Russia has a broad definition of what constitutes such a threat, and that it has the capabilities, doctrine, experience, and possibly the resolve, to employ nuclear or other strategic weapons first for war termination on its preferred conditions. This Russian emphasis on nuclear threats and employment appears to follow from the fact that Russian power ultimately could be dramatically outweighed by the conventional military power of NATO in a conflict—if the alliance is united in its resolve to exert the full weight of its military power. Any Russian strategy for attacking or undermining the alliance, therefore, must identify how to prevent this from happening. The "escalate-to-de-escalate" strategy intended to coerce alliance members appears to be Moscow's preferred choice for doing so, if it believes the stakes to be sufficiently high.

Gen. Curtis Scaparrotti, Commander, US European Command, has pointed explicitly to this challenge:

Most concerning, however, is Moscow's substantial inventory of non-strategic nuclear weapons in the EUCOM AOR and its troubling doctrine that calls on the potential use of these weapons to escalate its way out of a failing conflict. Russia's fielding of a conventional/nuclear dual-capable system that is prohibited under the INF Treaty creates a mismatch in escalatory options with the West.¹³

President Putin has threatened that he could have Russian troops in five NATO capitals in two days.¹⁴ This has important implications for the alliance's nuclear deterrence policy and posture. Any Russian *fait accompli* and/or "escalate-to-de-escalate" strategy would be focused on moving rapidly, dividing the alliance and weakening its resolve, and thereby precluding NATO's ability to bring to bear its greater strength. In other words, it would be about conflict and coercion via the manipulation of escalation threats. Therefore, NATO's ability to deny Russia any plausible expectations about the value of nuclear escalation will be an increasingly central issue. A primary NATO deterrence goal now must be to preclude any Russian expectation of advantage via nuclear escalation or its threat. This goal naturally includes the strategic nuclear forces of the alliance's three nuclear states as well as the non-strategic nuclear weapons assigned to NATO.

What are the implications of these realities for Western deterrence and assurance strategies and requirements? First, the United States must maintain its traditional role as leader of NATO nuclear policymaking, planning, and operations. Second, US policies and forces, as well as NATO's, must be of sufficient size and flexibility to adapt as necessary to an increasingly hostile and dynamic threat environment.¹⁵ These principles represent a shift from the earlier post-Cold War policy direction which sought largely to reduce and constrain US nuclear capabilities on a continuing basis, particularly including US theater nuclear capabilities.

More specifically the West must end Russian misperceptions that Moscow's will and readiness to break the West at the risk of war are greater than the West's will and readiness to prevent it from doing so. The United States and NATO must repeatedly make clear the indivisibility of the alliance and its nuclear policy: that an attack on one is an attack on all, and that any Russian nuclear escalation against the West would be the worst possible course for Russia under any circumstances.

Key Issues

NATO has been adapting, albeit slowly, to a more dangerous nuclear environment than that envisioned in previous NPRs, NATO's 2010 Strategic Concept, and the 2012 DDPR. It must now adapt in a timely way to a much more dangerous threat environment than was perceived or expected by many observers until very recently.

In light of this increasingly dangerous security environment, key issues regarding NATO and its nuclear policy and posture include:

- The appropriate strategy and posture for deterring and potentially fighting a Russia possessed of significant local conventional strengths and a large, ever more modern and growing, theater and strategic nuclear arsenal. This issue encompasses Russian views of nuclear escalation threats and their use in the event of conflict, as well as required countermeasures in Western capabilities, doctrine, and strategy. It includes the question of the relationship of the alliance's nuclear forces to its conventional weapon deployments and plans, including in the Baltics.
- The future of the US nuclear force designated for NATO, especially the modernization of the US B61 bomb and the dual-capable aircraft (DCA) to carry it.
- Changes in word or emphasis to alliance declaratory policy on the role of nuclear forces and/or nuclear strategy, and what form these changes should take—for instance, a replacement to the DDPR; statements by the Secretary General, SACEUR, and other senior officials; and, exercises and the reporting of exercises.
- A broader array of member states in nuclear-sharing arrangements and/or development of new mechanisms for such sharing, particularly in the more challenging air defense environment posed by Russia. This is particularly important due to security concerns and anxious signals from countries like Poland keen to participate more fully in the mission, as well as the possibility that traditional host countries may drop out of the nuclear mission.
- Whether NATO's nuclear forces are adequately ready and appropriately deployed and postured in light of the new strategic situation. Such issues would include military planning and command capability, and actual basing and DCA-tasks, including hosting exercises.
- How the United States and/or NATO should respond to continuing Russian arms control violations, particularly including the INF Treaty and Presidential Nuclear Initiative (PNI) commitments.

NATO's nuclear force posture is of critical political-military importance for deterrence and assurance, and this essential political and military link between the United States and European members of the alliance must remain strong. NATO's long-standing fundamental nuclear policy principles remain valid, specifically:

- The fundamental purpose of NATO nuclear forces is political: to preserve peace and help deter coercion and war;
- Nuclear forces must continue to fulfill an essential role by denying any plausible basis for confidence in the mind of any aggressor about the nature of member responses to military aggression;
- These nuclear forces must be perceived as credible, and have flexibility and survivability;
- They should be maintained at the readiness level necessary to preserve peace;
- The risks and responsibilities of remaining a nuclear alliance must be widely shared; and,
- The presence of US conventional and nuclear forces in Europe remains vital to the security of Europe, which is inseparably linked to that of the United States.

While these general principles remain valid, today's dramatically different security landscape argues that their implementation and realization must be reappraised. Indeed, the current deterrence strategy and posture is not optimized to deter Russia's new coercive nuclear threats or Russia's military doctrine on first use of nuclear weapons. The renewed adversarial relationship with Russia, and the narrowing of Western nonnuclear military advantages, mean that the United States and NATO need to reexamine and, if necessary, revise Western nuclear policy and posture to eliminate any exploitable vulnerabilities now perceived by Moscow—as evidenced by Moscow's felt freedom to engage in explicit, coercive nuclear threats against NATO and nuclear first-use planning.

While supporting an enhanced conventional deterrence posture for the eastern NATO flank, a clear message must be conveyed to Russia that NATO is also adjusting—no longer relaxing—its nuclear posture. As Camille Grand recently observed in *NATO Review Magazine*, “The Alliance’s language on deterrence—especially its nuclear component—has been continuously diluted in various relevant documents such as summit communiqués and strategic concepts since the end of the Cold War.”¹⁶ NATO must now tailor its approach to deterrence and assurance to the new challenges posed by Russian actions. Thus, with US leadership, the Strategic Concept and the DDPR should be adapted to take into account the new adversarial relationship between NATO and Russia, and the latter’s emphasis on nuclear threats and escalation. In so doing, because of the integral role of nuclear forces in Russia’s military planning, the United States will also need to work closely with allies to clearly define the character and role of an enhanced extended nuclear deterrence posture in its overall strategy to respond to the new threats posed by Russia.

The US extended deterrent posture has a vital role to play in the assurance of allies. Russia must understand the indivisibility of the alliance: that any attack on one is an attack on all, and that such an attack will be defeated and, if necessary, met with an “overwhelming” response, including the possible employment of nuclear weapons.¹⁷ In all cases of aggression against NATO, whether nuclear or non-nuclear, there will be no diminishment of US resolve to defend allies. US forward-deployed nuclear capabilities and leadership remain essential to managing the dynamics of escalation so that Moscow readily perceives the futility and intolerable cost of aggression against the alliance.

As then-Secretary of Defense Carter observed, “You [military personnel operating nuclear weapons] deter large-scale nuclear attack against the United States and our allies. [And] you help convince potential adversaries that they can’t escalate their way out of a failed conventional aggression.”¹⁸ Moving Moscow to the clear understanding that this is the reality of NATO’s will and power is the key for the future of deterrence and stability in Europe. Doing so will require the

continued provision of extended nuclear deterrence, forward deployment of US conventional and nuclear forces in Europe, and the strengthening of US and allied non-nuclear capabilities.

The interaction here between increased Western non-nuclear defense preparedness in Europe and the perceived credibility of the West's nuclear deterrent is important. In response to Russian threats and expansionism, Western efforts to deploy high-readiness, *non-nuclear* defensive capabilities to protect NATO front-line states from a Russian military *fait accompli* will likely reduce Moscow's perceptions of exploitable advantage and also strengthen the credibility of US extended deterrence commitments. Why? Because doing so will deny Moscow's perceptions of an easy Russian *fait accompli* and demonstrate united Western resolve to put itself on the line for this cause. The West understood this point well during the Cold War; in Cold War parlance, a conventional "tripwire" or "plate glass door" that is understood by Moscow to lead to intolerable loss if it should attack can be of great value for deterrence. However, Estonian President Kersti Kaljulaid recently observed that NATO now needs more than "just a tripwire" to make "our deterrent believable."¹⁹ The Lithuanian Defense Minister has similarly stated that NATO must improve its "reaction time" and add "more capability, and not only land troops but also air defenses and capabilities to counter any blockade."²⁰

The level of additional, forward-deployed NATO defensive capability needed for this deterrent purpose is an important question. Lt. Gen. Valery Zaparenko, a former deputy chief of the Russian General Staff, commented recently in this regard, "You can't deter much with a few battalions."²¹ A pertinent 2016 RAND study concluded that: "Having a force of about seven brigades, including three heavy armored brigades—adequately supported by airpower, land-based fires, and other enablers on the ground and ready to fight at the onset of hostilities" might provide an adequate initial deterrent.²²

The difference today, of course, is that NATO front-line states are former parts of the Soviet Union or former members of its Warsaw Pact. This point may be extremely significant because cognitive studies typically conclude that humans will accept greater risk to recover a value considered unfairly lost than to acquire a new gain.²³ The leadership in Moscow clearly believes the West has inflicted great losses on Russia that must be recovered. This point suggests the challenge of deterring Russian leadership in this second nuclear age; US Cold War approaches to deterrence are incomplete guides for contemporary deterrence strategies.

The US-NATO partnership is critical not only in deterring potential threats, but also in serving US nonproliferation goals—by demonstrating to neighboring states that their pursuit of nuclear weapons will not provide military or political advantages, and by assuring non-nuclear US allies and partners that their security interests will be protected without their own nuclear deterrent capabilities.

The 2016 NATO Warsaw Summit affirmed the importance of US nuclear weapons forward-deployed in Europe and the "capabilities and infrastructure provided by Allies concerned." The United States should continue to take the steps necessary to support the shared responsibilities for the nuclear deterrence role these weapons provide.

DCA, Deterrence and Assurance

The fact that NATO DCA are supplied and operated by several NATO countries is a powerful symbol of alliance cohesion and resolve. They clearly and visibly demonstrate alliance cohesion and also provide conventional capability, while the cost to maintain their nuclear capability is relatively modest. In the context of today's multi-faceted threats, NATO's DCA have the potential to help provide the needed force characteristics already noted. They are capable of striking a range of targets, surviving and operating in a wide range of environments—throughout the spectrum of conflict from acts of terrorism to full-scale war—and will perform as expected, if employed. The United States and its allies also are committed to ensuring NATO's nuclear forces are properly maintained, resourced, modernized, exercised and evaluated.

Current NATO DCA-sharing arrangements for US nuclear weapons in Europe have served two functions at once:

1. Communicating to adversaries that an alliance nuclear deterrent has been constituted, with multiple allies involved in consulting on policy, maintaining the posture, and preparing for possible operations; and,
2. Assuring allies of the credibility of US commitments, with the weapons, delivery systems, consultations, and other concrete and tangible arrangements creating a presumption of concerted action in the event of a crisis.

Rather than the United States bearing the full burden of extended deterrence, the allies have assumed practical security roles, financial costs, and political and military risks and responsibilities.

Indeed, the basing of US nuclear weapons in Europe plays an indispensable political role, by contributing to allied understanding of and sense of shared responsibility for the role of nuclear weapons in the overall deterrence and defense concepts of NATO. It also signals the special trust and confidence the United States places in its allies as full partners in this unique collective defense organization. The achievement of the alliance's security aims will also continue to depend critically on the equitable sharing of roles, risks and responsibilities, as well as the benefits of common defense. Accordingly, the United States, in consultation with its allies, should continue to deploy and maintain non-strategic nuclear weapons in Europe, sized and structured for the new security environment, for both US and allied forces.

The DDPR endorsed the need for and importance of burden sharing, in particular, "how to ensure the broadest possible participation of Allies in their nuclear sharing arrangements." The key tool for demonstrating the characteristics of flexibility and resilience, and maximizing participation among all allies remains the DCA and its logistic and operational support team. While NATO's current policy documents reflect more of an agreement to maintain the status quo while pursuing arms control opportunities with Moscow rather than any significant new departures, new steps to consider include the following:

Expand DCA Burden Sharing

Burden sharing, i.e., sharing the risks and burdens of conventional and nuclear deterrence, has long been a basic concept for NATO. In addition to the United States, the independent nuclear capabilities of the UK and France contribute to nuclear deterrence.²⁴ A number of NATO nations provide nuclear-capable aircraft, although custody of the nuclear weapons remains with the United States.²⁵ The allied DCA contributions increase the number of operational delivery systems available and, critically, also demonstrate resolve.

One option is to reconsider the pertinent points regarding deployment of nuclear forces established by the NATO-Russia Founding Act of 1997 (no intention, no plan, no reason to put nuclear weapons in Eastern Europe). Given consistent and ongoing Russian violations of the Founding Act and the INF Treaty, and the importance of burden-sharing and consultation in the alliance, it may be necessary to pursue innovative ways to expand the sharing of risks and responsibilities among all 28 NATO allies which will, in turn, increase the credibility of the deterrent and manifest alliance solidarity.

The deployment of NATO nuclear weapons into former Warsaw Pact countries would certainly enhance burden-sharing,²⁶ but also would be resisted by some NATO members, and certainly by Russia. Allied resistance to such a step may soften in the future if Russia's threatening behavior continues. For the time being, however, burden-sharing may also be expanded in other less dramatic ways. Allies can participate in the DCA aspect of NATO nuclear deterrence without having nuclear weapons on their territory. For example, they can provide pilots and maintenance personnel for service in either US or allied squadrons operating DCA; they might also provide various types of support, including participating in strike packages or providing electronic warfare support to aircraft carrying out a nuclear strike. Some Polish leaders believe that Poland could "provide conventional support forces to nuclear operations. Polish F-16s and MiG-29s can provide some of the tasks in any air strike, should changing political-military relations require their help."²⁷

It is quite routine for pilots to be assigned for service with allied air forces for a variety of reasons. This sometimes involves flying a different type of aircraft than they would fly in their home country. For example, British pilots assigned to the US Navy reportedly are flying F-18s from carriers for the purpose of maintaining experience in carrier operations, pending the availability of UK carriers.²⁸ The Polish Air Force flies an advanced version of the F-16, the same type of aircraft used by the United States and its allies for the DCA role,²⁹ and Romania is acquiring used F-16s.³⁰

Enhancing cooperation and burden-sharing for nuclear deterrence and assurance in this manner certainly is feasible and would be inexpensive for members that could provide pilots, maintenance personnel or other types of support for existing DCA operations.

Increase DCA Readiness

The readiness of US and allied DCA is critically important to its survivability and, hence, to its credibility as a nuclear deterrent. Russian non-strategic nuclear weapons far exceed those of the West in numbers, diversity and readiness.³¹ Russia has "increased training for nuclear operations in all military branches."³² NATO has done the opposite. NATO states that its DCA have been

reduced in nuclear readiness to the point that “the highest level of readiness is measured in weeks.”³³

Russia may perceive DCA’s level of readiness as making these aircraft essentially symbolic rather than an effective nuclear capability in support of deterrence. NATO’s 2015 Annual Report records that, “Russia has conducted at least 18 large-scale snap exercises, some of which have involved more than 100,000 troops. These exercises include simulated nuclear attacks on NATO Allies (e.g., ZAPAD) and on partners (e.g., March 2013 simulated attacks on Sweden)...”³⁴ In light of these developments, increasing US non-strategic deterrent capability via significantly increased readiness is quite prudent.

DCA readiness can be increased rapidly, possibly at little cost. It may, at least in part, be a matter of training priorities.³⁵ Increased readiness would allow DCA to be put on alert quickly during a crisis situation. Alert DCA is something that Russia would have to take into account before starting a war in Europe or deciding on the first use of nuclear weapons; Moscow would have to consider that no type of strike against alert DCA bases would guarantee their elimination. Russian lack of confidence in that regard should contribute to deterrence and to allied assurance.

Advance Availability of the B61-12

The B61-12 is very important because it will be the only US nuclear weapon based in Europe with precision accuracy, and it will have a low-yield option, which is reportedly sub-kiloton.³⁶ In recent years it has been delayed, thereby extending the Russian near-monopoly in precision low-yield nuclear weapons and potentially endangering deterrence. In 2010, then-Commander of USSTRATCOM General Kevin Chilton said the United States needed the B61-12 to be in production by 2017.³⁷ The first production units of the B61-12 are now scheduled for March 2020, and delays reportedly may continue.³⁸

John Harvey, former Principal Deputy Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs, has noted that, “Current plans are to retire the B83 well before the end of its service life, and possibly before sufficient experience is gained with the B61-12 LEP to fully assess any ‘birth defects’, in part to avoid a relatively small investment in B83 warhead surveillance. In light of the increased importance of extended deterrence in our security posture, it may make sense to revisit that decision.”³⁹ Another possible method of reducing this risk is to accelerate the availability date for the B61-12 to the extent possible.

Accelerate Availability of the F-35 for Nuclear Deterrence

The availability of F-35 nuclear capability has also been substantially delayed. The F-35 nuclear initial operational capability (IOC) reportedly will be 2024.⁴⁰ Until then, NATO DCA will be non-stealth aircraft that do not have standoff capability and, hence, will be vulnerable to advanced Russian air defenses.⁴¹ The F-35B and C will not be nuclear capable. The risk in delaying the F-35 nuclear capability, as Rebecca Grant noted in 2010, is that, “With its stealth and specialized sensors, the F-35 will soon likely be the only nuclear-capable fighter able to penetrate sophisticated enemy air defenses. The F-35 could be thrust into the spotlight if the planners judge that the B-2 reaches a point where it is no longer able to penetrate enemy air defenses—especially in daytime.”⁴²

The nuclear-capable F-35 reportedly can and should be accelerated.⁴³ Even under the current program, nuclear integration will start in 2018.⁴⁴ However, testing of a mockup of the B61-12 on the B-2 reportedly has already begun.⁴⁵ If possible, testing could begin earlier than currently planned with the Block 4 software which reportedly will be released in late 2020.⁴⁶ Accelerating the F-35 availability may not increase ultimate costs, although it would likely require that money be spent earlier than currently planned. To make the capability meaningful, the F-35, the B61-12 and the necessary support capability must be deployed in Europe in the same time frame.

Considering Adding Low-Yield Ballistic Missile Options to NATO's Deterrent Capability

In order to maintain and further enhance the credibility of its nuclear deterrent, the United States and its allies may need to consider increasing the flexibility in Western nuclear options. These characteristics include the capability of NATO's nuclear forces to threaten a range of targets in a manner that complies with the alliance's political principles. Also, NATO's nuclear forces must be survivable and operable in a wide range of environments, across the spectrum of possible conflict.

The US non-strategic deterrent capability is based entirely upon fighter aircraft carrying gravity bombs. Every other nuclear-armed state employs ballistic missiles, and frequently cruise missiles, to augment their fighter aircraft for nuclear deterrence.⁴⁷ The UK bases its sub-strategic deterrent entirely on low-yield Trident missiles. The apparent US lack of low-yield ballistic missile capability reduces the flexibility of NATO's nuclear deterrent and thus perhaps its deterrence credibility, given Russian perceptions. Russia has extensive and increasing means to threaten both the survivability and penetration capability of NATO nuclear-capable aircraft. Even if the United States employs its strategic bombers in non-strategic nuclear deterrence, the same vulnerabilities reportedly exist.⁴⁸

As Professor Matthew Kroenig points out, "...the yields of the warheads on [US] ICBMs, SLBMs, and even existing ALCMs are likely too large for a proportionate response to a limited Russian nuclear attack."⁴⁹ A US sub-strategic Trident and/or Minuteman capability reportedly can be achieved quickly at little cost if done as part of the existing life extension program.⁵⁰ The United States reportedly can obtain low yields "by choosing to detonate a warhead's unboosted primary, which would produce a yield of 1 kiloton or less, or by choosing to detonate the boosted primary, which would produce a yield of approximately a few kilotons."⁵¹ Low-yield warheads on Trident and/or Minuteman would substantially enhance both the survivability and penetration capability of the US theater nuclear deterrent. The United States also may have the option to create a *precision* low-yield capability in a timely way with a decision to proceed by using the warhead guidance system that was part of the conventional Trident missile proposal. The entire cost of the conventional Trident program was to be \$503 million, including the cost of the conventional warhead which would be unnecessary for a precision low-yield nuclear Trident or Minuteman capability.⁵²

Other Deterrence Options for Possible Consideration

Enhancing US theater nuclear deterrent capabilities must include a focus on increasing the survivability (probably through mobility and defenses) and penetration capability compared to the current DCA program. DCA are based on a small number of reportedly undefended bases and will have only non-stealth aircraft through 2024. There are other potential options relevant to the

deterrence of Russian first use of precision low-yield or low-collateral-damage nuclear weapons against NATO that may be considered and could be procured at a low-to-moderate cost.

For example, the Center for Strategic and International Studies *Project Atom* report made two relevant recommendations with respect to enhancing nonstrategic nuclear capability: developing a new nuclear-capable ship-launched cruise missile (SLCM); and providing the Navy's carrier-based F-35C with a nuclear capability.⁵³ The cost of a nuclear version of the F-35C could be low because almost everything necessary would be developed as part of the F-35A program. The Navy, however, plans only a slow introduction of F-35s on its carriers through 2035.⁵⁴ At this point, it is not clear what will replace the legacy F-18s. Carriers are obviously mobile and defended but are few in number.

The *Project Atom* report also recommended adapting the developmental Air Force nuclear cruise missile, the LRSO, as a nuclear SLCM.⁵⁵ This may be a possible long-term option, but it does not meet the need for a short-term improvement in US non-strategic nuclear deterrent capability. However, a possible, relatively short-term option exists. The United States reportedly has tested an anti-ship version of the Air Force Joint Air to Surface Missile (JASSM) that reportedly could be made nuclear capable.⁵⁶ Called the LRASM, it is a conventional missile that "is currently configured to fire from an Air Force B-1B bomber [2018] and Navy F-18 carrier-launched fighter [2019]."⁵⁷ The Navy reportedly is looking at the possibility of using it as a ship-launched anti-ship conventional cruise missile. A nuclear version could be deployed as a SLCM—possibly as part of the US response to the Russian violation of the INF Treaty. Either a sea- or land-basing mode would be capable of threatening land or sea targets. Both of these basing modes would be mobile and, hence, more survivable than fixed air bases. The LRASM range reportedly is 500 miles⁵⁸—clearly a non-strategic weapon. This rocket-boosted missile would clearly be distinguishable from the Air Force or Navy air-launched versions and the Air Force JASSM-ER, avoiding any possible counting problem with the New START Treaty.

Defenses

Survivability of DCA may be critically dependent upon defenses. Russia can attack NATO bases with a variety of conventional weapons before launching low-yield nuclear strikes. NATO lacks a modern integrated air defense system remotely comparable to the Russian system. The NATO Aegis Ashore missile defense system is not designed against a Russian level threat⁵⁹ and, moreover, has no reported air defense capability. Russia appears quite aware of this. For example, in May 2016, Colonel General Sergey Karakaev stated, "*Threats from the European segment of the missile defense system for the Strategic Missile Forces (SMF) are limited and don't critically reduce the combat capabilities of the SMF.*"⁶⁰ (Emphasis in the original).

Dealing with the Russian threat is impacted by the reported dramatic cuts in US air defense programs, including: 1) the truncation of the F-22 program at 187 aircraft; 2) the termination of the Airborne Warning and Control System (AWACS) replacement program; 3) the decision not to produce the advanced MEADS air defense; 4) the cut in the DG-1000 program to three ships and the elimination of most of its air defense capability; 5) the complete termination of the CG-X air and missile defense cruiser program; and, 6) the limitation of dual-frequency radar deployment to aircraft carriers, which assures very slow introduction. The United Kingdom has eliminated most of its air defense capability even against a conventional attack. General Sir Richard Barrons, Commander of the UK Joint Forces Command until his retirement in April 2016, reportedly wrote

to the UK Defense Minister saying, “Neither the UK homeland nor a deployed force—let alone both concurrently—could be protected from a concerted Russian air effort.”⁶¹ Germany is an exception with its procurement of the Patriot Pac-3.

Many of the US decisions regarding air defense need to be revisited to help deter a Russian attack or escalation. For the purpose of deterrence, it is extremely important to make a limited Russian nuclear attack against NATO Europe an unacceptably difficult and risky proposition. Deployment of Patriot Pac-3 to defend DCA bases could strengthen defense against Russian aircraft, cruise missiles and short- and some medium-range missiles⁶²—thus helping to deny Russia a plausible limited nuclear escalation option. Indeed, Patriot could be augmented by the Terminal High Altitude Area Defense system (THAAD) against longer-range ballistic missile threats.⁶³ In the future, an upgraded THAAD with multiple kill vehicles could provide much improved capability against a Russian level threat. Additionally, Aegis Ashore might be modified to give it a capability against airborne threats.

There are many advanced fighter aircraft in the NATO inventory, but they are not integrated into an air defense system designed to defend against Russia. According to Russian Defense Minister General of the Army Sergey Shoigu, “About 200 US nuclear bombs are currently deployed in Belgium, Italy, the Netherlands, Germany and Turkey.”⁶⁴ Except for Germany, which has the Eurofighter, every one of these nations will acquire the F-35, which appears to have very good air defense capabilities.⁶⁵ What these aircraft apparently will lack is integration with survivable command and control, surface-to-air missiles and enhanced AWACS detection and tracking aircraft. The improvement of NATO’s air defense would make it more difficult for Russia to conclude that it could in any way gain an advantage from limited nuclear strikes against NATO. It would also improve NATO’s conventional warfighting capability, thereby also contributing to deterrence and assurance.

Advancing Deterrence and Assurance

The United States, in partnership with its NATO allies, must deter, assure, and counter Russia’s so-called “escalate-to-de-escalate” nuclear policy. Five recommendations for consideration follow:

First, to sustain NATO’s deterrence credibility the alliance should address any conventional and nuclear capability shortfalls perceived by Moscow to be exploitable.

Second, in many cases clear communication is essential for effective deterrence, assurance and crisis management. The new strategic environment requires consistent statements regarding NATO’s resolve and intent when confronted with coercion, intimidation and threats. The United States should work with NATO to develop a coordinated deterrent communications strategy which, although challenging, would help ensure that deterrence does not fail and that any crises are brought to a peaceful conclusion. These efforts should include developing and instituting secure and cooperative measures to share accurate and timely intelligence on the full range of threats to Euro-Atlantic peace and security.

Third, US leadership in bolstering alliance nuclear deterrence policy and posture is essential. The United States must engage NATO counterparts to further strengthen the deterrence role of nuclear weapons in alliance strategy and policy. These actions will also strengthen the credibility

of the US extended deterrent to allies outside of NATO. Public education in the United States and throughout the alliance on the need and importance of nuclear deterrence remains critical to enhancing our overall assurance and deterrence posture.

Fourth, the United States should call for a review of NATO's readiness categories and deployment policy. This would include military planning and command capability, and the actual basing and DCA tasks, including hosting exercises. The DDPR concluded that the mix of nuclear capabilities is "sound" and "appropriate," and that it must be rightly "perceived as credible, effective, and capable of conducting nuclear operations if deterrence fails." Given the changes in the security environment since 2012, the DDPR conclusions need to be re-examined. This re-examination need not demand a new, high-visibility follow-on DDPR, but should address new threat realities.

Finally, the United States needs to work with alliance partners to address how burden-sharing can be broadened to include all 28 NATO members. While all allies participate in consultations on nuclear matters (the French do not participate in the Nuclear Planning Group but do comment on NATO nuclear policy in the North Atlantic Council meetings), only about two-thirds have committed forces to the nuclear mission.

In war, the United States and its NATO allies would be virtually unbeatable. But NATO's greatest contribution to Western security, and its founding purpose, is to deter war and, in so doing, assure allies. So too is the fundamental purpose of US nuclear forces forward deployed in Europe. They can continue to serve the dual purpose of assuring allies in the face of nuclear coercion and posing the deterring threat of incalculable costs in the mind of any potential aggressor. A flexible and resilient US nuclear posture at home and in Europe remains vital for this purpose, and for the security of both the United States and its allies.

¹ Walter B. Slocombe, "The Future of U.S. Nuclear Weapons in a Restructured World," in Patrick J. Garrity and Steven A. Maaranen, *Nuclear Weapons in the Changing World: Perspectives from Europe, Asia, and North America* (New York: Plenum Press, 1992), p. 56.

² Sam Jones, "Nato and EU need 'grand strategy' to resist Putin, says general," *Financial Times*, March 2, 2017, available at <https://www.ft.com/content/e8dc5f7c-ff67-11e6-8d8e-a5e3738f9ae4>.

³ It also included the nuclear forces of the United Kingdom; France's nuclear forces were not strictly part of the Allied deterrent force as France separated itself from the Alliance military system once it acquired nuclear weapons, though they cast a deterrent shadow generally beneficial to NATO deterrence. While France has since reentered the integrated military structure, its nuclear forces continue to be solely national assets. The nuclear forces of the United Kingdom are more connected to NATO's deterrent posture. They are normally assigned to the Supreme Allied Commander, Europe, but are ultimately under the direction of the British Prime Minister.

⁴ North Atlantic Treaty Organization, "Strategic Concept For the Defence and Security of The Members of the North Atlantic Treaty Organisation," Article 34, *NATO.int*, 2010, available at <http://www.nato.int/lisbon2010/strategic-concept-2010-eng.pdf>.

⁵ NATO, *Deterrance and Defense Review* (Brussels: NATO, May 20, 2012), available at: http://www.nato.int/cps/en/SID-5FA9EA63-48F5B397/natolive/official_texts_87597.htm.

⁶ Ibid.

⁷ Portions of this and subsequent discussions are drawn from, Keith B. Payne, "Prepared Statement," 115th U.S. Congress, Senate Armed Services Committee, March 8, 2017, available at www.armed-services.senate.gov/imo/media/doc/Payne_03-18-17.pdf.

⁸ Alexander Vershbow, "Remarks of the Deputy Secretary General," *NATO.int*, June 23, 2014, available at http://www.nato.int/cps/en/natohq/opinions_111209.htm?selectedLocale=en.

⁹ Kathrin Hille and Peter Spiegel, "NATO Chief Defends Eastern Advance," *Financial Times*, April 4, 2011, available at <https://www.ft.com/content/3236233a-bb21-11e3-b2b7-00144feabdc0>

¹⁰ Anders Fogh Rasmussen, "A Strong NATO in a Changed World," *NATO.int*, March 21, 2014, available at http://www.nato.int/cps/en/natohq/opinions_108215.htm?selectedLocale=en.

¹¹ North Atlantic Treaty Organization, "Warsaw Summit Communiqué," *NATO.int*, July 9, 2016, available at www.nato.int/cps/en/natohq/official_texts_133169.htm.

¹² See for example, "Russia to respond if Norway joins European missile shield – envoy," *TASS*, March 19, 2017, available at <http://tass.com/politics/936322>.

¹³ Curtis M. Scaparrotti, "Statement of Curtis M. Scaparrotti, Commander, United States European Command," *115th U.S. Congress*, House Armed Services Committee, March 28, 2017, p. 6, available at <http://docs.house.gov/meetings/AS/AS00/20170328/105780/HHRG-115-AS00-Wstate-ScaparottiC-20170328.pdf>.

¹⁴ Quoted in, Justin Huggler, "Putin 'privately threatened to invade Poland, Romania and the Baltic states,'" *The Telegraph*, September 18, 2014, available at <http://www.telegraph.co.uk/news/worldnews/europe/russia/11106195/Putin-privately-threatened-to-invade-Poland-Romania-and-the-Baltic-states.html>.

¹⁵ This need for adaptability has been emphasized by the Trump Administration's National Security Advisor, Lt. Gen. H.R. McMaster. See, "Strategy, Policy and History," Lieutenant General H.R. McMaster, U.S. Army, Moderator: Dr. Mark Moyar, *Foreign Policy Initiative*, FPI Forum Transcript, November 20, 2016, p. 10, available at <http://foreignpolicyi.org/files/uploads/images/2016-11-30-Transcript-McMaster-Final.pdf>.

¹⁶ Camille Grand, "Nuclear deterrence and the Alliance in the 21st century," *NATO Review Magazine*, 2016, available at <http://www.nato.int/docu/review/2016/Also-in-2016/nuclear-deterrence-alliance-21st-century-nato/EN/index.htm>.

¹⁷ Matthew Pennington, "US Warns 'Overwhelming' Response to any North Korea Use of Nukes," *Military.com*, October 19, 2016, available at <http://www.military.com/daily-news/2016/10/19/us-warns-overwhelming-response-any-north-korea-use-nukes.html>.

¹⁸ Jamie McIntyre, "Carter says nuclear-armed foes catching up to the US," *Washington Examiner*, November 3, 2016, available at <http://www.washingtonexaminer.com/carter-says-nuclear-armed-foes-catching-up-to-the-us/article/2606380>.

¹⁹ Lally Weymouth, "'Russia is a threat': Estonia frets about its neighbor," *The Washington Post*, March 24, 2017, https://www.washingtonpost.com/opinions/russia-is-a-threat-estonia-frets-about-its-neighbor/2017/03/24/011ad320-0f2b-11e7-9b0d-d27c98455440_story.html?utm_term=.a5d5a3c22108.

²⁰ Andrius Sytas, "Lithuania says Russia has ability to launch Baltic attack in 24 hours," *Reuters*, April 3, 2017, available at <http://www.reuters.com/article/us-lithuania-russia-idUSKBN1750Z0>

²¹ Matthew Bodner, "No End In Sight for Russia's Baltic Tit-for-Tat," *The Moscow Times*, September 23, 2016, available at <https://themoscowtimes.com/articles/baltic-tit-for-tat-55434>.

²² David A. Shlapak and Michael W. Johnson, *Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defense of the Baltics* (Washington, DC: RAND Corporation, 2016), p. 1, available at https://www.rand.org/content/dam/rand/pubs/research_reports/RR1200/RR1253/RAND_RR1253.pdf.

²³ Tom Scheber, "Evolutionary Psychology, Cognitive Function, and Deterrence," *Comparative Strategy*, Vol. 30, No. 5 (2011), pp. 453-480.

²⁴ NATO, "The role of NATO's nuclear forces," *NATO.int*, December 3, 2015, available at http://www.nato.int/cps/en/natohq/topics_50068.htm?selectedLocale=en.

²⁵ Ibid.

²⁶ Matthew Kroenig, "Toward a More Flexible NATO Nuclear Posture," *The Atlantic Council*, November 2016, p. 8, available at <http://www.atlanticcouncil.org/publications/issue-briefs/toward-a-more-flexible-nato-nuclear-posture>.

²⁷ Jeffrey A. Larsen, "The Future of U.S. Non-Strategic Nuclear Weapons and Implications for NATO," *NATO.int*, October 31, 2006, available at <http://www.nato.int/acad/fellow/05-06/larsen.pdf>.

²⁸ Caroline Wyatt, "Royal Navy 'Top Gun' pilots train to fly US fighters," *BBC News*, May 12, 2012, available at <http://www.bbc.com/news/uk-18041297>.

²⁹ "Polish F-16 Operations," *Code One*, February 7, 2012, available at http://www.codeonemagazine.com/article.html?item_id=87.

³⁰ "F-16s for LanceRs," *Air Forces Monthly*, July 2016, p. 79, available at [http://ebook-dl.com/magazine/airforces-monthly-july-2016\(www.ebook-dl.com\).pdf](http://ebook-dl.com/magazine/airforces-monthly-july-2016(www.ebook-dl.com).pdf).

³¹ Aleksey Arbatov, "Tactical Nuclear Weapons: Problems and Solutions: Strategic Offensive Weapon Reductions Could Extend to Nonstrategic Munitions," *Voyenno-Promyshlenny Nezavisimoye Online*, May 20, 2011, available at <http://www.dialog.com/proquestdialog/>; "Obama Advisor Gary Samore, 'The Ball Is Very Much in Tehran's Court,'" *Radio Free Europe*, April 14, 2011, http://www.rferi.org/content_iterview_samore_Russia_Iran_us_poicy/31557326.html.

³² Robert M. Gates and Samuel W. Bodman, *National Security and Nuclear Weapons in the 21st Century* (Washington, DC: Department of Defense, September 2008), p. 8, available at <http://www.aps.org/policy/reports/popareports/upload/nuclear-weapons.pdf>.

³³ NATO, "The role of NATO's nuclear forces," *NATO.int*, December 3, 2015, available at http://www.nato.int/cps/en/natohq/topics_50068.htm?selectedLocale=en.

³⁴ Jens Stoltenberg, *The Secretary General's Annual Report 2015* (Brussels: The North Atlantic Treaty Organization, January 2016), p. 19, available at http://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2016_01/20160128_SG_AnnualReport_2015_en.pdf.

³⁵ Mark B. Schneider, "Nuclear Deterrence in the Context of the European Security Crisis and Beyond," Lecture No. 1266, *Heritage Foundation*, December 21, 2016, p. 8, available at <http://www.heritage.org/research/reports/2015/12/nuclear -deterrence-in-the-context-of-the-european-security-crisis-and-beyond>.

³⁶ Matthew Kroenig, "Toward a More Flexible NATO Nuclear Posture," *The Atlantic Council*, November 2016, p. 5, available at <http://www.atlanticcouncil.org/publications/issue-briefs/toward-a-more-flexible-nato-nuclear-posture>; Hans M. Kristensen, "B61-12: The New Guided Standoff Nuclear Bomb," *Federation of American Scientists*, May 2, 2014, available at https://fas.org/programs/ssp/nuke/publications1/Brief2014_PREPCOM2.pdf.

³⁷ Rebecca Grant, "Nukes for NATO," *Air Force Magazine*, July 2010, available at <http://www.airforcemag.com/MagazineArchive/Pages/2010/July%202010/0710nato.aspx>.

³⁸ "Sen. McCain Issues Opening Statement at Hearing on Defense Budget Request for FY 2017," *Targeted News Service*, March 17, 2016, available at <http://www.dialog.com/proquestdialog/>.

³⁹ John R. Harvey, "Statement of Dr. John R. Harvey Future Nuclear Posture of the United States," *114th U.S. Congress*, Senate Armed Services Committee, January 26, 2016, available at http://www.globalsecurity.org/wmd/library/congress/2016_h/Harvey_01-27-16.pdf.

⁴⁰ "Senator Jeff Sessions Holds a Hearing on Department of Defense Nuclear Acquisition Programs and the Nuclear Doctrine," *Political Transcript Wire*, February 2016, available at <http://www.dialog.com/proquestdialog/>.

⁴¹ Brian P. McKeon, "Statement of Honorable Brian P. McKeon Principal Deputy Under Secretary of Defense for Policy," *114th U.S. Congress*, House Armed Services Committee, December 1, 2015, p. 7, available at <http://docs.house.gov/meetings/FA/FA18/20151201/104226/HHRG-114-FA18-Wstate-McKeonB-20151201.pdf>.

⁴² Grant, "Nukes for NATO," op. cit.

⁴³ Oriana Pawlyk, "F-35 Could Carry B61 Nuclear Warhead Sooner Than Planned," *DefenseTech.org*, January 10, 2017, available at <http://defensetech.org/2017/01/10/f-35-carry-b61-nuclear-warhead-sooner-planned/>.

⁴⁴ Frank Kendall and Christopher C. Bogden, "Statement of the Honorable Frank Kendall Under Secretary of Defense, Acquisition, Technology, and Logistics, and Lt General Christopher C. Bogden Program Executive Officer, F-35," *114th U.S. Congress*, Senate Armed Services Committee, April 26, 2016, available at http://www.armedservices.senate.gov/imo/media/doc/Kendall-Bogdan_04-26-16.pdf.

⁴⁵ Marcus Weisgerber, "The US Air Force Just Dropped Two Fake Nukes," *DefenseOne.com*, October 6, 2016, available at <http://www.defenseone.com/business/2016/10/us-air-force-just-dropped-two-fake-nukes/132180/>.

⁴⁶ Jen DiMascio. "Will The F-35 Learn From Past Missteps?," *Aerospace Daily & Defense Report*, April 27, 2016, available at http://aviationweek.com/defense/will-f-35-learn-past-missteps?NL=AW-05&Issue=AW-05_20160428_AW-05_93&sfvc4enews=42&cl=article_2&utm_rid=CPEN1000001572944&utm_campaign=5752&utm_medium=email&elq2=3e3a1b76786344fdb0364f48b401ed02

⁴⁷ Federation of American Scientists, "Worldwide Nuclear Arsenals," *Federation of American Scientists*, April 2010, available at <http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/Wordwide-Nuclear-Arсенals-Fact-Sheet.pdf>; David S. Yost, "France's New Nuclear Doctrine," *International Affairs*, Vol. 82, No. 4 (2006), p. 704.

⁴⁸ Matthew Kroenig, "Toward a More Flexible NATO Nuclear Posture," *The Atlantic Council*, November 2016, pp. 2-3, available at <http://www.atlanticcouncil.org/publications/issue-briefs/toward-a-more-flexible-nato-nuclear-posture>. See also, Elbridge A. Colby and Michael S. Gerson, eds., *Strategic Stability: Contending Interpretations*, (Carlisle, PA: US Army War College Press, 2013), available at <http://www.strategicstudiesinstitute.army.mil/pdffiles/pub1144.pdf>.

⁴⁹ Kroenig, "Toward a More Flexible NATO Nuclear Posture," op. cit., p.4.

⁵⁰ Mark B. Schneider, "Nuclear Deterrence in the Context of the European Security Crisis and Beyond," Lecture No. 1266, *Heritage Foundation*, December 21, 2016, p. 8, available at <http://www.heritage.org/research/reports/2015/12/nuclear -deterrence-in-the-context-of-the-european-security-crisis-and-beyond>.

⁵¹ Federation of American Scientists, "Trident-II D-5," *Federation of American Scientists*, December 4, 2006, available at <http://fas.org/nuke/guide/uk/slbd/d-5.htm>.

⁵² "Conventional Strike Missile Conventional TRIDENT Modification (CTM)," *Global Security Organization*, July 24, 2011, available at <http://www.globalsecurity.org/wmd/systems/ctm.htm>.

⁵³ Center for Strategic and International Studies, *Project Atom* (Washington, DC: Center for Strategic and International Studies, May 2015), p. 98, available at <https://www.csis.org/analysis/project-atom>.

⁵⁴ "Rep. Mike Turner Holds a Hearing on Naval Strike Fighters," *Political Transcript Wire*, February 5, 2016, available at <http://www.dialog.com/proquestdialog/>.

⁵⁵ Ibid., p. 110.

⁵⁶ Sam LaGrone, "LRASM Scores in Navy Test Ship Launch," *USNI News*, July 29, 2016, available at <https://news.usni.org/2016/07/20/lrasm-scores-ship-launch-test>.

⁵⁷ Kris Osborn, "Navy Weighs New Ship-Deck-Launched Attack Methods for LRASM Weapon," *Scout.com*, October 7, 2016, available at <http://www.scout.com/military/warrior/story/1675704-navy-weighs-new-attack-methods-for-lrasm>.

⁵⁸ "LRASM Missiles: Reaching for a Long-Range Punch," *DefenseIndustry.com*, May 17, 2016, available at <http://www.defenseindustrydaily.com/lrasm-missiles-reaching-for-a-long-reach-punch-06752/>.

⁵⁹ "Remarks by NATO Secretary General Jens Stoltenberg at the Aegis Ashore operationalisation ceremony," *NATO.int*, May 12, 2016, available at http://www.nato.int/cps/en/natohq/opinions_130696.htm.

⁶⁰ "US missile shield in Europe poses no critical threat to Russia – General," *RT*, May 10, 2016, available at <https://www.rt.com/news/342559-missile-shield-europe-russia/>.

⁶¹ Sam Jones, "Britain's 'withered' forces not fit to repel all-out attack," *Financial Times*, September 16, 2016, available at <https://www.ft.com/content/36f47240-7c0e-11e6-ae24-f193b105145e>.

⁶² "Elements Patriot Advanced Capability-3 (PAC-3)," *Missile Defense Agency*, no date, available at https://www.mda.mil/system/pac_3.html.

⁶³ Ankit Panda, "What Is THAAD, What Does It Do, and Why Is China Mad About It?," *The Diplomat*, February 25, 2016, available at <http://thediplomat.com/2016/02/what-is-thaad-what-does-it-do-and-why-is-china-mad-about-it/>.

⁶⁴ "US deployed 200 N bombs in Europe: Russia," *The New Nation*, December 13, 2015 available at <http://www.dialog.com/proquestdialog/>.

⁶⁵ Mark B. Schneider, "The F-35 vs. the Russian Su-35 and the PAK FA," *Real Clear Defense*, November 5, 2015, available at http://www.realcleardefense.com/articles/2015/11/05/the_f-35_vs_the_russian_su-35_and_the_pak_fa_108649.html.

Section IX. Adapting US Policies and Capabilities for Asian Security

Introduction

Just as factors in the Euro-Atlantic security environment play an important role in shaping the nuclear policy and posture of the United States, so too do factors in the Asian security environment. Four main factors stand out:

- The requirement to deter and defend against a nuclear- and missile-armed North Korea;
- The need to ensure the necessary strategic relationship with China, including the deterrence of Chinese expansion at the expense of US interests and allies;
- The assurance of US allies in the region; and,
- The rising nuclear dangers in South Asia.

The value of US adaptability is well-illustrated by the shifting threat conditions in Asia and the corresponding need to adjust US (and allied) strategies and capabilities accordingly for the priority goals of deterrence, assurance, and defense.

Deterring a Nuclear-Arming North Korea

North Korea has been an object of US deterrence strategy for more than six decades, with rising concern over the last two decades about its emerging capabilities to deliver WMD with long-range delivery systems. In recent years it has accelerated its nuclear and missile programs. It now has the capability to attack US forces and US allies in the region with ballistic missiles, possibly tipped with conventional, chemical, and biological warheads. In the near future it will likely have the means to deliver nuclear weapons by long-range ballistic missiles, including against targets in the United States. Over the next eight-10 years (the timeline for the NPR), and barring a political and diplomatic breakthrough (which should remain an objective of US diplomacy), North Korea may emerge as a state with a small nuclear force of somewhere between 60 and 100 weapons, many deployed on a mix of short- and long-range delivery systems.

Pyongyang has set out a nuclear strategy that emphasizes the “pivotal role” of its nuclear-armed forces in deterrence and war strategies. North Korea’s political and military leaders regularly make threats to employ nuclear weapons. Evidently they see nuclear weapons as useful instruments for coercion and separating the United States from its allies, deterring Japanese support for the conventional defense of the Republic of Korea, deterring US support for its Asian allies, and ensuring regime survival in case of war.

Additionally, as North Korea builds up an arsenal of nuclear weapons, it poses a new proliferation threat. Given its renegade status in international affairs, it may choose to sell or otherwise make available nuclear weapons to others. Given its long identification as a sponsor of terrorism, this is especially troubling.

The US need to, and available defensive means to, defend against North Korea are discussed in Section VII above. The US strategy for deterring North Korea has evolved over the years in response to changing circumstances and requirements. A new strategy for the deterrence of North Korea and North Korean nuclear escalation was agreed to by the US-ROK alliance in 2013. This strategy emerged from the work of a bilateral coordination mechanism for extended deterrence established in 2010, which itself serves as a signal to the North of the alliance's resolve to defend its interests in the face of North Korean nuclear-backed provocations and aggression. A similar bilateral coordination mechanism was established at the same time in the US-Japan relationship, with a similar intent. These dialogues can play a useful role in deterring North Korea and should be both sustained and invested with the necessary political leadership.

Deterring North Korea includes US and allies' non-nuclear capabilities. Accordingly, for more than two decades US leaders have seen a significant role for ballistic missile defense for deterring North Korean missile strikes and also, of course, for protecting the United States, its allies and forces, if deterrence fails. The 2001 NPR set out an approach integrating offensive and defensive means (the "new triad") toward this end, and the Obama Administration's various reviews in 2009 established the so-called "comprehensive approach to strengthening regional deterrence architectures." South Korea is also pursuing non-nuclear strike capabilities—in the form of a regional ballistic missile capable of promptly striking North Korean targets with conventional warheads. Japan may pursue a similar capability.¹

While such capabilities can be helpful for deterrence, they present the requirement for coordination and management regarding possible escalation steps; accordingly, such programs should be developed in consultation with Washington.

The strategic offensive and defensive forces of the United States play an important role in deterring attacks, including but not limited to nuclear attacks, on US allies and forces in the region, by strengthening the credibility of US deterrence commitments.² A key supporting role is played by forward-deployable US nuclear weapons. With its triad of nuclear forces, the United States can deliver nuclear weapons with strategic delivery systems anywhere in the world within 30 minutes in support of a commitment to an ally. But nuclear deterrence isn't just about nuclear targeting—it is also about signaling resolve and managing escalation, while also providing assurance to allies. For these purposes, the triad must be well-complemented by additional nuclear deterrence capabilities. Allies tend to value capabilities that directly oppose a potential adversary—that are nearby and visible. They also value capabilities that can signal alliance nuclear resolve, not only US resolve, when it is being tested. These forces are also well-suited to providing intermediate steps on the escalatory ladder (well below strategic force escalation) that can be useful in crisis or conflict situations.

From 1990 to 2010, the United States relied upon the nuclear-armed Tomahawk cruise missile (TLAM/N) for this role in Northeast Asia. A number of missiles were kept in storage and were available for deployment to the region in time of nuclear crisis. In the context of the 2010 NPR, the Obama Administration decided to retire TLAM/N (as it was aging out) and to rely on dual-capable fighter-bombers to support the nuclear commitment to US allies globally. The forward-deployable weapon (the B61 bomb) is sometimes incorrectly characterized as a tactical weapon. These weapons may be thought of as non-strategic weapons because of their association with delivery systems not defined as strategic in arms control agreements, but their actual deployment and employment, if that were ever to occur, would likely be intended to have a strategic effect.

In Northeast Asia, the DCA option may have some advantages over the previous TLAM/N option alone. For example, the DCA option can more clearly convey the collective nuclear resolve of the United States and its allies since it is visible. In an escalating conflict with North Korea, Pyongyang can be expected to use nuclear escalation threats to coerce Seoul and/or Tokyo not to support any US war effort. Seoul and Tokyo's resolve to stay in the fight and to safeguard their interests may more effectively be communicated by sharing risks (such as by hosting US forces in the extreme circumstances associated with the brink of nuclear war) than by relying solely on displays of US resolve. DCA can be hosted at ROK and/or Japanese airbases, along with their weapons, sending a clear signal of shared risk and resolve. Such demonstrations of collective resolve—and the foreshadowing of such demonstrations in peacetime—may help to deter North Korea by showing the allied cohesion necessary to prevail.

But while DCA play a central role, they are not the only useful and necessary means for displaying resolve in an escalating crisis. The United States should retain the ability to deploy nuclear-capable bombers into the region. And, it should clearly demonstrate the capability for stand-off attack with stealthy delivery systems (that is, LRSO) against adversaries with modern air defense systems.

The growing nuclear capabilities of North Korea may provide further impetus for an established but neglected requirement in the US nuclear umbrella—a requirement for a low-yield nuclear weapon that can be delivered promptly against defended airspace. Today, the only nuclear weapons that can be delivered promptly (that is, by a ballistic missile rather than an air-breathing system) are high-yield. Leaders in Pyongyang may calculate that the United States would be reluctant to employ high-yield weapons because of the potential collateral radiation hazard to US allies and China, *inter alia*. The United States and its allies could be well served by the addition of a more discriminate capability if, as a practical political matter, the pursuit of such a capability does not jeopardize domestic US political support for the broader modernization of US nuclear forces.

Emerging North Korean capabilities similarly provide additional support for a conventional prompt strike capability. This has been a subject of US interest for over a decade, but a procurement program does not yet exist. A prompt regional strike capability, as opposed to a global capability, would be a worthy alternative for the purposes of deterrence and assurance in Asia. But the United States has foresworn such capabilities in a ground-launched configuration, at least, with the INF Treaty. Accordingly, it should welcome initiatives by its allies to fill this gap in the comprehensive regional deterrence architecture, as long as they are coordinated, especially in their operational configuration and planning, with the United States. In the event that continuing Russian violation of the INF Treaty leads to its demise, the United States also should consider the potential value of ground-based prompt regional strike capabilities for deterrence and assurance purposes in Asia.

The Necessary Strategic Relationship with China

Different administrations have thought in varying ways about what defines the necessary strategic relationship with China. In a complex relationship involving elements of both competition and cooperation, some have put the emphasis more on one than the other. There have been some common themes across administrations. No US administration, for example, has deemed it

necessary or appropriate to formally or clearly accept mutual vulnerability as the basis of the deterrence relationship with China. Neither has any recent administration seen it as necessary or appropriate to design the missile defense of the American homeland with an eye to negating China's strategic deterrent. Moreover, every post-Cold War US administration has wanted to hedge against the possibility of more intense nuclear competition with China while creating incentives to moderate possible future Chinese nuclear ambitions.

Tensions are clearly rising between the United States and China in ways that seem unlikely to disappear, especially as these tensions stem—at least from the US perspective—largely from increased Chinese assertiveness and strength in the region and China's stated opposition to the existing regional security order. Deterrence, including nuclear deterrence, clearly has a renewed salience in the relationship.

In the past, there has been considerable consistency in the core tenets of China's nuclear strategy. It has pursued what it has recently described as a “lean and effective” nuclear deterrent with a declared commitment to no first use. The precise meaning of “lean and effective” is not clear, and there exists ambiguity about China's no-first-use declaration.³ But China's publicly expressed nuclear strategy is to “absorb the first blow” and counter-attack with nuclear weapons until enemy nuclear attacks cease. It appears to see a large force as unnecessary for this purpose and regularly attests to its commitment not to be drawn into an arms race. Beijing rejects official dialogue on its nuclear policy and posture with the United States, but embraces unofficial dialogue, which it uses to express its concerns about developments in the US posture and to explain that its nuclear modernization is driven by the need to ensure deterrence in the face of developments in the offense/defense posture of the United States and its allies.

However, such explanations appear to be self-serving and increasingly discordant, as China's nuclear forces grow and become increasingly sophisticated, presenting better options for use and, possibly, escalation control. Its modernization program is leading to a larger, more diverse, and considerably more sophisticated force. Beijing's historical reliance on a small fleet of silo-based ICBMs is giving way to reliance on a force of both silo-based and mobile ICBMs, some of which are MIRVed, and sea-based SLBMs, as well as possible roles for a nuclear bomber.

China also is creating a modern command and control and warning system, which will give it the capability for limited nuclear war-fighting options and launch under attack. All of this appears to be having the effect of moving China away from a minimum deterrence strategy toward a more robust deterrence strategy—even if China's publicly stated policy does not reflect such a shift.

China's transparency about its nuclear policy and strategy has improved somewhat over the last decade, with increased coverage of its policy in its defense white papers and more open dialogue at the unofficial level. Nevertheless, its transparency about its nuclear posture is unchanged, and China remains the least transparent of all of the P-5 states. It makes no statements about the size of its nuclear arsenal and offers no commitments about its future size. Its modernization program is headed to a destination that it has not explained to any of its interested neighbors such as Japan, India, and Australia, a point that is increasingly troubling in light of China's growing power and greater assertiveness in the region.

The United States has worked to keep nuclear weapons in the background of its bilateral relationship with China, in the sense that it has not wanted the nuclear relationship to be a central

concern and source of competition and political conflict. China's expansionist drive at the expense of US interests and allies, along with its nuclear modernization program and continuing lack of transparency, have made this increasingly difficult (as have developments in the US offense/defense posture driven by the US decision to deploy defenses against North Korean missile threats).

Equally, China's conventional military buildup and development of its nuclear forces are likely to make nuclear weapons more salient in the relationship and in the Asia-Pacific more broadly. Such greater capabilities on the part of Beijing may induce it to be more assertive and ambitious in its goals. A more capable Chinese military, and a more even conventional military balance, may also increase the scope and ferocity of any potential conflict between the United States and China, and thereby increase the potential for escalation. Further, China's more sophisticated nuclear force will give it more discriminate options for limited employment designed to deter US or allied escalation. These pressures are already generating concerns among key US allies like Japan and Australia. As China's military capabilities grow, these concerns are likely to intensify, as are pressures to demonstrate greater US conventional and nuclear deterrence.

This dynamic will increase the importance not only of a more capable US and allied conventional military posture but also of more credible US nuclear deterrent options. China's increasing military power will potentially enable it to create areas of advantage, and even the potential for *faits accomplis* as Russia appears to be capable of in Eastern Europe.⁴ China's more sophisticated nuclear forces may give it effective escalation threats to deter a robust and unified US and allied response to Chinese expansionism—again similar to the scenarios of concern in Eastern Europe. Correspondingly, the United States will therefore need to consider carefully more tailored and discriminate nuclear options to respond to any potential Chinese attempt to escalate from a conventional defeat or even stalemate. Limiting escalation in this fashion may be extremely challenging, but is preferable to not attempting to impose any limits on escalation should deterrence fail.

The United States must have the ability to deter nuclear escalation by China via credible deterrent threats, particularly in the event China establishes meaningful conventional superiority over US or allied areas or interests. US nuclear deterrent options must provide a credible response to Chinese nuclear employment in a way that would strongly disincentivize further PRC escalation, and help to stop a Chinese assault on US or allied core interests. This suggests a force that retains flexibility and resilience in the face of uncertainty about China's future capabilities and intent. Consequently, China's expansionist goals and military modernization programs may well create additional nuclear requirements for the United States and the corresponding need now to consider whether, when, and how to deploy additional capabilities for deterrence and assurance purposes.

Missile Defense

The regional missile defense posture must become more capable against Chinese regional missile threats, both ballistic and cruise. However, a central question for the United States remains whether or not to formally or overtly accept mutual vulnerability as the basis of its strategic relationship with China. A clear rejection of mutual vulnerability could inspire a more robust and wide-ranging program of Chinese nuclear modernization and buildup, and it is unclear what the United States would gain from the overt rejection of mutual vulnerability in the absence of a

determination and capability to move forward with the corresponding strategic defensive capabilities.

In contrast, a clear US acceptance of mutual vulnerability as an enduring policy position might lead to a moderation of China's nuclear ambitions or, alternatively, to the reinforcement of any Chinese expectations of a United States that is subject to coercion via limited nuclear threats. Just how China would respond cannot be known with confidence in advance, in part because of China's lack of transparency.

Of perhaps equal or greater concern, however, is the fact that an expressed US acceptance of mutual vulnerability as an established policy position would be deeply troubling to Japan, which is concerned that China would receive it as a sign that the United States is unwilling to defend its interests in the region. Some Japanese officials have expressed concern that formal or *de facto* US acceptance of mutual vulnerability could encourage Chinese strategies to coerce and deter the United States and Japan. Moreover, it is possible, and perhaps likely, that China would simply pocket such a declaration and continue on with its nuclear programs, rather than moderate them.

Given these allied concerns, continued ambiguity seems the most prudent US policy. Such a position could be reconsidered if and when the United States has the political will, resources and technological prowess to seriously pursue active defenses for the United States against Chinese missiles. Until such a time, it may most prudently adopt neither a declared policy to tailor its missile defense programs to negate China's nuclear deterrent nor commit to an enduring policy of mutual vulnerability. In choosing continued ambiguity in this regard, US policy makers must recognize that it is unlikely to resolve Chinese suspicions of future US strategic intent—although the same would be true even with a declared US policy commitment to mutual vulnerability (as such declarations have done little to resolve Russian suspicions on this same question).

Chinese leaders are disposed to see US military actions as part of a strategy of encirclement and containment; they suspect that strategic ambiguity is simply used by the United States to develop the necessary technological means to eliminate China's deterrent. They can be expected to continue to work hard to prevent this outcome.

Assurance of Allies

In Northeast Asia today, the assurance of Japan and South Korea, both their governments and peoples, has been a focus of rising US policy concern over the last two presidential administrations. They have recognized that US allies are in the nuclear crosshairs of the most likely regional adversaries.

As emphasized previously, assurance flows from confidence that the regional deterrence strategies of the United States and its allies are sound and supported by the necessary capabilities (and will become more robust with expected capabilities). Assurance also flows from consultations. Allies are not assured when presented with a US "solution" to a problem they have not helped define and an approach with which they may not agree. True dialogue can help ensure the convergence of perceptions of the security environment, analysis of the new and emerging challenges of deterrence, and agreement about a division of deterrence labor. Consequently, the United States must continue to pursue its comprehensive approach to strengthening the regional deterrence architecture in close partnership with Japan and South Korea.

The formal extended deterrence dialogues with Japan and the ROK begun by the Obama Administration in 2010 have had a positive impact in this regard. Today, the governments of both countries are supportive of the US approach to adapting and strengthening the regional deterrence architecture and to the tailoring of new approaches to North Korea and China.

Some observe the rising debate in Northeast Asia about nuclear deterrence and equate it with rising concern about the credibility of the US nuclear umbrella. Such a concern does exist in some allied quarters. Yet, this is a subject not to be shunned or denied, but part of an important dialogue the United States should want and can lead. This dialogue is necessary and appropriate, and reflects a widening of participation among allies to develop new insights into, and consensus about, the deterrence and assurance challenges in the region. As already noted toward this goal, the official dialogues should be continued and invested with the necessary senior political leadership.

A key missing ingredient historically in the US nuclear assurance strategy in Northeast Asia has been in the realm of nuclear consultation. The comprehensive nuclear consultation process developed in NATO has had no analogue in Northeast Asia. Allies reasonably want to be able to provide input to the American president when the subject is employing nuclear weapons in defense of their vital interests, but allies in Northeast Asia are not clear how they might do so and how existing institutional processes would enable the necessary political agreement in time of war. The dialogues established in 2010 go part of the way in meeting this need, but allies in Northeast Asia continue to press for consultations that are more “NATO-like” in character, even if the NATO model may not suit them well. The United States must meet this requirement for consultations in a manner that also meets US interests.

This is a reminder also that allies in Northeast Asia watch very closely the developments in NATO’s nuclear policy and posture. They look for lessons about how the United States treats the interests of its allies—and also for the balance of toughness and deference shown to the interests of the neighboring expansionist major power. In short, US behavior and politics *vis-à-vis* NATO allies shape the perceptions of Asian allies with regard to exigencies of deterrence and assurance.

The United States must also continue to press its two allies in Northeast Asia for more trilateral deterrence cooperation. It is important to recall that the US alliance structure in East Asia is unlike the structure in Europe; whereas the latter is multilateral, the former is hub-and-spoke, with the United States retaining separate bilateral alliances with allies who have no legal responsibility to defend each other. The political division between South Korea and Japan is deep and abiding; it is also a prime target for North Korea. In war, Pyongyang would likely target Japan to compel the Japanese people to decide whether or not to suffer an attack in defense of South Korea. A potentially useful way to reduce North Korea’s confidence in its strategy to divide the US allies, and thus to deter Pyongyang, is to signal that South Korea and Japan would be unified in case of North Korean aggression and, if under mutual attack, would be prepared to use all means necessary to deter escalation and defend each other.

Rising Nuclear Dangers in South Asia

The nuclear dangers in South Asia are not a direct problem for US deterrence strategy. The United States does not expect to face a circumstance in which it would have to threaten to impose

nuclear-backed threats to prevent nuclear attack on it or its interests by a South Asian country. However, these dangers are a problem for US nuclear strategy. After all, a primary objective of that strategy is to reduce nuclear dangers globally to the fullest extent possible.

Pakistan is engaged in a major buildup of its nuclear forces, possibly aimed at deploying potentially many hundreds of weapons in support of tactical, operational, and strategic objectives. India is reluctant to be drawn into an arms race, but also is moving toward improved and more numerous weapons. Both are developing operational doctrines aimed at gaining decisive advantages as early as possible in a conflict, in part to achieve a *fait accompli* before outside powers—particularly the United States—might intervene to try to stop the process. All of this is a recipe for regional nuclear crises and possibly war that all seek to avoid but no one can afford to lose.

Moreover, a buildup of nuclear weapons in Pakistan brings with it increased risks that it might lose control of one or many such weapons. These could find their way into the hands of radical terrorists willing to set off those devices in Western cities.

US nuclear policies should continue to encourage diplomatic means to try to persuade both countries to work together to avoid misperceptions and misunderstandings that could lead to a greater chance of conflict. Unofficial dialogues can help establish a basis upon which official activities can be built, and such dialogues should continue. The United States must also continue to emphasize preparations for emergency responses to a loss of Pakistani control of nuclear weapons.

Conclusions

Trends in the strategic environment in Asia point to the growing salience of nuclear weapons in US and allied security strategy for the region, and to the need to consider options for strengthening deterrence and assurance in the face of these trends. Adaptability, as a metric for nuclear force adequacy, provides a key guide for US defense policy in this unstable environment.

North Korea's advancing missile and nuclear arsenals, and its willingness to risk and possibly even use them, suggest that US nuclear forces will play a greater role in continuing to extend deterrence against Pyongyang, which appears likely to gain more and better options for nuclear coercion in the coming years. US nuclear forces, especially forward-deployable nuclear forces and options for discriminate use, may be particularly valuable in persuading Pyongyang of the excessive danger and futility of any attempt at nuclear employment or blackmail against the United States or its allies.

China's growing military power, both its expanding and increasingly sophisticated conventional forces as well as its modernizing nuclear arsenal, is giving it greater coercive power in the Asia-Pacific region to match its expansionist goals. The United States and its allies are seeking to maintain conventional advantages in the region in order to sustain effective conventional deterrence, and these efforts need to be continued and amplified. The possibility that China may secure areas of continuing conventional advantage and the reality of Beijing's more survivable, capable, and flexible nuclear arsenal, however, mean that US nuclear forces are likely to play a more salient role in deterrence of the PRC and the assurance of allies. In particular, the United States will need escalation options that are credible and tailored to plausible contingencies, such

as Chinese first use against important military targets in the region or Chinese conventional successes against core US or allied interests.

While these two dynamics are likely to drive US nuclear force policy, planning, and procurement with respect to the Asia-Pacific, other nuclear weapons-related issues will also demand Washington's attention. The potential for nuclear employment and escalation in South Asia, in particular, will be an important focus.

In sum, as the Asia-Pacific comes to play an increasing role in global affairs and as the military balance becomes more competitive there, US nuclear forces are likely to play a more important role in sustaining US deterrence and extended deterrence goals. Correspondingly, these realities once again underscore the value of adaptability as a primary metric of US strategies and forces.

¹ Tim Kelly and Nobuhiro Kubo, "As North Korea missile threat grows, Japan lawmakers argue for first strike options," *Yahoo.com*, March 8, 2017, available at <https://www.yahoo.com/news/north-korea-missile-threat-grows-japan-lawmakers-argue-091140657--finance.html>.

² Herman Kahn, *On Thermonuclear War* (Princeton, NJ: Princeton University Press, 1960), pp. 132-133.

³ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2016* (Washington, DC: Department of Defense, April 26, 2016), p. 58, available at <http://www.defense.gov/Portals/1/Documents/pubs/2016%20China%20Military%20Power%20Report.pdf>.

⁴ David Shlapak and Michael Johnson, *Reinforcing Deterrence on NATO's Eastern Flank* (Santa Monica: RAND Corporation, 2016), pp. 4-7.

Section X. The Affordability of Nuclear Deterrence

Introduction

Maintaining and sustaining credible, reliable, and effective nuclear capabilities for deterrence, assurance, and defense will require significant fiscal resources. The development, procurement, and deployment of nuclear and non-nuclear enabling forces (e.g., delivery platforms, command and control, etc.) sufficient to support these priority national goals adequately now, and in the future, under the least and most stressing circumstances, will not be inexpensive. However, virtually any failure to support these goals would be intolerable.

Ultimately, the cost of US nuclear capabilities must be judged against the value they provide in support of US national goals, especially deterring war, assuring allies, and working to prevent the escalation of conflict. Given the possible consequences of even a “limited” nuclear war, that value may be considered virtually infinite.

Spending, however, cannot be infinite and thus budget questions loom large given the need to recapitalize virtually every element of the US nuclear force posture after decades of very limited investment. The expense is greater today because the United States has deferred necessary modernization for so long that all three “legs” of the strategic nuclear triad are aging out together and need to be modernized simultaneously. While budget considerations are critical in the ultimate determination of US capabilities, the primary driving factors must be a realistic assessment of the threat environment and the character of US capabilities needed to support US priority goals in that environment (with full recognition that threat environments can shift rapidly and surprisingly).

Spending on nuclear forces is often seen as an unattractive prospect for multiple reasons. The demise of the Soviet Union and the end of the Cold War (which provided the original impetus for the development of the US strategic nuclear triad and the deployment of non-strategic nuclear weapons overseas) have led some to advocate a minimalist US nuclear posture. Likewise, the belief that the United States is unlikely ever to employ nuclear weapons, that such weapons are ill-suited to counter 21st century threats, or that spending on nuclear forces “starves” more important conventional forces of much-needed fiscal resources, has resulted in calls to reduce or eliminate one or more “legs” of the US strategic nuclear triad. In addition, overall fiscal concerns and budgetary constraints have heightened calls to rethink US military investment priorities and the need to spend billions of dollars on modernizing nuclear forces. In particular, there have been calls to eliminate ICBMs or strategic bombers, or to reduce the number of ballistic-missile carrying submarines (SSBNs), because of the expense associated with sustaining or modernizing these systems.

Despite downward budgetary pressures in recent years, the security environment as discussed previously is increasingly threatening and dynamic, and unexpected threats will likely emerge periodically. Therefore, the US nuclear forces budget must be sufficiently flexible to support a nuclear posture that can adequately adapt and be responsive to dynamic, and sometimes

surprising, changes in the international security environment and resultant changes in the likely requirements for deterrence, assurance and defense. The United States cannot afford to risk deterrence or assurance failure as a consequence of a desire to preserve a particular fiscal profile or the low level of investment that has pertained since the end of the Cold War. As Air Force Chief of Staff Gen. David Goldfien stated recently, “the only thing more expensive than deterrence is fighting a war, and the only thing more expensive than fighting a war is losing a war.”¹

“The Highest Priority”

As US leaders face an era of constrained defense budgets they must prioritize the programs they believe are most essential for the United States to achieve US security goals in an unpredictable security environment. When presented with the choice, Obama and Trump Administration officials have chosen to prioritize nuclear deterrence capabilities. Then-Secretary of Defense Ashton Carter recently described the US nuclear mission as “the highest priority of the Department of Defense.”² The Vice Chairman of the JCS Gen. Paul Selva concurred with this assessment, stating in testimony: “Perhaps the clearest indicator of this prioritization is how we have chosen to spend our resources and the tradeoffs we have been willing to accept. Although our current nuclear strategy and program of record were developed before the Budget Control Act imposed strict caps on defense spending, we are emphasizing the nuclear mission over other modernization programs when faced with that choice.”³ If US nuclear capabilities and missions are the first priority, as US officials have confirmed, then that prioritization must manifest itself in priority funding in US defense budgets. As then-Chairman of the JCS Gen. Martin Dempsey stated in the *2014 Quadrennial Defense Review*, the top two national interests of the United States are: “1. The survival of the nation,” and “2. The prevention of catastrophic attack against U.S. territory.” Given these interests, the highest priority mission that Gen. Dempsey identified is to “Maintain a secure and effective nuclear deterrent,” thus requiring prioritized funding.⁴

The “Unaffordability” Argument

Critics of current US nuclear modernization plans often assert that the cost of such modernization is “unaffordable.”⁵ For example, analysts at the Center for Arms Control and Non-Proliferation have called modernization of the triad “an unaffordable plan.”⁶ The congressionally mandated National Defense Panel charged with assessing the *2014 Quadrennial Defense Review* concluded that “a recapitalization of the triad... under current budget constraints is unaffordable, especially considering that the nuclear deterrent’s supporting infrastructure, command and control system, and other enabling capabilities also require expensive renovations.”⁷ These assertions that US nuclear modernization is unaffordable deserve greater scrutiny.

The affordability issue is often raised in the context of current budgetary constraints. However, assertions about affordability often are, instead, statements that reflect preferences about spending priorities. And few, if any, priorities are more important than preventing nuclear war, which is the priority function of the US nuclear deterrent. To suggest that the United States cannot afford to maintain a level of spending sufficient to support deterrence and assurance is to suggest that other societal priorities are so important that the spending necessary for credible, reliable, and effective US nuclear capabilities must be sacrificed in their favor, or that those capabilities can be bought “on the cheap.” That is, some argue that deterrence and assurance can be supported reliably for the indefinite future at significantly lower US nuclear force levels than exist today and, by extension, with lower modernization costs.⁸

Critics of nuclear spending typically dismiss the possibility that the reductions in nuclear investments they propose would entail the risk of undermining effective deterrence or assurance. In a complex, dangerous, and dynamic threat environment, however, considering the requirements for nuclear deterrence and assurance primarily through the prism of monetary cost is a risky approach; as noted, the strategies and capabilities deemed necessary to support these national goals should drive investment considerations, not an enduring commitment to essentially fixed, low-cost budget ceilings.

Those who seek to cut nuclear programs to save money often argue that conventional forces are in greater need of scarce resources.⁹ For example, one analyst has argued that current nuclear modernization plans are “unnecessary” and “will impose an increasing burden on the defense budget, making it difficult to maintain our conventional military superiority—the real guarantee of U.S. security.”¹⁰ Another has stated that funding nuclear modernization “would ‘rob Peter to pay Paul,’ in that the funding is also desperately needed for conventional forces.”¹¹ Yet funds invested in conventional vice nuclear forces do not translate into defense budget “savings” any more than spending that is redirected from one account to another can be characterized as a “savings.” Moreover, while the value of US non-nuclear forces is beyond dispute, the amount of money being spent on conventional forces consistently dwarfs the amount allocated to nuclear forces.¹² And, moving in general to conventional forces to provide the needed support for US deterrence, assurance, and damage-limitation goals currently provided by US nuclear forces, even if feasible in principle, would be many times more costly because it would likely require substantial increases in the size and capabilities of those forces.¹³

In addition, a 2008 National Academy of Sciences study concluded that deploying advanced conventional forces that could hold at risk Russian nuclear forces “would likely involve building at least several hundred additional intercontinental-range missiles and their associated launchers” at a cost that would exceed “several tens of billions of dollars.”¹⁴ And, according to some estimates, emerging Russian aerospace defenses will reduce US conventional strike capabilities from their current ability to cover roughly 30 percent of potential targets to as few as 10 percent—a significant degradation with potential negative implications for deterrence and assurance via conventional forces.¹⁵ These numbers alone should give pause to assertions that non-nuclear capabilities can essentially replace nuclear in support of priority national goals, and somehow do so at lower cost.

Critics who oppose US nuclear modernization based on budgetary considerations often cite former Under Secretary of Defense for Acquisition, Technology, and Logistics Frank Kendall’s statement that the United States faces a “huge affordability problem” with respect to modernization of the nuclear triad. Former Secretary Kendall recognized, however, that the nation can afford to spend what is necessary on nuclear deterrence if US policy makers choose to do so. He stated, “My view is that the country can afford that; it has to make a choice to afford it.”¹⁶ Similarly, as current Commander of US Strategic Command Gen. John E. Hyten testified, “I think the nuclear Triad is affordable as we go forward in the future.”¹⁷

The importance of adequately funding US nuclear forces to support priority national goals similarly was recognized by then-Deputy Secretary of Defense Ashton Carter who announced in 2013 that, “We are exempting our nuclear deterrent” from the arbitrary and damaging budget cuts mandated by sequestration as a result of the Budget Control Act of 2011.¹⁸ This exemption was necessary,

in Secretary Carter's words, because U.S. nuclear forces are "so important to our security."¹⁹ More recently as Secretary of Defense, he reiterated the importance of modernizing US strategic nuclear forces, declaring "America's nuclear deterrence is the bedrock of our security, and the highest priority mission of the Department of Defense."²⁰

There is no doubt that nuclear modernization involves considerable cost. However, as these senior Defense officials emphasize, it is not unaffordable in absolute terms and the priority of the national goals served by these forces is very high. The elimination of US nuclear programs some recommend in response to anticipated peaks in spending would lead to a degradation of resilience and flexibility in US capabilities, the potential loss of US credibility in the eyes of adversaries and allies and, consequently, greater potential overall risk to the nation. Even reductions in the current modernization plan proposed by some—for example, scaling back the number of new strategic submarines procured under the Ohio Replacement Program—carry strategic and operational risks that could negatively impact the effectiveness of US deterrence and assurance strategies in ways that far outweigh any monetary benefit.

Cyclical Procurement and the Cost Factor

Historically, US defense spending has followed a pattern of peaks and troughs, with security alarms and domestic political developments driving this dynamic—the Korean War in the early 1950s, the Berlin crisis of the late 1950s and early 1960s, heightened US-Soviet tensions in the late 1970s and early 1980s—resulting in buildups with peaks in spending, followed by troughs during which the United States essentially lived off its investment until the next alarm and consequent buildup. This pattern is far from optimal and often leads to spending inefficiencies and other challenges, such as aging systems potentially vulnerable to enemy countermeasures, systems increasingly expensive to maintain, crash programs in times of crisis, and abrupt program cancellations.

US spending on strategic force modernization has traditionally followed these decades-long cycles, with spending troughs and "bow waves." In addition, complex and cumbersome Defense Department acquisition processes have produced a system that is largely unresponsive to rapid changes in requirements.²¹ Spending bow waves can be seen in the early 1950s, early-to-mid 1960s, and the 1980s in response to the aforementioned crises, as the United States developed, deployed, and upgraded a range of nuclear weapons and delivery vehicles that comprise the three legs of the strategic nuclear triad. The life expectancy of these systems has been repeatedly extended beyond their original parameters—in some cases, many decades beyond. This is a stop-gap approach rather than a long-term answer to operational performance, maintenance, and reliability issues associated with an increasingly aging nuclear force. As then-Secretary Carter stated, the United States has "underinvested in an aging force" since the end of the Cold War, adding:

The fact is, most of our nuclear weapon delivery systems have already been extended decades beyond their original expected service lives. So it's not a choice between replacing these platforms or keeping them; it's really a choice between replacing them or losing them. That would mean losing confidence in our ability to deter, which we can't afford in today's volatile security environment.²²

Another cycle of modernization now again looms large. The deferment of planned modernization leads to significant funding challenges during those cyclical periods, as it becomes increasingly costly to keep older systems functional and reliable. Furthermore, continued deferment of critical modernization plans will result in additional nuclear force reductions, as older systems reach the end of their life expectancy and are retired before newer systems can be operationally deployed.²³

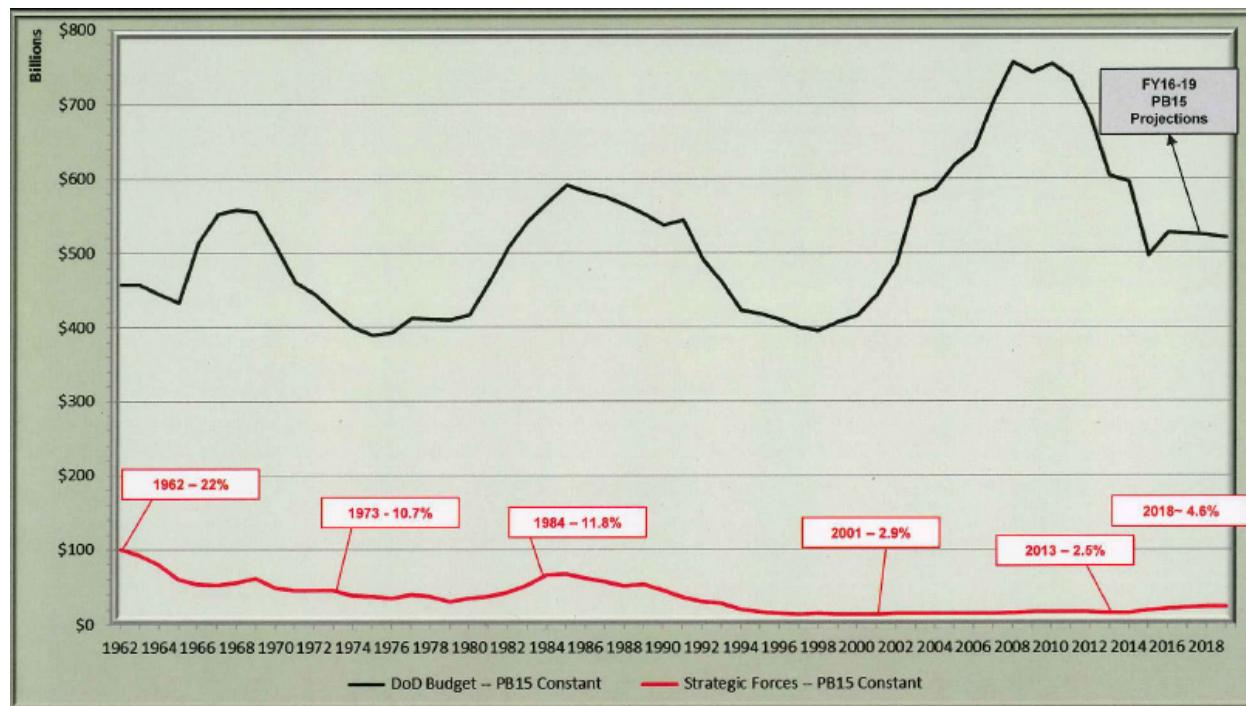
Nuclear Deterrence: A Fiscal Bargain

Despite frequent claims by those who call for US nuclear force reductions, cuts in nuclear forces may yield only relatively limited savings. As then-Deputy Secretary of Defense Carter stated, “nuclear weapons don’t actually cost that much.... And so it is not a big swinger of the budget. You don’t save a lot of money” as a result of reductions in nuclear forces.²⁴ As one defense budget analyst concluded in 2015, the desire to save money by cutting nuclear forces is a “hunt for small potatoes.”²⁵

As emphasized above, however, perhaps more important is the relationship between cost and value. US nuclear forces help deter existential nuclear threats to the United States and its allies. They also provide a deterrent against the use of other types of WMD—including chemical or biological agents—where the United States no longer possesses the ability to threaten retaliation in kind; they strengthen and solidify US security guarantees to allies and strategic partners; and, by deterring an opponent’s escalation, they underpin the US damage-limitation goal and ability to use conventional military forces where needed to protect American interests abroad. US nuclear forces do this while consuming less than five percent of the defense budget, a smaller percentage of the federal budget, and a still smaller percentage of the nation’s gross domestic product. Relative to the important national goals they achieve, US nuclear forces are a fiscal bargain; the “return on investment” is potentially infinite.

US nuclear forces account for roughly three-to-five percent of the overall defense budget.²⁶ (See Figure 3, below.)

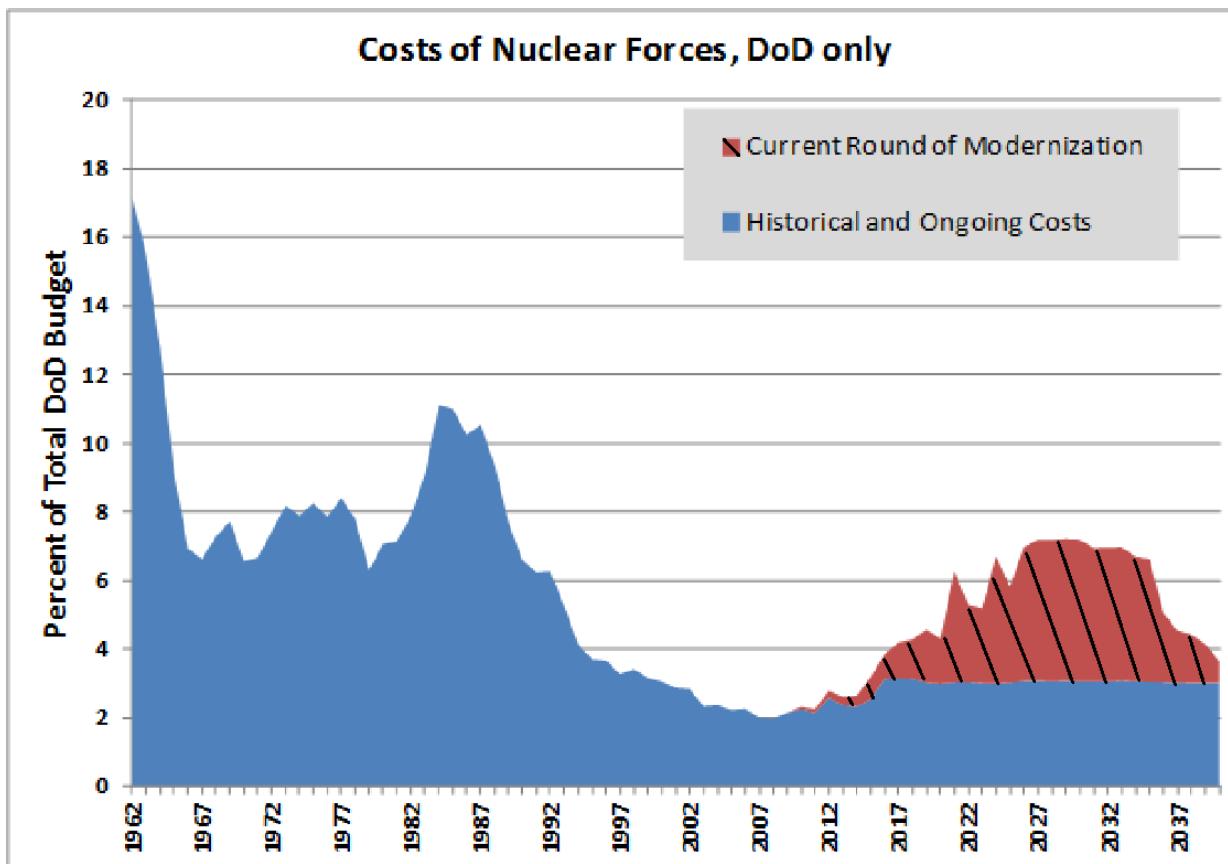
Figure 3: Strategic Forces vs. DoD Budget: Historical Trends²⁷



Even with the “bow wave” of spending on the US nuclear modernization plan, this percentage is unlikely to rise beyond approximately seven percent of the defense budget—still less than the 10 percent or more of defense spending devoted to nuclear forces during the buildups of the 1960s and 1980s.²⁸ (See Figure 4, below.) Former Secretary Carter has said that “funding for the nuclear enterprise... is a relatively small percentage of total defense funding—and even as we replace aging platforms, we don’t expect that fact to change.”²⁹ It will comprise less than one percent of the total federal budget.

Estimates of the cost of US nuclear modernization range from roughly \$400 billion over the next 10 years to as much as \$1 trillion over the next three decades,³⁰ with half of this cost projected to be spent on extending the life of existing systems rather than building new ones.³¹ These figures are relatively small compared to many other areas of defense and federal spending. When seen in this perspective and given the national goals served, spending on nuclear forces is not unaffordable. This is all the more so when considering that the new SSBNs, strike aircraft (bombers and DCA), ICBMs, and warheads procured will be in service and contributing to the goals of deterrence, assurance and damage limitation for many decades. In addition, the Center for Strategic and Budgetary Assessments has noted that the cost figures typically presented include the full expected costs of bombers and DCA when, in fact, these aircraft will primarily be used in their conventional roles, and making them “nuclear-capable” would require relatively little additional cost. Thus, overall cost estimates often presented overstate the true nuclear costs.³²

Figure 4: US Nuclear Forces Spending as a Percentage of the Overall Defense Budget³³



As noted previously, the level of fiscal resources provided for US nuclear forces must be adequate to provide reliable and effective support for national goals, including in the most stressing contingencies. The consequences of failing to do so would be intolerable.

A Path Forward

Ensuring adequate funding for US nuclear forces requires the support and concurrence of both the executive and legislative branches of government. While the executive branch can propose funding levels sufficient to sustain a robust and resilient nuclear arsenal, it is ultimately up to Congress to appropriate the fiscal resources necessary to maintain US nuclear capabilities. Understanding the importance and relative cost-effectiveness of US nuclear forces is a necessary prerequisite for obtaining such support over the long term.

Several proposals other than dramatically reducing US forces have been advanced for addressing the issue of funding nuclear forces in a constrained budget environment. For example, one proposal calls for the Department of Defense “to adopt a ‘mandatory insurance’ policy, requiring a constant, material percentage of every defense budget to be allocated to nuclear forces, with an entity in the Office of the Secretary of Defense determining the division between the Navy and the Air Force.” Proponents of this approach estimate the appropriate level to be somewhere between three and eight percent of the defense budget annually.³⁴

Another proposed approach is to create a “strategic deterrence fund” (similar to the National Sea-Based Strategic Deterrence Fund that Congress authorized for the Navy’s *Ohio*-class SSBN replacement program), which would be used to fund all nuclear programs, including the Air Force’s Ground-Based Strategic Deterrent (Minuteman ICBM follow-on) and next-generation B-21 strategic bomber programs.³⁵ The creation of a Joint Service Strategic Deterrence Fund could be useful for highlighting the importance of the nuclear deterrent mission and as a tool to improve contracting efficiencies while saving money through block purchases and procurement of long lead items. For example, the Congressional Budget Office has noted that applying this approach to the *Ohio* replacement program “could potentially save several hundred million dollars per submarine.”³⁶ However, the utility of this approach for reducing friction and avoiding trade-offs among competing service priorities remains controversial.³⁷

Proposals such as these are not universally supported by those who favor nuclear modernization and may not solve the problem of resourcing US nuclear forces, but they do reflect concern over potential cuts that could undermine US deterrence and assurance objectives. Other possible approaches are also worth considering. These include:

- Establishing a research and development (R&D) “carve out” for the development of new nuclear capabilities tailored to the variable and dynamic requirements of deterrence and assurance. This would allow a certain percentage of the overall defense R&D budget to be set aside for research and development of flexible nuclear capabilities more applicable to the challenges of the 21st century. In addition, focusing a small tranche of R&D funding on developing new system prototypes could also help accelerate production of the most critical capabilities.
- Reassessing fiscal requirements and the appropriate balance between R&D on new, next-generation nuclear capabilities, procurement of strategic and tactical upgrades to existing nuclear systems and platforms, and operations and maintenance (O&M) for existing nuclear forces. In recent years, long-term investment accounts for modernization of defense capabilities (R&D and procurement) have been neglected in favor of short-term O&M spending to maintain the readiness of existing systems. While all of these investments are critical, longer-term nuclear modernization programs have been deferred well beyond what is prudent. Investment in nuclear deterrence should not be approached as a “zero-sum game,” where a choice must be made between preserving current nuclear capabilities or developing nuclear forces applicable to future deterrence and assurance requirements. Both are essential and should be funded adequately.
- Allowing the services to commit funds over a longer period of time to purchase long lead items in order to improve efficiency in the planning and procurement process.
- Allowing greater flexibility to shift funds allocated for nuclear modernization from one account to another as needed without being subject to standard bureaucratic processes, such as reprogramming requirements, that tend to complicate and add time to the acquisition process. Such flexibility was granted to the National Reconnaissance Office in the 1960s and 1970s.³⁸
- Developing special contracting arrangements with private industry that provide for greater flexibility and allow for more expeditious development of nuclear capabilities than current DoD contracting vehicles.
- Exempting nuclear modernization programs from some of the DoD 5000-series acquisition requirements in order to expedite deployment of necessary nuclear deterrent capabilities. There is precedent for such action. For example, when it was created in 2002, the Missile

Defense Agency was allowed to exercise unique flexibility to manage the missile defense acquisition effort by exempting it from some of the defense acquisition system rules established in DoD guidance. This helped expedite deployment of an initial missile defense capability for the United States.³⁹ A similar approach could be considered for procurement of nuclear systems and capabilities.

- Creating a special advisory task force to review acquisition requirements for the nuclear enterprise with a view toward streamlining and improving the process for developing and deploying needed nuclear capabilities. Such a task force could be patterned on existing DoD efforts intended to identify improvements in the overall acquisition process.⁴⁰

For the near term, spending on nuclear forces would again be at risk beginning in fiscal year 2018 in the context of the return of sequestration mandated by the Budget Control Act of 2011 and the expiration of the temporary budget relief embodied in the Bipartisan Budget Act of 2015. The administration has proposed a supplemental budget for fiscal year 2017 and a defense budget blueprint for fiscal year 2018 that would focus additional resources on near-term readiness concerns as opposed to major modernization requirements. The proposed increases, however, would require relief from the budgetary caps imposed by the Budget Control Act of 2011. At a minimum, if current budget law is not amended or repealed, the Trump Administration should exempt spending on nuclear forces from the mandatory sequestration cuts that are scheduled to be reinstated next year.

Most importantly, the administration should immediately begin engaging with Congress to explain the critical importance of adequately funding US nuclear forces and to explore options for accomplishing this—perhaps legislatively—by seeking budget relief through statutory amendments to the Budget Control Act of 2011 and other legislation as appropriate. As noted, adequately funding US nuclear forces is a responsibility shared by both the executive and legislative branches of government. Consultation and cooperation between the administration and Congress are, therefore, essential elements of a sound and successful strategy for ensuring a credible and effective US nuclear posture. In this regard, prioritizing the work of the national laboratories on nuclear deterrence, focusing their efforts on system prototyping, and explaining the benefits of this approach to Congress could help expedite the development of necessary nuclear capabilities and keep modernization costs down. In addition, the Trump Administration should explore what new force posture options might be available in a future, less-restricting defense budget environment.

Finally, the administration should conduct periodic assessments of nuclear deterrence needs and strategic capability requirements in light of changes in the geo-strategic threat environment. Such assessments were called for in the 2001 Nuclear Posture Review, but appear not to have been undertaken with any regularity. They should be used to inform US nuclear force budgets and service fiscal and programmatic planning. They could also be a useful tool to inform Congress.

The Importance of Strategic Messaging

The spirited, if conspicuously uninformed, public debate about the cost and value of US nuclear programs indicates the importance of addressing the general lack of understanding of the importance of nuclear missions among multiple communities and constituencies. The overwhelming value of deterrence, assurance and defense, and the value of US nuclear forces to support these goals, has been only sporadically and often inadequately explained by senior-

level decision makers to the Congress, the uniformed military, and the general public. This reality has a direct connection to nuclear budget issues: the failure to communicate this basic, yet vitally important, information has contributed to the failure to resource the US nuclear enterprise appropriately.

Numerous studies have highlighted the importance of strategic messaging that conveys the importance of the nuclear enterprise and the forces needed to ensure its successful functioning. For example, the 2014 *Independent Review of the Department of Defense Nuclear Enterprise*, co-chaired by Gen. Larry Welch (USAF, ret.) and Adm. John Harvey (USN, ret.) cited “public declarations by former (and, occasionally, current) senior national security leaders and others who question or deny the continuing relevance of the nuclear forces or segments of the nuclear forces,” while noting “the lack of public response to these views by... current senior leadership.” The review concluded that this “significant disconnect” causes “confusion in the force about the national and DoD leadership commitment to the nuclear mission” and called on the Secretary of Defense to “Establish and support programs that maintain high awareness of verbal and written public declarations that question the need for nuclear forces and respond with equally public declarations.”⁴¹

In addition, then-Secretary of the Air Force Deborah Lee James in 2014 noted a perception within the service that “the nuclear mission is no longer valued by either the Nation or the Air Force” and that this perception “is pervasive at all levels of the enterprise.” While stating that “senior Air Force leaders have highlighted the importance of the nuclear mission,” she also noted that “there has been little reinforcement of this message by other leaders.”⁴²

The 2008 *Report of the Secretary of Defense Task Force on DoD Nuclear Weapons Management* found a “distressing degree of inattention to the role of nuclear weapons in deterrence among many senior DoD military and civilian leaders” and stated, “Developing and sustaining nuclear deterrence capabilities require strong DoD leadership. Senior officials must be actively engaged in the nuclear weapons mission. Unless there is high-level attention, articulation, and oversight by the Secretary of Defense, the Department’s motivation to sustain the deterrent may be weakened and resources diverted elsewhere.” Importantly, it concluded, “To be fully credible, the role of nuclear deterrence should be firmly articulated by the White House itself.”⁴³

Other reports have been equally harsh in their assessment of the inadequacy of leadership understanding and advocacy of the nuclear mission and the importance of maintaining nuclear forces capable of ensuring mission success. For example, one Defense Science Board (DSB) Task Force concluded that “senior leaders need to do more than reaffirm the need for a modern, safe, and reliable nuclear deterrent. They need to engage more directly to articulate the persuasive case for nuclear transformation that provides an integrated vision of the role of nuclear weapons.”⁴⁴ Another DSB Task Force report recommended that “Senior civilian and military leaders should reinforce the necessity for and value to the nation of the nuclear deterrence mission” and that this should be a “concerted and continuing effort.”⁴⁵ This broad and demanding communication task must be addressed deliberately, systematically, and consistently in order to sustain the support necessary to ensure US nuclear capabilities are appropriately funded.

Some senior DoD officials have recently spoken out forcefully in support of the nuclear mission and nuclear modernization. For example, as noted previously, former Secretary Carter stated, “America’s nuclear deterrence is the bedrock of our security, and the highest priority mission of

the Department of Defense.⁴⁶ Then-Secretary of the Air Force Deborah Lee James stated similarly, “there is no question in my mind that our nuclear mission is first and foremost.”⁴⁷ Military officials have also emphasized the continuing importance of nuclear deterrence. As the former head of USSTRATCOM Admiral Cecil Haney noted, “Some question whether deterrence is still relevant in today’s world; I assure you it is.” However, strong statements like these are a relatively recent development and still often are lost in a sea of alternative commentary by those who challenge the continued relevance of the nuclear deterrence mission, believe conventional forces alone can provide adequate security, oppose current nuclear modernization plans, support eliminating one or more legs of the strategic nuclear triad, or favor additional budget reductions for nuclear forces.

Moreover, a recent study by the Center for Strategic and International Studies (CSIS) concluded that “a coherent narrative about the fundamental role of U.S. nuclear weapons has not been sufficiently stated and promulgated across the force”⁴⁸ and recommended that policy makers “from the top” better communicate the “role, function, posture, and priority of U.S. nuclear weapons in U.S. national security.”⁴⁹ The CSIS study concluded that this message must be “fully and formally owned and communicated by the president and the president’s most senior national security advisors” using “diverse communication modes” in a manner that is “compelling” and easily understandable across all audiences.⁵⁰ As the report notes:

Clear statements from the highest possible echelons of policymaking—the president, the secretary of defense, the secretaries of state and energy—carry a weight all their own, especially in terms of priority and strategic vision. What senior leadership says matters, but what they do not say also matters. Silence can be deafening.⁵¹

Conclusion

The importance of ensuring a flexible, resilient, and credible nuclear capability that also is safe and secure cannot be overemphasized. It is essential to the deterrence of adversaries, the assurance of allies and US defensive goals. Funding the needed nuclear force and modernization programs ultimately is both necessary and affordable. Failing to do so would be dangerously imprudent and short-sighted, and could increase the risk to the nation of intolerable consequences. The new administration and 2017 NPR should communicate to the American people and their elected representatives the importance of US nuclear forces and the urgency of nuclear modernization as a matter of the highest priority.

¹ “Air Force Chief of Staff Claims US ‘Can’t Afford’ Not to Buy New Nuclear Weapons,” *Sputnik News*, March 3, 2017, available at <https://sputniknews.com/us/201703031051218246-us-new-nuclear-weapons/>.

² Ashton Carter, “Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota,” *Defense.gov*, September 26, 2016, available at <https://www.defense.gov/News/Transcripts/Transcript-View/Article/956079/remarks-by-secretary-carter-to-troops-at-minot-air-force-base-north-dakota>.

³ Paul Selva, “Statement of General Paul Selva, Vice Chairman of the Joint Chiefs of Staff,” *115th U.S. Congress*, House Armed Services Committee, March 8, 2017, p. 6, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-SelvaUSAFFP-20170308.pdf>.

⁴ U.S. Department of Defense, *Quadrennial Defense Review 2014* (Washington, DC: Department of Defense, March 4, 2014), pp. 60-61, available at https://www.defense.gov/Portals/1/features/defenseReviews/QDR/2014_Quadrennial_Defense_Review.pdf.

⁵ See Angela Canterbury and Kingston Reif, "It's Time to Rein in Nuclear Spending," *Defense One*, September 25, 2014 and Tom Z. Collina and the Arms Control Association Research Staff, *The Unaffordable Arsenal: Reducing the Costs of the Bloated U.S. Nuclear Stockpile* (Washington, DC: Arms Control Association, October 2014).

⁶ John Isaacs and Greg Terryn, "Nuclear Weapons: The 'All of the Above' Strategy," *The Hill*, June 3, 2015, available at <http://thehill.com/blogs/congress-blog/homeland-security/243807-nuclear-weapons-the-all-of-the-above-strategy>.

⁷ William J. Perry, John P. Abazaid, et al., *Ensuring a Strong U.S. Defense for the Future, The National Defense Panel Review of the 2014 Quadrennial Defense Review* (Washington, DC: U.S. Institute of Peace, July 2014), p. 50, available at https://www.usip.org/sites/default/files/Ensuring-a-Strong-U.S.-Defense-for-the-Future-NDP-Review-of-the-QDR_0.pdf.

⁸ See for example, Rachel Bronson, "We Should Be Strategic About How the Nuclear Arsenal Is Modernized," *The New York Times*, October 26, 2016, available at <http://www.nytimes.com/roomfordebate/2016/10/26/a-nuclear-arsenal-upgrade/we-should-be-strategic-about-how-the-nuclear-arsenal-is-modernized>.

⁹ In a July 20, 2016 letter to President Obama, five senior Democratic Members of Congress argued that "squandering hundreds of billions of dollars" on nuclear modernization programs "will plunder much-needed funds for conventional military forces." The letter is available at https://drive.google.com/viewerng/viewer?url=http://ec.militarytimes.com/static/pdfs/20160720_letter_Obama_Congress_nuclear.pdf.

¹⁰ Barry Blechman, "A Trillion-Dollar Nuclear Weapon Modernization Is Unnecessary," *The New York Times*, October 26, 2016, available at <http://www.nytimes.com/roomfordebate/2016/10/26/a-nuclear-arsenal-upgrade/a-trillion-dollar-nuclear-weapon-modernization-is-unnecessary>.

¹¹ Alex Lockie, "The Pentagon is so focused on nukes, it may lose its conventional military edge," *Business Insider*, November 4, 2016, available at <http://www.businessinsider.com/us-nuclear-arsenal-modernization-unnecessary-2016-11>.

¹² Some have suggested that spending on conventional forces is up to 30 times more expensive than nuclear modernization. For example, former Deputy Secretary of Defense and President and CEO of the Center for Strategic and International Studies John Hamre testified before the Senate Appropriations Subcommittee on Energy and Water Development on July 13, 2016 that "when people say it's a trillion-dollar triad, that's in the context of us spending \$30 trillion over the same period of time on conventional forces. So this (nuclear modernization) is not something we can't afford." Video of his remarks are available at <https://www.appropriations.senate.gov/hearings/hearing-to-review-budget-requirements-and-justification-for-the-nuclear-cruise-missile>.

¹³ As one analyst noted, "replacing current nuclear capabilities with conventional capabilities is an expensive and unrealistic proposition." See Adam Lowther, "Why America Needs More Nukes," *The National Interest*, August 5, 2011, available at <http://nationalinterest.org/commentary/why-america-needs-more-nukes-5708>.

¹⁴ Committee on Conventional Prompt Global Strike Capability, National Research Council, *U.S. Conventional Prompt Global Strike: Issues for 2008 and Beyond* (Washington, DC: The National Academies Press, 2008), p. 86, available at <https://www.nap.edu/catalog/12061/us-conventional-prompt-global-strike-issues-for-2008-and-beyond>.

¹⁵ A 2012 Global Zero U.S. Nuclear Policy Commission Report noted "we estimate that U.S. conventional forces could cover between ten (10) and thirty (30) percent of an expansive Russian target base previously covered by U.S. nuclear forces. If Russia's planned \$150 billion investment in 'air-space defense' over the next ten (10) years is productive then the target coverage figure would be lean [sic] toward the lower end of the range." See James Cartwright, *Modernizing U.S. Nuclear Strategy, Force Structure and Posture* (Washington, DC: Global Zero, May 2012), p. 11, available at http://www.globalzero.org/files/gz_us_nuclear_policy_commission_report.pdf.

¹⁶ "Kendall: Current Strategic Forces Modernization Plans Unaffordable Without Topline Relief," *Inside Defense*, April 14, 2015, available at <http://www.nukewatch.org/media2/postData.php?id=3359>.

¹⁷ Reported by Richard R. Burgess, "Strategic Command Nominee: 'Submarines are the Most Survivable' Nuclear Deterrent," *Seapower Magazine*, September 20, 2016, available at <http://seapowermagazine.org/stories/20160920-stratcom.html>.

¹⁸ See speech by Deputy Secretary of Defense Ashton B. Carter, "Above and Beyond Sequestration," *Defense.gov*, March 12, 2013, available at <http://archive.defense.gov/Speeches/Speech.aspx?SpeechID=1757>. Also see Ashton B. Carter and James A. Winnefeld Jr., "Deputy Secretary of Defense Ashton B. Carter and Vice Chairman of the Joint Chiefs of Staff Admiral James A. Winnefeld, Jr.," 113th U.S. Congress, House Armed Services Committee, August 1, 2013, available at <http://docs.house.gov/meetings/AS/AS00/20130801/101242/HHRG-113-AS00-Wstate-CarterA-20130801.pdf>, and Ashton B. Carter, speech before the Center for a New American Security, June 12, 2013, available at <http://www.americanrhetoric.com/speeches/ashcarternewamericancenter.htm>.

¹⁹ Ashton B. Carter and James A Winnefeld Jr., "Deputy Secretary of Defense Ashton B. Carter and Vice Chairman of the Joint Chiefs of Staff Admiral James A. Winnefeld, Jr.," op. cit.

²⁰ Ashton Carter, "Sustaining Nuclear Deterrence," *Defense.gov*, September 26, 2016, available at <http://www.defense.gov/News/Speeches/Speech-View/Article/956630/remarks-on-sustaining-nuclear-deterrence>.

²¹ See the discussion in, Richard Danzig, *Driving in the Dark: Ten Propositions About Prediction and National Security* (Washington, DC: Center for a New American Security, October 2011), pp. 5-6, 19-23.

²² Ashton Carter, "Sustaining Nuclear Deterrence," op. cit.

²³ As one former U.S. government official with responsibility for nuclear weapons issues has testified, "We have to spend money on the triad because it gets modernized at 20-year intervals. There's a Kennedy administration triad, the Reagan administration modernized it, Bush 43 should have, but did not. Now we're facing a modernization or we have to start retiring systems without replacement." Franklin Miller, "Prepared Remarks," 114th U.S. Congress, Senate Appropriations Subcommittee on Energy and Water Development, July 13, 2016, pp. 3-4, available at <https://www.appropriations.senate.gov/imo/media/doc/071316-Miller-Testimony.pdf>.

²⁴ Ashton Carter, "Remarks by Deputy Secretary of Defense Carter at the Aspen Security Forum at Aspen, Colorado," *Defense.gov*, July 18, 2013, available at <http://archive.defense.gov/transcripts/transcript.aspx?transcriptid=5277>.

²⁵ David Mosher, "The Hunt for Small Potatoes: Savings in Nuclear Deterrence Forces," in Cindy Williams, ed., *Holding the Line: U.S. Defense Alternatives for the 21st Century*, cited in Todd Harrison and Evan Braden Montgomery, *Are U.S. Nuclear Forces Unaffordable?* (Washington, DC: Center for Strategic and Budgetary Assessments, June 2015), p. 4, available at <http://www.csbaonline.org/wp-content/uploads/2015/06/Cost-of-Nuclaer-Forces-WEB.pdf>.

²⁶ Ibid., p. 3.

²⁷ Graphic provided by US Strategic Command.

²⁸ Lt. Gen. Jack Weinstein, Air Force Deputy Chief of Staff for Strategic Deterrence and Nuclear Integration has stated, "If we're talking about supporting a foundation that works to keep our homeland safe, 7 percent doesn't sound like a ridiculous amount of money." See Kristen Torres, "Official; Money 'Not An Issue' for Future of Air Force Nuclear Deterrent," *National Defense Magazine*, July 21, 2016, available at <http://www.nationaldefensemagazine.org/blog/Lists/Posts/Post.aspx?ID=2254>.

²⁹ Ashton Carter, "Sustaining Nuclear Deterrence," op. cit.

³⁰ Congressional Budget Office, *Projected Costs of U.S. Nuclear Forces, 2017 to 2026* (Washington, DC: CBO, February 14, 2017), p. 1, available at <https://www.cbo.gov/sites/default/files/115th-congress-2017-2018/reports/52401-nuclearcosts.pdf>.

³¹ Peter Huessy, "The True Cost of Nuclear Deterrence," *Real Clear Defense*, July 28, 2016, available at http://www.realcleardefense.com/articles/2016/07/28/the_true_cost_of_nuclear_deterrence_109635.html.

³² Todd Harrison and Evan Braden Montgomery, *The Cost of U.S. Nuclear Forces: From BCA to Bow Wave and Beyond* (Washington, DC: Center for Strategic and Budgetary Assessments, 2015), pp. 16-18, available at http://csbaonline.org/uploads/documents/CSBA-NCS_Resize_FINAL_WEB.pdf.

³³ Chart prepared by Senate Armed Services Committee Staff with data provided by the DoD Office of Cost Analyses and Program Evaluation and other sources, June 2016.

³⁴ Ben Jonsson and Andrew Hill, "Tomorrow Never Comes: Neglecting the Nuclear Force," *War on the Rocks*, June 3, 2016, available at <http://warontherocks.com/2016/06/tomorrow-never-comes-neglecting-the-nuclear-force/>.

³⁵ At a briefing on March 7, 2016, Secretary of the Air Force Deborah Lee James stated, "If there is to be a fund for nuclear modernization, it seems to me appropriate that it be for all three legs of the triad and not just for one leg of the triad. So if indeed that is the approach that is selected, it seems to me that ought to be a joint fund." Secretary James also testified in March 2016, "If [there] is a strategic deterrence fund that would help or benefit one leg of the triad, I would ask for consideration that all legs of the triad be included in such an approach." "Department of Defense Press Briefing by Secretary James and Gen. Welsh on the current state of the Air Force in the Pentagon Briefing Room," *Defense.gov*, March 7, 2016, available at <http://www.defense.gov/News/News-Transcripts/Transcript-View/Article/688118/department-of-defense-press-briefing-by-secretary-james-and-gen-welsh-on-the-cu>. Also see Lara Seligman, "Air Force Asks Congress for Strategic Deterrence Fund for B-21 Bomber, GBSD," *Defense News*, March 16, 2016, available at <http://www.defensenews.com/story/defense/air-space/2016/03/16/air-force-asks-congress-strategic-deterrence-fund-b-21-gbsd/81863166/>.

³⁶ See testimony of Eric J. Labs, Congressional Budget Office, "An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan," 114th U.S. Congress, House Armed Services Subcommittee on Seapower and Projection Forces, December 1, 2015, p. 25, available at <https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50981-ShipbuildingTestimony.pdf>.

³⁷ For a critical assessment of this approach, see Ryan Alexander, "Sink the Navy's Submarine Slush Fund," *U.S. News and World Report*, December 9, 2015, available at <http://www.usnews.com/opinion/economic-intelligence/2015/12/09/sink-the-navys-sea-based-deterrance-fund>.

³⁸ See comments of Lt. Gen. Trey Obering (USAF, Ret.), former Director of the Missile Defense Agency, "The Missile Defense Agency and the Color of Money: Fewer Resources, More Responsibility, and a Growing Budget Squeeze," *Center for Strategic and International Studies*, July 29, 2016, available at https://csis-prod.s3.amazonaws.com/s3fs-public/event/160729_CSIS_Color_Money_Transcript.pdf.

³⁹ See for example, various 2001 and 2002 DoD policy and program memoranda from Secretary of Defense Donald Rumsfeld and Under Secretary of Defense (Acquisition, Technology, and Logistics) Pete Aldridge, available at <http://library.rumsfeld.com/doclib/sp/2477/2002-01-02%20to%20Deputy%20Secretary%20of%20Defense%20et%20al%20re%20Missile%20Defense%20Program%20Direction%20with%20Attachments.pdf>.

⁴⁰ For example, in August 2016, an Advisory Panel on Streamlining and Codifying Acquisition Regulations was created by DoD with the goal of identifying changes to existing DoD acquisition processes. See Aaron Mehta, "DoD Launches Acquisition Regulations Advisory Panel," *Defense News*, August 30, 2016, available at <http://www.defensenews.com/articles/dod-launches-acquisition-regulations-advisory-panel>.

⁴¹ Larry D. Welch and John C. Harvey Jr., *Independent Review of the Department of Defense Nuclear Enterprise* (Washington, DC: Department of Defense, June 2, 2014), pp. 5, 10, available at <http://www.defense.gov/Portals/1/Documents/pubs/Independent-Nuclear-Enterprise-Review-Report-30-June-2014.pdf>.

⁴² Memorandum for the Secretary of Defense from Secretary of the Air Force Deborah Lee James, "Report on Nuclear Deterrence Mission," March 27, 2014.

⁴³ James R. Schlesinger, *Report of the Secretary of Defense Task Force on DoD Nuclear Weapons Management, Phase II: Review of the DoD Nuclear Mission* (Washington, DC: Department of Defense, December 2008), pp. iv, xii, available at <http://www.defense.gov/Portals/1/Documents/pubs/PhaseIIReportFinal.pdf>.

⁴⁴ Defense Science Board, *Report of the Defense Science Board Task Force on Nuclear Capabilities: Report Summary* (Washington, DC: Defense Science Board, December 2006), p. 2, available at <http://www.acq.osd.mil/dsb/reports/ADA459527.pdf>.

⁴⁵ Defense Science Board, *Report of the Defense Science Board Task Force on Nuclear Deterrence Skills* (Washington, DC: Defense Science Board, September 2008), p. 68, available at <http://www.acq.osd.mil/dsb/reports/ADA487983.pdf>.

⁴⁶ Carter, "Sustaining Nuclear Deterrence," op. cit.

⁴⁷ Deborah Lee James, "State of the Air Force," *AF.mil*, at the Air Force Association Air and Space Conference and Technology Exposition, September 15, 2014, available at http://www.af.mil/Portals/1/documents/af%20events/Speeches/15SEP2014-SecAF-Deborah-Lee-James-AFA-State%20of%20the%20AF_v2.pdf.

⁴⁸ Clark Murdock, Rebecca K.C. Hersman, Shanelle Van, *The Evolving U.S. Nuclear Narrative: Communicating the Rationale for the Role and Value of U.S. Nuclear Weapons, 1989 to Today* (Washington, DC: Center for Strategic and International Studies, October 2016), p. v, available at <https://csis-prod.s3.amazonaws.com/s3fs-public/public/publication/Evolving-US-Nuclear-Narrative.pdf>.

⁴⁹ Ibid., p. xii.

⁵⁰ Ibid., p. xii.

⁵¹ Ibid., p. viii.

Section XI. Declaratory Policy

Introduction

US declaratory policy should support the priority goals of deterrence and assurance, and contribute to the US flexibility and resilience critical for deterrence and assurance. US leaders need periodically to emphasize publicly the role of US nuclear forces to counter threats to the United States, its allies and partners. Official statements and speeches often are a primary means of communicating declaratory policy, but displays of power and exercises that involve the integration of strategic capabilities also can serve as forms of declaratory policy to enhance the credibility of US deterrence and assurance commitments.

In 2009, the bipartisan Strategic Posture Commission recommended to the then-new Obama Administration that it undertake a major review of US declaratory policy with the objectives of adding clarity and consistency to declaratory policies that had emerged in piecemeal fashion over many decades. In response, the administration reasserted traditional positive security assurances to allies, and traditional negative security assurances with a modification—the promise not to employ nuclear forces against countries “in good standing with their nuclear nonproliferation [NPT] obligations.” It did not adopt “no first use” and “sole purpose” formulations (the assertions, respectively, that the United States would escalate to nuclear employment *only* in response to nuclear attack, and that the sole purpose of US nuclear weapons is to deter nuclear attack). Implicit in both these formulations is that US nuclear capabilities have no role in deterring non-nuclear attacks against the vital interests of the United States and its allies.

Rather than adopting “no first use” or “sole purpose” as declaratory policies, the Obama Administration retained the traditional approach of calculated ambiguity regarding nuclear employment. Moving forward, US declaratory policy should emphasize continuity where possible, as this reinforces a consistent message from Washington and lends credibility to US threats and promises. It also should make changes where needed to support US flexibility and resilience. Several key issues stand out in this regard.

Sole Purpose

The Obama Administration’s rejection of a US sole purpose declaratory policy was appropriate and should be sustained. A number of conditions would have to be well-established to make this a plausibly prudent declaratory policy even in principle. Those conditions prominently include the elimination of chemical, biological, and conventional threats to the vital interests of the United States and its allies. However, as recent events in Syria and the annual arms control compliance reports to the Congress attest, chemical and biological threats remain. And, the conventional force balances in Northeast Asia and Europe are now not sufficient, and are unlikely to become sufficient, to eliminate the deterrence and assurance roles for US nuclear weapons. As a senior State Department official in the Obama Administration, Robert Einhorn emphasized regarding sole purpose, “allies and friends around the world... indicated to us that such a radical shift in US approach could be unsettling to them.”¹

No First Use

The time also has not arrived to adopt a declaratory policy of no first use. This issue was hotly debated in the waning months of the Obama Administration. Advocates argued that the deterrent threat of nuclear escalation is neither credible nor necessary. They see it as not credible because they cannot imagine a scenario in which the United States would be the first to escalate to nuclear use. They see it as unnecessary, asserting that US conventional forces are sufficient to deter any regional aggressor. In addition, they see the views of US allies opposed to US adoption of a no-first-use policy as unnecessarily constraining the United States and assert that over time “they’ll come around.” Moreover, they argue that adopting no first use would reinforce the nonproliferation regime at a time of mounting concern about whether it will survive the 2020 NPT review conference (which will be the 50th anniversary of its entry into force and the 25th anniversary of its indefinite extension).

These arguments are fundamentally flawed and unpersuasive. First, US nuclear deterrence threats can be credible if vital US and allied interests are at stake, and there are plausible scenarios in Europe, Northeast Asia and elsewhere wherein such stakes could be at risk. In addition, US conventional forces are potent, but nuclear deterrence of non-nuclear attack remains essential. US conventional forces must be amassed, often from great distance, and then must defeat enemy air defenses before gaining air supremacy—processes that may be in doubt in some cases, and could take many weeks or months, a time during which US allies could be highly vulnerable. Correspondingly, the views of key US allies in strong opposition to a US no-first-use declaratory policy must not be dismissed given the importance of assurance as a primary US nuclear policy objective.² As the Strategic Posture Commission concluded in its 2009 report, abandoning the long-standing US policy of calculated ambiguity in favor of no first use would be unsettling to some allies and could undermine deterrence.³ Calculated ambiguity remains the more prudent approach.

While the United States should not adopt no-first-use or sole purpose declaratory policies, it should consider greater specificity and clarity regarding its declaratory nuclear policy in some cases. US declaratory policy has emphasized calculated ambiguity since the end of the Cold War. However, in the face of Russia’s “escalate-to-de-escalate” concept and China’s increasing military power, more specific nuclear threats may be needed to strengthen deterrence and assurance in some contingencies. This will involve the United States (and NATO) more clearly conveying that it has implementable nuclear deterrent options at its preferred levels of escalation, and that those levels of threatened US escalation most likely to counter Russian and Chinese escalation threats and strategies must be communicated. This need not necessarily entail a change to the core policy of “calculated ambiguity,” but would suggest the possible value for more specific discussion of US/NATO targeting plans and options, publicizing of exercises, and other forms of declaratory policy. The purpose of such efforts would be to make clear that the United States has a spectrum of credible nuclear deterrent options that make it simply too dangerous or costly for any opponent to engage in nuclear coercion, nuclear-backed aggression, or nuclear escalation, even in the most trying of circumstances.

De-Alerting and Launch Under Attack

A common criticism of US nuclear forces is that they are on “hair-trigger alert,” thus increasing the risk of mistaken or accidental launches and, by extension, nuclear war. By announcing the de-alerting of US ICBMs and SLBMs (the bomber force has been off day-to-day alert since the end of the Cold War), some commentators claim that the United States would reduce the chance of accidental war, expand presidential decision-making time, increase strategic stability, and promote transparency.⁴

But this critique and purported benefits were not endorsed by previous NPRs. The danger of accidental launch by US forces is extremely remote; modern command and control systems have proven themselves quite robust in comparison to the earlier systems. In addition, US missiles have been assigned wide area ocean targeting, thus moderating the prospective consequences of an accidental launch. There is also a significant potential deterrence cost of standing down the ICBMs, thereby lowering the threshold at which a country might contemplate a first strike on the US homeland and the potential consequences of such a strike. Moreover, at least one country (Russia) has the ability to launch a major attack on the United States with little or no strategic warning and another (China) is moving toward such a capability—thus underscoring the importance of alert forces.

In addition, US nuclear forces simply are not on “hair-trigger alert.” The term “hair-trigger” implies a system that could send a “launch order” at the slightest shock or clumsy movement. However, the US nuclear command and control system “employs multiple, rigorous and redundant technical and procedural safeguards to protect against accidental or unauthorized launch” as a US State Department fact sheet shows.⁵ Indeed, there is a “carefully designed combination of technical and procedural measures [which] ensures only the President of the United States can authorize the use of US nuclear weapons.”⁶ It is a *non sequitur* that because US nuclear weapons reportedly can be launched within minutes of a verified presidential order the command and control system is on a “hair-trigger” and susceptible to accidental or unauthorized launches.

In contrast to de-alerting proponents’ assertions, de-alerting the US nuclear force would likely not improve stability during a crisis or increase the president’s decision-making time. US State Department fact sheets indicate the Obama Administration concluded that “de-alerting would be very difficult to verify; even if verifiable, further de-alerting would be destabilizing in a crisis as sides raced to ‘re-alert.’”⁷ The 2010 NPR elaborates further: “such steps could reduce crisis stability by giving an adversary the incentive to attack before ‘re-alerting’ was complete.”⁸ In addition, the Obama Administration concluded that de-alerting would not increase presidential decision-making time, stating that the “time is not determined by our force posture, but rather by the promptness of the weapons system employed by the adversary. Therefore, de-alerting doesn’t create more time to decide, it eliminates it.”⁹

In conjunction with de-alerting proposals, some advocate eliminating US capabilities and options for “launch under attack” scenarios. Under these scenarios, the United States would detect and confirm attack indicators and retain the ability to launch its nuclear weapons to avoid potentially losing them in the attack. Many commentators conflate the option of “launch under attack” with a “launch on warning” doctrine. As the US State Department wrote recently:

A launch under attack option is not the same as a launch on warning doctrine. There are two fundamental differences.

- First, a launch under attack decisions [sic] is not based solely on a single warning indicator. It is informed by an attack assessment that considers and confirms warning information from multiple, independent sensors. An attack also considers the apparent intent of the incoming attack in the context of the international situation.
- Second, the President does not have to launch under attack. Our current day-to-day posture ensures the President does not face a ‘use it or lose it’ situation, which he could if our forces were de-alerted. Our command and control system and submarines at sea would survive a surprise attack and enable a devastating response. The decision to launch under attack is a choice, not an imperative.¹⁰

The United States does not have a launch on warning doctrine; it retains but does not rely on a launch under attack option.¹¹

The 2013 unclassified Nuclear Employment Strategy also stated, “Recognizing the significantly diminished possibility of a disarming surprise nuclear attack, the guidance directs DoD to examine further options to reduce the role of Launch Under Attack plays [sic] in U.S. planning, while retaining the ability to Launch Under Attack if directed.”¹² Significantly, the 2010 NPR recommended exploring “new modes of ICBM basing” as a means of reducing reliance on “launch under attack options” for survivability.¹³

No “New” Nuclear Capabilities

Another area for which greater clarity and specificity over US policy would be helpful is the US policy regarding “new nuclear capabilities” and the deliberate, periodic exercising of skills needed to design, develop, produce, and certify nuclear warheads. As discussed in Section VI, all three post-Cold War administrations have supported—explicitly or implicitly—maintaining skills and processes needed to develop and produce nuclear warheads. Since the end of the Cold War, the policies associated with new nuclear capabilities have varied from administration to administration with differing degrees of clarity. For example:

- During the William J. Clinton Administration, the stated policy was that the United States would maintain the capability to design new weapons.¹⁴ However, studies on possible new nuclear capabilities were terminated and, as a result of the PLYWD Law, discussed earlier, nuclear warhead design activities were mostly inactive. The only warhead development-related activity by the United States that was completed and deployed was a relatively minor modification to a then-existing nuclear gravity bomb (the B61 Mod7) to develop the B61 Mod11 earth penetrating weapon. The B61-11 program was undertaken to enable the retirement of an extremely old type of nuclear gravity bomb (the B53) without loss of significant military capability.¹⁵ With all significant development idle, many critical skills fell inactive.
- During the George W. Bush Administration, significant reductions in the strategic nuclear force were accompanied by a hedge policy of maintaining a nuclear infrastructure that was responsive to emerging needs. In fact, a “responsive infrastructure” was listed as one of the three legs of a new strategic triad. For the NNSA, readiness metrics were established for certain types of stockpile-related tasks. For example, the stated goal for readiness to

design, develop, and produce a small build of prototype nuclear weapons was five years.¹⁶ To keep critical nuclear skills sharp, a program of studies and prototyping was initiated—the Advanced Concepts Initiative (ACI). The ACI, however, was unpopular with some members of the relevant congressional committees and never achieved its intended potential. The Bush Administration also initiated the development of the Reliable Replacement Warhead (RRW)—a reliability replacement for the W76 warhead carried on Trident II missiles. However, Congress withheld funding for the RRW (and, soon after taking office, the Obama Administration abandoned this program). Skills atrophied further. In fact, in 2008, Secretary of Defense Robert Gates and Secretary of Energy Samuel Bodman reported jointly to Congress that, “the United States does not have the ability to produce new nuclear weapons.”¹⁷

Both the Clinton and Bush Administrations explicitly supported maintaining nuclear design and development capabilities and were willing to embark on programs to sustain critical skills. The Obama Administration’s policy was to modernize infrastructure capabilities, but to eschew any new warhead development.

At present, there appears to be some confusion over the US policy regarding “new nuclear capabilities.” Some Obama Administration officials emphasized that the administration would not develop any new nuclear capabilities, and added that no requirement for new capabilities existed—all requirements could be met via warhead life extension programs.¹⁸ However, other senior officials emphasized that if a need for a new nuclear capability arose, that need would be addressed.¹⁹

The 2017 NPR should consider making clear, including as part of declaratory policy, that the United States will maintain the capabilities needed to design, develop, produce, certify and, if necessary, deploy nuclear warheads in support of national deterrence and assurance goals. Furthermore, the United States should routinely exercise those skills and capabilities in order to maintain critical skills, provide greater adaptability, train the next generation of specialists, and identify any existing shortfalls in development or production capabilities. In fact, much of such a policy statement appears to have bipartisan support and currently is mandated by public law.²⁰ (Section VI, Part II above discusses in some detail the existing atrophy in critical skills and infrastructure shortfalls.)

All nuclear weapons and warheads in the existing US arsenal were designed in the 1970s and 1980s. While some have been life-extended, there is no *prima facie* reason to believe that these weapons would be sufficient to support deterrence and assurance goals for the 21st century. The nuclear-armed adversaries to be deterred are more diverse than during the Cold War, leaderships are different, and the goals of potential adversaries, as well as the stakes involved, have changed. And, these trends appear to be continuing.

Consequently, new or additional capabilities may be needed in the years ahead to deter adversaries, assure allies and limit escalation. The United States needs to be ready to respond to various future needs and should work deliberately to reverse the atrophy of critical skills at the nuclear laboratories and production plants. A policy of no-new-nuclear capabilities makes no sense in an environment in which Russia, China, North Korea, and others have been and are continuing to develop and deploy new types of nuclear weapons. The United States should,

instead, state clearly its policy of improving, maintaining and exercising nuclear development and production skills and processes.

By clarifying this issue as part of US declaratory policy, assurance would likely be served as allies would have tangible evidence of US long-term commitments to capabilities important for extended nuclear deterrence. The deterrence of adversaries would be served by the resultant manifest readiness of the United States to respond to potential challenges. Furthermore, unproductive arguments in technical and policy journals of the semantics over “what constitutes a new nuclear capability” would be avoided and rendered moot.²¹

Summary Conclusion

Declaratory policy remains a vital component of nuclear deterrence and assurance goals. It should contribute to, not limit, US adaptability. Current US declaratory policy is appropriate to today’s security environment and does not require significant overhaul. However, consideration should be given to greater specificity and manifest allied cohesion regarding deterrence signaling, and the clear demonstration of US intent to maintain its nuclear capabilities into the future.

¹ Robert Einhorn as quoted in, U.S. Department of Defense, *Foreign Press Center Briefing with Dr. James Miller, Principal Deputy Undersecretary of Defense Policy; Thomas P. D’Agostino, Undersecretary for Nuclear Security & Administrator, National Nuclear Security Administration; and Robert J. Einhorn, Special Advisor, Nonproliferation and Arms Control, Department of State* (Washington, DC: Department of Defense, April 7, 2010), p. 4, available at http://archive.defense.gov/npr/docs/FPC%20_4-7-10_%20Nuclear%20Posture%20Review.pdf.

² Josh Rogin, “U.S. allies unite to block Obama’s nuclear ‘legacy,’” *The Washington Post*, August 14, 2016, available at https://www.washingtonpost.com/opinions/global-opinions/allies-unite-to-block-an-obama-legacy/2016/08/14/cdb8d8e4-60b9-11e6-8e45-477372e89d78_story.html?utm_term=.f45eb053a24e.

³ 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: United States Institute of Peace Press, 2009), p. 36.

⁴ For a summary of these arguments, see: James E. Cartwright, et al., *De-Alerting and Stabilizing the World’s Nuclear Force Postures* (Washington, DC: Global Zero, April 2015), available at http://www.globalzero.org/files/global_zero_commission_on_nuclear_risk_reduction_report_0.pdf.

⁵ U.S. State Department, “Myths and Facts Regarding the Nuclear Non-Proliferation Treaty and Regime,” *State.gov*, April 14, 2015, available at <http://state.gov/t/isn/rls/fs/2015/240650.htm>.

⁶ U.S. State Department, “U.S. Nuclear Force Posture and De-Alerting,” *State.gov*, December 14, 2015, available at <http://www.state.gov/t/avc/rls/250644.htm>.

⁷ Ibid.

⁸ U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, DC: Department of Defense, April 2010), p. 26, available at https://www.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf.

⁹ U.S. State Department, “U.S. Nuclear Force Posture and De-Alerting,” op. cit.

¹⁰ Ibid.

¹¹ Ibid.

¹² U.S. Department of Defense, *Report on Nuclear Employment Strategy of the United States* (Washington, DC: Department of Defense, June 2013), p. 5, available at https://www.defense.gov/Portals/1/Documents/pubs/ReporttoCongressonUSNuclearEmploymentStrategy_Section49_1.pdf.

¹³ U.S. Department of Defense, *Nuclear Posture Review Report*, 2010, op. cit., p. x.

¹⁴ Walter B. Slocombe, Under Secretary of Defense for Policy, Department of Defense, "The Future of Nuclear Deterrence," 105th U.S. Congress, Senate Subcommittee on International Security, Proliferation, and Federal Services and the Committee on Governmental Affairs, February 12, 1997 available at <http://www.gpo.gov/fdsys/pkg/CHRG-105shrg38379/html/CHRG-105shrg38379.htm>.

¹⁵ U.S. Secretaries of Defense and Energy, *Report to Congress on the Defeat of Hard and Deeply Buried Targets*, (Washington, D.C.: Department of Defense, July 2001); See also, Jonathan Medalia, *Nuclear Earth Penetrator Weapons* (Washington, DC: Congressional Research Service, January 27, 2003), available at <https://fas.org/sgp/crs/nuke/RS20834.pdf>.

¹⁶ John Gordon, Under Secretary of Energy for Security and Administrator, National Nuclear Security Administration, Department of Energy, Prepared Statement for the Senate Armed Services, February 14, 2002.

¹⁷ Secretary of Defense Robert M. Gates and Secretary of Energy Samuel W. Bodman, *National Security and Nuclear Weapons in the 21st Century* (Washington, DC: Department of Defense, September 2008), p. 12, available at <http://archive.defense.gov/news/nuclearweaponspolicy.pdf>.

¹⁸ "DOD News Briefing with Secretary Gates, Navy Adm. Mullen, Secretary Clinton, and Secretary Chu," *Defense.gov*, April 6, 2010, available at <http://archive.defense.gov/transcripts/transcript.aspx?transcriptid=4599>.

¹⁹ James Cartwright, Vice Chairman of the Joint Chiefs of Staff, "Council on Foreign Relations Meeting," *Defense.gov*, April 8, 2010, available at http://archive.defense.gov/npr/docs/Council_on_Foreign_Relation.pdf.

²⁰ U.S. Code, Title 50, Chapter 42, Subchapter II, Part A, paragraph 2538b.

²¹ For example, Len Ackland and Burt Hubbard, "U.S. Nuclear Bomb: New or Improved?" *Daily Camera News.com*, July 18, 2015, available at http://www.dailycamera.com/news/ci_28504114/u-s-nuclear-bomb-new-or-improved. Also, Hans M. Kristensen, "General Confirms Enhanced Targeting Capabilities of B61-12 Nuclear Bomb," *FAS.org*, January 23, 2014, available at <http://blogs.fas.org/security/2014/01/b61capability/#more-6201>.

Section XII. Arms Control and US Goals in the New Threat Environment Context

Introduction

As discussed at length above, the characteristics of US nuclear forces and supporting infrastructure can be critical for deterrence, assurance and limiting damage by enabling the United States to adapt in a timely manner to changing geopolitical and technological challenges. Arms control policy, in turn, can affect US capabilities in various ways and should be formulated to facilitate adaptability rather than to impose impediments that undercut the US priority goals of deterrence, assurance and defense. It should be noted that previous NPRs, including the 2010 NPR, emphasized that arms control should contribute to US deterrence and assurance goals.

Arms Control Policies for Adaptability

Arms control policy should seek to support the deterrence of war, assurance of allies, and US defensive goals if deterrence fails. It can do so by preserving and advancing US options and capabilities that contribute to greater adaptability in the face of change and possibly also by promoting transparency. This should be a primary guideline for US arms control policies. Future US arms control policy should be designed to preserve or advance adaptability for US strategic capabilities, in general, and the US nuclear force, in particular.

The 2002 Moscow Treaty, for example, helped do so to some extent by preserving freedom of the number of strategic launchers and by establishing a range, vice a specific ceiling, for US and Russian operationally-deployed strategic warheads (1,700-2,200). Both provisions helped to preserve the US capability to adjust and reconstitute forces in the future, if necessary.

In addition, future US arms control efforts should be made in close consultation with allies and partners because US assurance goals must inform US arms control initiatives, negotiations and agreements. Indeed, allied interests may be significantly involved in US arms control efforts, as is demonstrated in the case of Russia's recent deployment of ground launched cruise missiles (GLCMs) in violation of the INF Treaty.¹ As the Polish Ministry of Foreign Affairs noted in 2014, Russia's noncompliance poses "a serious challenge to Europe's security."² It is important that US arms control steps help rectify, or at least not create or codify, capability or credibility gaps that disadvantage US deterrence and assurance strategies, and instead advance those goals. As the 2010 NPR rightly noted, "...large disparities in nuclear capabilities could raise concerns on both sides and among U.S. allies and partners..."³ It is important in this regard to recognize the existing large disparity in Russia's favor in the number of non-strategic nuclear weapons.

The US-Russian Arms Control Context

The United States has made significant reductions in all types of nuclear weapons, especially over the quarter-century since the height of the Cold War. Active and inactive US nuclear warheads declined by 85 percent, from their 1967 peak of 31,255 to 4,571 at the end of FY 2015.

The pace of those reductions was dramatic during the two Bush Administrations. The warhead stockpile fell by over 5,000 (50 percent) in the eight years of the George W. Bush Administration, and by over 8,500 (40 percent) in the four years under George H.W. Bush. The stockpile declined by 934 warheads in the Clinton Administration and 542 in the first seven years of the Obama Administration.⁴

Under the September 1991 PNI, the United States eliminated all of its ground-launched, and half of its sea-launched, nonstrategic nuclear delivery vehicles. The remaining nuclear sea-launched cruise missiles were eliminated pursuant to the 2010 NPR. In October 1991, the NATO Nuclear Planning Group decided to reduce air-delivered nonstrategic weapons, reportedly by one-half.⁵ Public estimates are that the current number of deployed nonstrategic US nuclear warheads is 180 (all in Europe), with another 320 in central storage.⁶

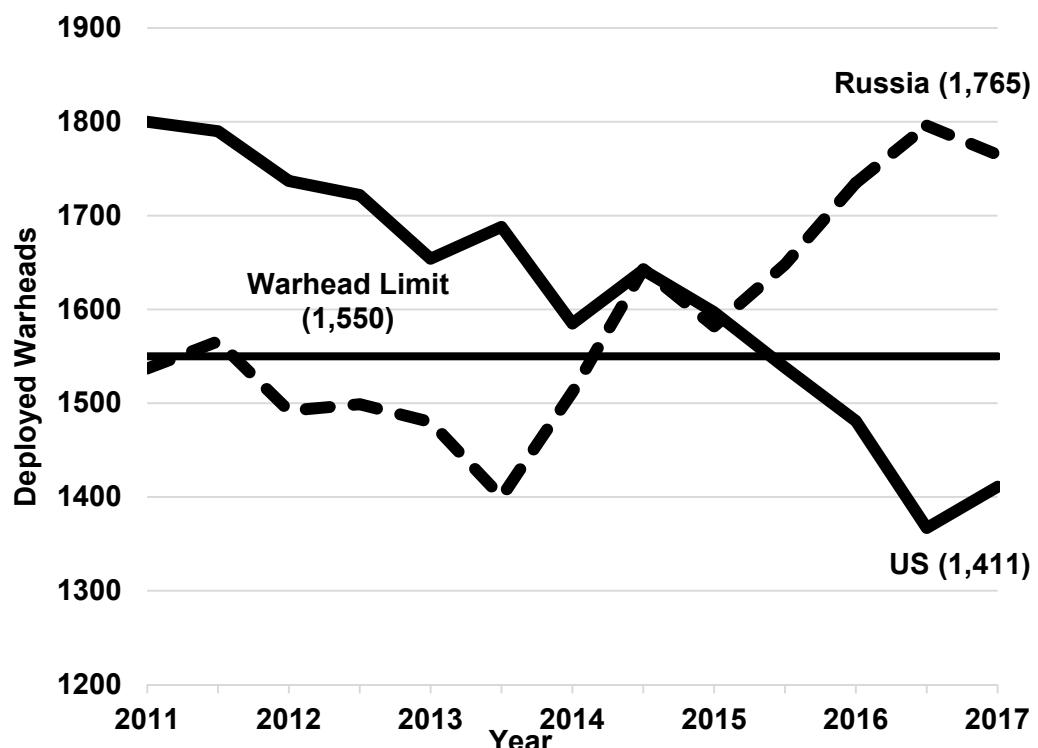
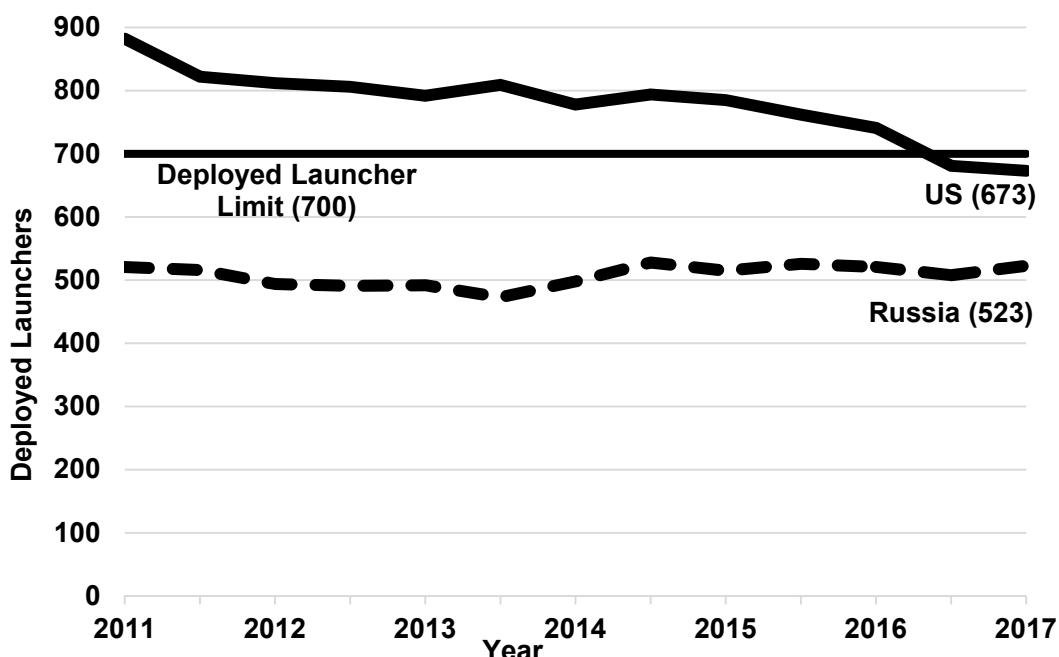
Unlike the United States, Russia has not released any data on its nuclear warhead stockpile. Public estimates are that Russia has a total of approximately 4,500 deployed and nondeployed warheads—including 2,000 nonstrategic in storage, and another 2,800 strategic and nonstrategic warheads awaiting dismantlement.⁷ Russian nonstrategic warheads may be in storage, but that could simply mean that they are stored at operational bases.

Some observers consider these estimates far too low. For example, the Congressional Commission on the Strategic Posture of the United States reported in 2009 that Russia had 3,800 operational nonstrategic warheads, with an unspecified number in reserve and awaiting dismantlement.⁸ Some observers believe that the Strategic Posture Commission estimate itself is now too low, given heightened Russian emphasis in the intervening years on nonstrategic forces, including the deployment of a nuclear-capable cruise missile in violation of the INF Treaty.

Far from being a good arms control partner, Russia under Putin has violated numerous legally-and politically-binding commitments, including the PNIs, the INF Treaty, the Budapest Declaration, and possibly the Biological and Chemical Weapons Conventions. Its violations of the PNIs and the INF Treaty have enabled it to present a steadily growing nonstrategic threat to US friends and allies in Europe and increasingly in Asia. Russian disregard of the 1994 Budapest Declaration's pledge to respect Ukrainian sovereignty and territorial integrity may carry a lesson for its other neighbors, including some NATO allies.⁹ Russia has also ended most cooperative security-related programs with the West, most recently the plutonium reduction agreement.

New START Treaty

The 2010 US-Russian New START Treaty has governed the following numeric changes in US and Russian accountable strategic nuclear forces, as seen in Figures 5 and 6 below. It established a ceiling for deployed strategic warheads that is roughly compatible with the low end of the range in the 2002 Moscow Treaty, 1,550 warheads. It also imposed significant reductions and limits on the number of accountable deployed launchers. This ceiling of 700 deployed launchers and 800 total deployed plus non-deployed launchers requires significant US reductions by 2018. Based on the initial data exchange between the United States and Russia, the United States will have to reduce by 182 the number of launchers deployed at the time for SLBMs, ICBMs, and heavy bombers and 324 launchers overall (deployed plus non-deployed).¹⁰

Figure 5: New START Counted Warheads**Figure 6: New START Counted Deployed Launchers**

Source for Figure 5 and Figure 6: US State Department data available at
<https://www.state.gov/t/avc/newstart/269406.htm>. Last accessed April 1, 2017.

Regarding subsequent negotiated reductions following the New START Treaty, the 2010 NPR announced that the president had directed a review of future arms control objectives and that:

Any future nuclear reductions must continue to strengthen deterrence of potential regional adversaries, strategic stability *vis-à-vis* Russia and China, and assurance of our allies and partners. This will require an updated assessment of deterrence requirements; further improvements in U.S., allied and partner non-nuclear capabilities; focused reductions in strategic and non-strategic weapons; and close consultations with allies and partners.¹¹

In June 2013, President Obama announced that the United States was prepared for further reductions—"up to one-third"—in the number of deployed US nuclear weapons.¹² Senior Obama Administration officials continued to press for this initiative through November 2016, and declared that "the United States remains committed to reducing the numbers of nuclear weapons in the world and the role they play in our security."¹³ Senior Russian officials, however, reacted immediately and negatively at the time, announcing a series of unacceptable preconditions required even to begin negotiations. Those included prior withdrawal of the remaining US nuclear forces from Europe, and expanding negotiations to include other states' nuclear forces, as well as limits on missile defenses and advanced conventional weapons. In short, Russian officials show no serious interest in further, reasonable arms control measures at this point.

US Nuclear Weapons and Nonproliferation

An assumption shaping US nuclear policy for many years has been that the United States should pursue the reduction of the salience and numbers of US nuclear forces to promote nuclear nonproliferation. For example, the 2010 NPR stated that nuclear arms reductions could help discourage proliferation by others: "By working to reduce the salience of nuclear weapons in international affairs and moving step-by-step toward eliminating them, we can reverse the growing expectation that we are destined to live in a world with more nuclear-armed states, and decrease incentives for additional countries to hedge against an uncertain future by pursuing nuclear options of their own."¹⁴ This linkage of progressive US nuclear reductions to the success of nonproliferation efforts has had a significant impact on US nuclear policy.

Those who posit a link between the US nuclear arsenal and the proliferation decisions of other states make two sets of claims about how US nuclear weapons affect the spread of nuclear weapons globally.¹⁵ First, they argue that the US nuclear posture has a direct effect on states considering nuclear weapons programs themselves. Second, they maintain that US nuclear weapons have an indirect effect by shaping the US ability to achieve international cooperation on global nonproliferation efforts.

For example, proponents of a US nuclear weapons-nonproliferation link maintain that the possession of a large nuclear force by the United States will encourage other countries to build nuclear weapons. Focusing on formal international institutions, they argue that the 1968 NPT Treaty enshrines into international law a link between US nuclear weapons and nonproliferation. They claim that a grand bargain of the NPT is the promise by nonnuclear weapons states not to acquire nuclear weapons in exchange for the nuclear weapons states' pledge in Article VI "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race and nuclear disarmament."¹⁶ According to then-President Obama, "The basic bargain is

sound: countries with nuclear weapons will move toward disarmament, countries without nuclear weapons will not acquire them.”¹⁷ Therefore, these analysts conclude, in order to strengthen the NPT, the United States must make continuing visible progress on its Article VI commitments through nuclear reductions. If it does not, they argue, then the NPT will be weakened and nonnuclear states will reconsider their options regarding nuclear weapons.

The United States often seeks international cooperation to bring international pressure to bear on proliferators and prevent nuclear proliferation. It is argued that a manifest commitment to maintain its nuclear capabilities would reduce its ability to secure international nonproliferation cooperation. In Article I of the NPT, states pledge, “not in any way to assist, encourage, or induce any non-nuclear weapon State to manufacture or otherwise acquire nuclear weapons.”¹⁸ The argument in this regard is that if the United States is not seen to be honoring its Article VI commitments, other states might be less likely to maintain cooperation against proliferation through strict adherence to Article I.

However, claims that the United States is not honoring its NPT obligations lack credibility. The obligation they cite in Article VI of the NPT applies to every *party* to the Treaty, not just to the P-5 states, and certainly not exclusively to the United States. It states, “Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament under strict and effective international control.”¹⁹ Since the adoption of the NPT, there has not been a serious negotiation concerning general and complete disarmament, while the United States was the only member of the P-5 to have fewer nuclear weapons at the end of the Cold War than it had when the NPT was adopted and, as noted above, has reduced its nuclear arsenal deeply since the end of the Cold War.²⁰

Another corresponding claim is that the United States can shape international norms about the value and desirability of nuclear weapons through its own nuclear policy. US claims for additional nuclear weapons for its security may lead other states to conclude that nuclear weapons are desirable and that they too need nuclear weapons to remain secure. And, if the United States maintains a large nuclear arsenal to provide for its own security, it will be perceived as hypocritical in its nonproliferation efforts. The frequent claim is, “We don’t have a lot of moral authority to argue [for nonproliferation] when we aren’t doing it.”²¹ If, on the other hand, the United States deemphasizes nuclear weapons in its policy, then other nations will view nuclear weapons as less valuable and will be less likely to pursue them.

As evidence of these claimed linkages between US nuclear reductions and nonproliferation, proponents generally cite the statements of foreign diplomats who maintain that their countries’ reluctance to adopt tougher nonproliferation measures is the result of Washington’s failure to make greater progress on its Article VI commitments. This claim, however, ignores the fact that other states, not the United States, are increasing their nuclear forces, and some are making overt nuclear threats. As then-Secretary of Defense Ashton Carter pointed out, US nuclear modernization programs are:

...not intended to stimulate competition from anyone else, we know they aren't having that effect because the evidence is to the contrary. After all, as I said earlier, we didn't build anything new for the last 25 years. But others did, including Russia, North Korea, China, India, Pakistan and for a period of time, Iran, where our allies around the world, in Asia,

the Middle East, and NATO, did not. And our allies are not creating new types of nuclear weapons either, that some nations are, unfortunately, doing. So this is about maintaining deterrence in a world very different from the Cold War.²²

Fallacies of the Asserted US Nuclear Weapons-Nonproliferation Link

When deciding whether to initiate a nuclear weapons program, foreign leaders consider a variety of security, economic, and political factors. As such, US nuclear forces and extended nuclear deterrence contribute to nonproliferation among allies.

There is little logic or evidence to conclude that reductions in the US nuclear arsenal serve to limit nuclear proliferation or will do so. Existing scholarly studies on why countries explore, pursue, and acquire nuclear weapons have examined the role played by: security threats, domestic politics, and international norms;²³ levels of economic development;²⁴ the receipt of sensitive nuclear assistance;²⁵ civilian nuclear cooperation agreements;²⁶ economic development strategies;²⁷ proliferation rings;²⁸ state institutions;²⁹ and, the psychology of individual leaders.³⁰ However, despite decades of research and numerous identified causes other than the positive linkage of US nuclear forces to the assurance of allies, academic analyses have not found any serious evidence supporting the claim that the size or direction of the US nuclear arsenal is an important determinant of nuclear proliferation.

There is no evidence, for example, to suggest that foreign leaders would be more likely to build nuclear weapons if the United States possessed the 2,200 accountable strategic nuclear weapons permitted under the 2002 Moscow Treaty, the 1,550 accountable nuclear warheads as agreed to in the 2010 New START Treaty, or the approximately 1,000 nuclear warheads President Obama proposed in the summer of 2013. For the vast majority of states in the international system, threat perceptions are much more likely to be determined by the capabilities of regional rivals.³¹ Moreover, even states that feel directly threatened by the United States are more likely to confront, and therefore fear, America's conventional, as opposed to its nuclear, capabilities.³²

In short, beyond the potential linkage to proliferation among US allies dependent on extended deterrence, the US nuclear posture is likely a peripheral, if not completely irrelevant, consideration in other states' proliferation decisions.

There is a smaller, but growing body of literature on the determinants of states' policies regarding nonproliferation. The general question is why states vary in the degree to which they are willing to cooperate to help or hinder nuclear programs in other states—such as whether they provide sensitive nuclear assistance to a proliferator,³³ or whether they consider military action to stop the spread of nuclear weapons.³⁴ Again, the frequent claim by disarmament activists and some senior officials is that reductions in the number and role of US nuclear weapons are necessary to establish the international norm against nuclear proliferation around which the international community will rally.

Yet, varying policies toward proliferators have been attributed to: the political relationship between the state and the proliferator;³⁵ a state's ability to project conventional military power over the proliferator;³⁶ the existence of common enemies with the proliferator;³⁷ and, the history of past conflict with the proliferator.³⁸ As with the causes of nuclear proliferation, dedicated analyses have not found that the size of the US nuclear arsenal is a determinant of nuclear

nonproliferation policy. When one considers the panoply of factors that shape states' proliferation and nonproliferation policies, the details of US nuclear posture do not appear to be a decisive, or even relevant, determinant of their decisions regarding proliferation.

Evidence Against the Asserted US Nuclear Weapons-Nonproliferation Link

Rather than supporting the claim that US nuclear reductions contribute to nonproliferation, empirical evidence supports the notion that the character of the US nuclear arsenal does *not* contribute to nuclear proliferation. There reportedly are nine countries with nuclear weapons in the world today, but none appears to have acquired nuclear weapons because of the size of the US nuclear arsenal or because Washington did not do more to de-emphasize nuclear weapons. Careful examination of the histories of these countries' nuclear programs has identified several important motivators, including international security threats, but none of these histories points to a lack of US nuclear disarmament as a cause of nuclear proliferation.³⁹

In addition, the recent Iranian nuclear crisis also indicates that Iran's proliferation and nonproliferation decisions are driven by considerations other than the size or salience of the US nuclear arsenal.⁴⁰ Iran's nuclear program has been motivated by several factors, including a desire to deter direct security threats and to advance Iran's standing in the Middle East. Moreover, whatever limits Tehran places on the program occur in response to international pressure, not reductions in the US nuclear posture.

The international community was willing to increase sanctions on Iran in response to the growing threat posed by Iran's advancing nuclear program, not as a result of US nuclear reductions. Despite voluminous reporting on this issue, no serious scholarly examination has identified the size or character of the US nuclear posture as a salient driver of developments in Iranian nuclear decision making.

President Obama's director for Iran policy at the White House acknowledged that America's commitment to nuclear disarmament did not have a primary effect on diplomacy with Iran. Nitin Chadda, Director for Iran Affairs at the National Security Council from 2011 to 2015, explains, "our success in building an international coalition against Iran was primarily the result of our sustained commitment to a meaningful diplomatic process, which included a realistic and clearly articulated end state *vis-à-vis* Iran's nuclear program. We had also been greatly aided by the provocative nuclear behavior of the Iranians." When asked about the role of US nuclear weapons policy, he said that "the President's clear commitment to disarmament has been a helpful framing principle in multilateral settings, but, as it relates to Iran policy, while serving as an intellectual basis for the policy approach to Iran, it was secondary to these other more specific features that helped to sustain the international coalition."⁴¹

For years, arguments about a US nuclear weapons-nonproliferation link remained in the theoretical realm. However, systematic empirical examinations have examined the relationship between the size of the US nuclear arsenal and a variety of nuclear nonproliferation outcomes.⁴² Their conclusions reveal no evidence of a relationship between the size of the US arsenal and: the exploration, pursuit, or acquisition of nuclear weapons by other states; the provision of sensitive nuclear assistance to nonnuclear weapon states; and, voting on nonproliferation issues in the United Nations Security Council. Consistent with the factors identified above, there is much empirical evidence that a wide variety of security, economic, and political factors correlate with

the spread of nuclear weapons and with other states' nuclear nonproliferation policies. These findings are robust in dozens of statistical tests, including those that incorporate alternate conceptualizations and measurements of US nuclear weapons in various time periods, including the Cold War and more recently.

These findings do not definitively prove that there is no link between US nuclear weapons and other states' proliferation and nonproliferation policies (no methodology, statistical or otherwise, can do that), but they do demonstrate that, if there is a link, it is not discernible in dozens of straightforward tests of the asserted linkage.

In sum, there is little, if any, quantitative or qualitative evidence in support of the frequently-asserted US nuclear weapons-nonproliferation link. The scant evidence that does exist, namely diplomatic complaints linking nonproliferation policy to a supposed lack of US progress on Article VI, does not appear to explain states' actual behavior. Rather, it appears that when foreign diplomats make these claims, they are rhetorical devices employed for self-serving reasons to rationalize why their governments are unwilling or unable to adopt tougher nonproliferation policies.

Why US Nuclear Weapons Strengthen Global Nonproliferation

As discussed above, for US allies reliant on the US extended nuclear deterrent, a credible US nuclear arsenal is not a cause for concern, but a source of reassurance. The 2010 NPR identified the importance of extended deterrence and allied assurance for nonproliferation, "by reassuring non-nuclear US allies and partners that their security interests can be protected without their own nuclear deterrent capabilities."⁴³

In a series of multilateral and bilateral treaties, including the NATO charter, Washington commits itself to come to the defense of over 30 allies in the event of armed attack. US nuclear capabilities, therefore, help prevent the spread of nuclear weapons among US allies, contributing to global nonproliferation efforts. There is systematic empirical evidence demonstrating that states under the US nuclear umbrella are less likely than others to explore, pursue, or acquire nuclear weapons.⁴⁴

Some contemporary leaders in allied countries have stated that if the credibility of the US security guarantee comes into question, they would be tempted to pursue independent deterrent capabilities, including nuclear.⁴⁵ Indeed, when the United States considers alterations to its posture that might weaken nuclear deterrence, such as retiring nuclear delivery systems or a "no-first-use" policy, US allies such as Japan and South Korea reportedly often express serious concern.⁴⁶

Furthermore, the international security environment is placing more, not fewer, demands on the US nuclear umbrella. Nuclear threats from existing US nuclear rivals—Russia, China and North Korea—are growing, including a Russian limited nuclear first-use policy. In this context, further US nuclear reductions may fuel further proliferation.

In sum, careful examination of the relationship between US nuclear weapons and nuclear proliferation reveals no evidence of a relationship between the size of the US nuclear arsenal and a variety of nuclear proliferation outcomes, including whether other states engage in nuclear

proliferation themselves or are willing to adopt policies designed to prevent the spread of nuclear weapons to additional countries. Arguments in favor of such a link are superficially persuasive, but collapse under careful scrutiny. Behavior on nuclear issues for most states is determined by calculations about how nuclear proliferation outcomes affect their interests more narrowly defined without reference to the US nuclear arsenal. The exception to this conclusion involves US allies; maintenance of a robust US nuclear arsenal deters enemy challenges and assures America's security partners and, therefore, helps to discourage nuclear proliferation.

Available evidence suggests that reductions in US nuclear force size will not have a meaningful impact on the proliferation behavior of other states and, if anything, could encourage allied nuclear proliferation. The United States is correct to recognize nuclear proliferation as a threat to international peace and security, but the long-standing drive to reduce US nuclear arms progressively as a means of advancing nonproliferation is contrary to available evidence and potentially dangerous.

Instead of focusing the US arms control agenda on further US nuclear reductions for nonproliferation purposes, the United States should instead emphasize proven approaches to minimizing and countering proliferation, such as extending credible nuclear deterrence to allies, denying other countries the technology required to produce nuclear weapons, addressing the actual factors that motivate countries to pursue nuclear weapons in the first place, and pursuing a variety of defensive measures to protect against proliferation.

Arms Control in the New Strategic Environment

The current international security environment presents the United States, allies and partners with a range of threats and challenges. When the Soviet Union dissolved in 1991, the United States and NATO worked to create a long-term partnership with Russia. After a decade of unprecedented cooperation in nuclear arms reductions and nonproliferation, the relationship deteriorated—although the change was not fully appreciated until Russia invaded Ukraine in early 2014. As discussed previously in detail, Russia has become an expansionist, hostile power, wielding large, modernized nuclear, conventional and nontraditional forces, and singling out the United States and NATO as its primary enemies.

Other nuclear threats are not as dramatic, but are nonetheless very serious and, in many cases, present existential dangers to US friends and allies. China is steadily expanding and modernizing its nuclear forces, and becoming increasingly aggressive toward its neighbors. North Korea is steadily expanding its nuclear and missile capabilities. Iran has the largest, most modern ballistic missiles in the Middle East and is able to resume a nuclear weapons program once the Joint Comprehensive Plan of Action (JCPOA) expires—or even earlier if it does not comply with that agreement. Some allies and partners may ultimately choose to reconsider nuclear weapons if they lose confidence in the US extended deterrent. Terrorist use of a nuclear or radiological weapon remains a prospective danger—one whose risk may be greater now that Russia has ended partnership with the United States on the security of nuclear weapons and material.

Therefore, the priority objectives underlying the contemporary approach to nuclear arms control must be to support effective, credible strategic and extended deterrence, the assurance of allies against Russian, North Korean and Chinese threats, and defense. As discussed above, these priority objectives require modernized, flexible and resilient nuclear delivery systems and a safe,

secure and effective nuclear warhead stockpile. They will also require homeland and regional missile defense to help counter proliferation threats to the United States and its allies.

These objectives foreclose the prioritization of far-term and likely implausible goals such as “nuclear zero,” and related contemporary United Nations initiatives to ban nuclear weapons, in US arms control policy. They do not, however, foreclose a US arms control agenda that might advance US adaptability, in addition to predictability and transparency measures. On the contrary, success in the pursuit of modernized, flexible and resilient forces may prove a strong incentive for Russia to work with the United States on agreements and endeavors—just as it did to a progressively greater extent in the last decades of the Soviet Union, culminating in the 1987 INF and 1991 START I Treaties. This point is well-illustrated by a comment on Russian arms control incentives by Col. Gen. Sergei Ivanov, then-Kremlin Chief of Staff. According to Ivanov, Russia has had little incentive for further nuclear arms control negotiations with the United States because: “When I hear our American partners say: ‘Let’s reduce something else,’ I would like to say to them: ‘Excuse me, but what we have is relatively new.’ They [United States] have not conducted any upgrades for a long time.”⁴⁷ This is an overstatement, but the Russian point is clear: as Winston Churchill and John F. Kennedy both emphasized, a state must arm if it expects to “parley.”

The INF experience is particularly illuminating in this regard. The Soviet Union walked out of the negotiations when NATO began deploying INF-range ballistic and cruise missiles in November 1983, assuming that would induce the United States to change course. When instead the United States and NATO held firm, the Soviets returned to the negotiating table in March 1985 and signed the INF Treaty in December 1987.

Following are several basic principles—building on the arms control objective of supporting the priority goals of deterrence, assurance and defense—that the United States should follow in pursuing any further nuclear arms reduction or limitation agreements.

Arms control must not be pursued for its own sake and/or necessarily as a step to the elimination of nuclear weapons, but instead to advance national goals by helping to secure the force characteristics of flexibility and resilience. By doing so, the US arms control agenda can correspondingly support the classic arms control goals set by Thomas Schelling and Morton Halperin over 50 years ago: to reduce the probability of war; to reduce the destruction of war; and, to minimize the cost of sustaining an effective deterrent and defense.⁴⁸ In contrast, arms reductions pursued in a misguided quest for nonproliferation, or for its own sake, could well prove counterproductive to these goals.

Further consideration of the arms control agenda should not be bound by the June 2013 US proposal for further negotiated bilateral reductions of up to one-third in deployed strategic warheads. The security environment pertaining to that initiative no longer exists; it has been replaced by a more dangerous security environment that again places great value on the modernization and adaptability of US nuclear forces.

If US-Russian nuclear arms control negotiations again become feasible, Russian nonstrategic nuclear forces must be included. In addition, if strategic nuclear delivery vehicles are included, so too must all actual and potential delivery vehicles, irrespective of either side’s known

deployment plans. For example, unlike in New START, any rail-mobile or air-delivered ICBMs must fall explicitly and unambiguously under any new agreement provisions.

Effective verification and enforcement are essential. As President Obama observed regarding compliance with agreements: “Rules must be binding. Violations must be punished. Words must mean something.”⁴⁹ Consequently, the US arms control agenda must insist on strict verification conditions and serious enforcement efforts when necessary. For example, Russia must return to compliance with the INF Treaty, dispel questions regarding New START implementation,⁵⁰ and fulfill its commitment to the PNIs. The United States must not consider new arms control steps with Russia as long as Russia remains in stark noncompliance with multiple existing agreements. Further negotiations while Russia violates existing agreements degrades the arms control process by teaching the lesson that there is no enforcement of agreements once successfully negotiated, and also sends a message of weakness to enemies and allies alike.

In the highly unlikely event that revived US-Russian cooperative arms control and verification programs are restored, even a return to the relatively strict START I verification provisions (as compared to the more recent New START Treaty verification provisions), may be inadequate because limitations on nonstrategic nuclear forces and warheads will require much more intrusive verification measures.

Indeed, the Defense Science Board’s 2014 report *Assessment of Nuclear Monitoring and Verification Technologies* notes the difficulty of verifying nonstrategic nuclear weapon agreements and states that such verification will require a “paradigm shift.” The assessment states, “Because of the increasing challenges of controlling, limiting, and stabilizing the global nuclear regime and the increasing difficulty of monitoring it, the Task Force believes that efforts beyond incremental improvements of traditional approaches to monitoring will be required.”⁵¹ The report goes on to state:

The technical approach for monitoring cannot continue to derive only from treaty and agreement dictates for ‘point’ compliance to the numbers and types formally agreed upon and geographically bounded. Proliferation in this future context is a continuous process for which persistent surveillance, tailored to the environment of concern, is needed. This leads to the need for a paradigm shift in which the boundaries are blurred between monitoring for compliance and monitoring for proliferation, between cooperative and unilateral measures. Monitoring will need to be continuous, adaptive, and continuously tested for its effectiveness against an array of differing, creative and adaptive proliferators.⁵²

Therefore, just as US nuclear forces must be adaptable to an unpredictable security environment, so too must US verification and enforcement efforts be adaptable to friendly and hostile compliance environments. Verification provisions without enforcement mean little in the context of a negotiating partner that cheats with seeming abandon.

In addition, the United States should not pursue unilateral, unilateral/reciprocal or nonbinding reduction commitments in the expectation of corresponding Russian behavior; the experience of Russian non-compliance with the PNIs must not be repeated.

Finally, the United States should avoid reestablishing treaty limits on missile defense.

Some might argue that these conditions would never be accepted by Russia and would prevent any new bilateral arms reduction agreement. In fact, however, they are more likely to work to prevent any future agreement contrary to US and allied interests. And, as discussed above, a strong US commitment to strengthen deterrence and assurance could help to persuade Russia that equitable, effective arms control is in its national security interest. Indeed, given the advanced state of Russian theater and strategic modernization programs, nothing less is likely to do so. As noted above, that was the US experience in the 1980s when, under President Reagan, a firm US and allied arms control stance and determination to maintain effective strategic and extended deterrence capabilities led eventually to the farthest-reaching nuclear arms control agreements in history. That experience should be the basis for any future expectations.

The opposite argument often is made, i.e., that US nuclear modernization programs are the primary motivation for others' arms racing. However, ample available evidence disputes this familiar claim. As former Secretary of Defense Carter concluded: "Those who suggest that the U.S. recapitalization is a major stimulus to other powers to build more do not have the evidence of the past 25 years on their side."⁵³

With regard to the New START Treaty, the Trump Administration should continue adhering through the 2021 end date as long as Russia remains in compliance with all limits and rules. If, however, Russia does not comply with New START Treaty limits or rules, the United States should undertake responsive measures, outside the Treaty if needed, that mitigate the consequences of that noncompliance and strengthen US adaptability. (In this regard, as noted in the past by officials in the Bush and Obama Administrations, the US potential to reconstitute nuclear forces can help deter an opponent's violation of arms control limits.)⁵⁴

The Trump Administration should also review the Obama Administration's position in support of the Comprehensive Test Ban Treaty (CTBT). There may be no near-term need to resume nuclear weapons testing; nevertheless, for prudence sake, the National Nuclear Security Administration (NNSA) should be directed to increase its test readiness to improve adaptability. The United States should continue to support the related International Monitoring System, which plays an important role in monitoring nuclear test and other seismic activity. As the NNSA reported in 2014: "a very limited test to signal the readiness of the U.S. nuclear deterrent or to respond to another Nation's test could be conducted in 6 to 10 months, but such a test is not a component of stockpile stewardship." To conduct a more technically-demanding stockpile surety test with full diagnostic equipment and personnel could take as long as three years.⁵⁵ The NNSA's FY2017 report indicates this status has not changed.⁵⁶

In addition, the administration should consciously seek to pursue the three classic goals of arms control—to reduce the probability of war, the destruction of war, and the cost of sustaining effective deterrence and defense capabilities—through means other than the traditional, formal arms control process. For example, for two decades, the United States and Russia engaged in unprecedented cooperation in formerly sensitive areas. The process began in December 1991 with the initiation of the DoD Cooperative Threat Reduction (CTR) program, which worked to reduce former Soviet strategic nuclear delivery vehicles (SNDVs), remove all nuclear warheads from Ukraine, Belarus and Kazakhstan, and secure Russian nuclear warheads and materials. Four new multilateral initiatives of the George W. Bush Administration expanded US-Russian cooperation against proliferation and terrorism: the 2002 G-8 Global Partnership Against the

Spread of Weapons and Materials of Mass Destruction; the 2003 Proliferation Security Initiative (PSI); the 2006 Global Initiative to Combat Nuclear Terrorism (GICNT); and, the 2007 Declaration on Nuclear Energy and Nonproliferation Joint Actions. The Obama Administration added the Nuclear Security Summit process to these cooperative efforts.

CTR in Russia essentially ended in June 2013, when Russia refused to renew the umbrella agreement governing the program. A few projects continued to completion, but the great majority were summarily cancelled. Russia officially ended nuclear material security cooperation with the Department of Energy in December 2014. The last Nuclear Security Summit was held in March 2016, but Russia did not attend. Russia is still technically a Global Partnership member, but the group has not met since Russia was expelled from the G-8 in 2014. It remains a PSI participant and co-chairs the GICNT with the United States. The United States should seek to use those two fora to engage Russia as appropriate in nonproliferation and counterterrorism cooperation. The United States should also look for new cooperative initiatives that may be helpful and plausible, such as new groups like PSI or individual activities.

Further, the United States should continue to seek cooperative endeavors with China. Its participation in GICNT provides one important venue. The United States should seek to advance efforts to persuade China to endorse PSI. Additionally, it should explore possibilities for expanding its current limited cooperation on nuclear material security. As in the Russian case, the United States should also look for new cooperative initiatives; the most important, but also the demonstrably most difficult, would be to constrain North Korean proliferation and aggressive behavior.

Conclusion

Prospects for further nuclear reductions appear low given Russian and Chinese opposition and aggressive expansionism. But, if those conditions change, the United States may be able to pursue an arms control agenda that, properly understood, can serve the priority US nuclear policy goals as it has done periodically in the past.

Every US administration has endorsed the ultimate goal of the elimination of nuclear weapons. However, it is necessarily a long-term goal that will not be realized for many decades, if ever. As the bipartisan Perry-Schlesinger Commission concluded in its 2009 report: “The conditions that might make the elimination of nuclear weapons possible are not present today and establishing such conditions would require a fundamental transformation of the world political order.”⁵⁷ There is little or no evidence that such conditions are emerging or are feasible in principle. Until then, the United States must continue to seek flexible and resilient nuclear forces to deter adversaries, assure allies and, if necessary, help limit damage. These goals are consistent with the classic goals of arms control and should underlie the US nuclear arms control agenda.

¹ Michael R. Gordon, “Russia Deploys Missile, Violating Treaty and Challenging Trump,” *The New York Times*, February 14, 2017, available at <https://www.nytimes.com/2017/02/14/world/europe/russia-cruise-missile-arms-control-treaty.html>.

² Ministry of Foreign Affairs, Republic of Poland, “MFA statement on information about Russia’s non-compliance with the INF Treaty,” *MSZ.gov.pl*, July 30, 2014, available at http://www.msz.gov.pl/en/news/mfa_statement_on_information_about_russia_s_non_compliance_with_the_inf_treaty.

³ U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, DC: Department of Defense, April 2010), p. 30, available at https://www.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Report.pdf.

⁴ U.S. Department of Defense, "Stockpile Numbers: End of Fiscal Years 1962-2015," *Defense.gov*, available at http://open.defense.gov/Portals/23/Documents/frddwg/2015_Tables_UNCLASS.pdf.

⁵ Susan J. Koch, *The Presidential Nuclear Initiatives of 1991-1992* (Washington, DC: National Defense University Press, September 2012).

⁶ Hans M. Kristensen and Robert S. Norris, "Status of World Nuclear Forces," *FAS.org*, available at <https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/>.

⁷ Hans M. Kristensen and Robert S. Norris, "Russian Nuclear Forces, 2016," *Bulletin of the Atomic Scientists*, Vol. 72 No. 3 (April 2016), pp. 125-134.

⁸ 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: United States Institute of Peace Press, 2009), p. 111.

⁹ Franklin C. Miller and Keith B. Payne, *No More US-Russian Arms Treaties Until Moscow Stops Violating Existing Treaties and Agreements* (Fairfax, VA: National Institute Press, March 9, 2017), Information Series, No. 418.

¹⁰ U.S. Department of State, "New START Treaty Aggregate Numbers of Strategic Offensive Arms," *State.gov*, June 1, 2011, available at <http://www.state.gov/t/avc/rls/164722.htm>.

¹¹ U.S. Department of Defense, *Nuclear Posture Review Report*, 2010, op. cit., p. xi.

¹² Barack Obama, "Remarks by President Obama at the Brandenburg Gate- Berlin Germany," *WhiteHouse.gov*, June 19, 2013, available at <https://obamawhitehouse.archives.gov/the-press-office/2013/06/19/remarks-president-obama-brandenburg-gate-berlin-germany>.

¹³ Susan Rice, "Statement by National Security Advisor Susan E. Rice on the Five-Year Anniversary of the New START Treaty Entry into Force," *WhiteHouse.gov*, February 5, 2016, available at <https://obamawhitehouse.archives.gov/the-press-office/2016/02/05/statement-national-security-advisor-susan-e-rice-five-year-anniversary>; See also, Madelyn Creedon, "U.S. Nuclear Weapons Policy and Programs," *State.gov*, October 2016, slide 8, available at <https://2009-2017.state.gov/documents/organization/263735.pdf>; and, Thomas M. Countryman, "EU Non-Proliferation and Disarmament Conference: Plenary Session: Disarmament and Deterrence - Bridging the Divide," *State.gov*, November 3, 2016, available at <https://2009-2017.state.gov/t/us/2016/264078.htm>; and, Barack Obama, "Obama: How we can make our vision of a world without nuclear weapons a reality," *The Washington Post*, March 30, 2016, available at https://www.washingtonpost.com/opinions/obama-how-we-can-make-our-vision-of-a-world-without-nuclear-weapons-a-reality/2016/03/30/3e156e2c-f693-11e5-9804-537defcc3cf6_story.html?utm_term=.5647dada69c4.

¹⁴ U.S. Department of Defense, *Nuclear Posture Review Report*, 2010, op. cit., p. vi.

¹⁵ Ibid.

¹⁶ "Treaty on the Nonproliferation of Nuclear Weapons," *UN.org*, July 1, 1968, available at <https://www.un.org/disarmament/wmd/nuclear/npt/text>.

¹⁷ Barack Obama, "Remarks by President Barack Obama In Prague As Delivered," *WhiteHouse.gov*, April 5, 2009, available at <https://www.whitehouse.gov/the-press-office/remarks-president-barack-obama-prague-delivered.cretary>

¹⁸ "Treaty on the Nonproliferation of Nuclear Weapons," op. cit.

¹⁹ U.S. State Department, "Treaty on the Non-Proliferation of Nuclear Weapons (NPT)," *State.gov*, March 5, 1970, available at <http://www.state.gov/t/isn/trty/16281.htm>. <http://www.state.gov/t/isn/trty/16281>.

²⁰ Ibid.

²¹ As stated by Adam Scheinman, the President's Special Representative for Nonproliferation. See Elena Sucharetza, "Obama representative on nuclear nonproliferation encourages U.S., others to ratify nuclear test ban treaty," *TheDailyNorthwestern.com*, February 2, 2016, available at <https://dailynorthwestern.com/2016/02/02/campus/obama-representative-on-nuclear-nonproliferation-encourages-u-s-and-others-to-ratify-nuclear-test-ban-treaty/>.

²² Ashton Carter, "Remarks by Secretary Carter to troops at Minot Air Force Base, North Dakota," *Defense.gov*, September 26, 2016, available at <https://www.defense.gov/News/Transcripts/Transcript-View/Article/956079/remarks-by-secretary-carter-to-troops-at-minot-air-force-base-north-dakota>.

²³ Scott D. Sagan, "Why Do States Build Nuclear Weapons?: Three Models in Search of a Bomb," *International Security*, Vol. 21, No. 3 (1996), pp. 54–86; Maria Rost Rublee, *Nonproliferation Norms : Why States Choose Nuclear Restraint* (Athens, GA.: University of Georgia Press, 2009).

²⁴ Sonali Singh and Christopher R. Way, "The Correlates of Nuclear Proliferation: A Quantitative Test," *The Journal of Conflict Resolution*, Vol. 48, No. 6 (2004), pp. 859–85; Dong-Joon Jo and Erik Gartzke, "Determinants of Nuclear Weapons Proliferation," *The Journal of Conflict Resolution*, Vol. 51, No. 1 (2007), pp. 167–94.

²⁵ Matthew Kroenig, "Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation," *The Journal of Conflict Resolution*, Vol. 53, No. 2 (2009), pp. 161–80; Christoph Bluth et al., "Civilian Nuclear Cooperation and the Proliferation of Nuclear Weapons," *International Security*, Vol. 35, No. 1 (July 1, 2010), pp. 184–200.

²⁶ Matthew Fuhrmann, "Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements," *International Security*, Vol. 34, No. 1 (2009), pp. 7–41.

²⁷ Etel Solingen, *Nuclear Logics: Contrasting Paths in East Asia and the Middle East* (Princeton: Princeton University Press, 2007).

²⁸ Chaim Braun and Christopher F. Chyba, "Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," *International Security*, Vol. 29, No. 2 (October 1, 2004), pp. 5–49.

²⁹ Jacques E.C. Hymans, *Achieving Nuclear Ambitions: Scientists, Politicians and Proliferation* (New York: Cambridge University Press, 2012).

³⁰ Jacques E.C. Hymans, *The Psychology of Nuclear Proliferation: Identity, Emotions, and Foreign Policy* (Cambridge, UK: Cambridge University Press, 2006).

³¹ Sagan, "Why Do States Build Nuclear Weapons?," op. cit.

³² Christopher F. Chyba, "Time for a Systemic Analysis: U.S. Nuclear Weapons and Nuclear Proliferation," *ArmsControl.org*, December 2008, available at https://www.armscontrol.org/act/2008_12/Chyba.

³³ Matthew Kroenig, *Exporting the Bomb : Technology Transfer and the Spread of Nuclear Weapons* (Ithaca, NY: Cornell University Press, 2010).

³⁴ Matthew Fuhrmann and Sarah E. Kreps, "Targeting Nuclear Programs in War and Peace: A Quantitative Empirical Analysis, 1941–2000," *The Journal of Conflict Resolution*, Vol. 54, No. 6 (2010), pp. 831–59.

³⁵ Peter D. Feaver and Emerson M.S. Niou, "Managing Nuclear Proliferation: Condemn, Strike, or Assist?," *International Studies Quarterly* Vol. 40, No. 2 (1996), pp. 209–33.

³⁶ Matthew Kroenig, "Force or Friendship? Explaining Great Power Nonproliferation Policy," *Security Studies*, Vol. 23, No. 1 (January 1, 2014), pp. 1–32.

³⁷ Matthew Kroenig, "Exporting the Bomb: Why States Provide Sensitive Nuclear Assistance," *The American Political Science Review*, Vol. 103, No. 1 (February 2009), pp. 113–33; Matthew Fuhrmann, "Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements," *International Security*, Vol. 34, No. 1 (2009), pp. 7–41.

³⁸ Fuhrmann and Kreps, op. cit.

³⁹ David Holloway, *Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939–1956* (New Haven: Yale University Press, 1994); Margaret Gowing, *Britain and Atomic Energy 1939–1945* (London: Palgrave Macmillan, 1964); John Lewis and Litai Xue, *China Builds the Bomb* (Stanford, CA: Stanford University Press, 1991); Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge, MA: The MIT Press, 1998); Avner Cohen, *Israel and the Bomb* (New York: Columbia University Press, 1999); George Perkovich, *India's Nuclear Bomb: The Impact on Global Proliferation Updated Edition with a New Afterword* (Berkeley: University of California Press, 2001); Feroz Khan, *Eating Grass: The Making of the Pakistani Bomb* (Stanford, CA: Stanford Security Studies, 2012).

⁴⁰ Matthew Kroenig, "US Nuclear Weapons and Non-Proliferation: Is There a Link?," *Journal of Peace Research*, Vol. 53, No. 2 (March 1, 2016), pp. 166–79.

⁴¹ Quotes from interview with Matthew Kroenig, July 9, 2015.

⁴² Kroenig, "US Nuclear Weapons and Non-Proliferation: Is There a Link?," op. cit.

⁴³ Ibid., p. 31.

⁴⁴ Philipp C. Bleek and Eric B. Lorber, "Security Guarantees and Allied Nuclear Proliferation," *Journal of Conflict Resolution*, Vol. 58, No. 3 (April 1, 2014), pp. 429–54.

⁴⁵ "South Korea's President Park Asked to Consider US Nukes," *South China Morning Post*, October 14, 2016, available at <http://www.scmp.com/news/asia/east-asia/article/2028072/south-koreas-president-park-asked-consider-us-nukes>.

⁴⁶ Josh Rogin, "U.S. Allies Unite to Block Obama's Nuclear 'Legacy,'" *The Washington Post*, August 14, 2016, available at https://www.washingtonpost.com/opinions/global-opinions/allies-unite-to-block-an-obama-legacy/2016/08/14/cdb8d8e4-60b9-11e6-8e45-477372e89d78_story.html?utm_term=.2f1ecdeeee33.

⁴⁷ "Russia Not Interested in U.S.-Proposed Arms Reductions—Russian Presidential Chief-of-Staff," *Russia Beyond the Headlines*, March 5, 2013, available at http://services.rbth.ru/news/2013/03/05/russia_not_interested_in_us-proposed_arms_reduction_-_russian_presidenti_23504.html.

⁴⁸ Thomas C. Schelling and Morton H. Halperin, *Strategy and Arms Control* (New York: Twentieth Century Fund, 1961), pp. 1-2.

⁴⁹ Barack Obama, "Remarks By President Barack Obama In Prague As Delivered," *WhiteHouse.gov*, April 5, 2009, available at <https://obamawhitehouse.archives.gov/the-press-office/remarks-president-barack-obama-prague-delivered>.

⁵⁰ Mark Schneider, *The Russian Nuclear Weapons Buildup and the Future of the New START Treaty* (Fairfax, VA: National Institute Press, October 27, 2016), Information Series No. 414, available at <http://www.nipp.org/wp-content/uploads/2016/10/IS-414-formatted.pdf>.

⁵¹ Defense Science Board, *Assessment of Nuclear Monitoring and Verification Technologies* (Washington, DC: Defense Science Board, January 2014), p. 18, available at <http://www.acq.osd.mil/dsb/reports/2010s/NuclearMonitoringAndVerificationTechnologies.pdf>.

⁵² *Ibid.*, p. 2.

⁵³ Ashton Carter, "Nuclear Deterrence: Still the Bedrock of US Security," *The American Interest*, April 6, 2017, available at <https://www.the-american-interest.com/2017/04/06/nuclear-deterrence-still-the-bedrock-of-us-security/>.

⁵⁴ See 111th U.S. Congress, "Treaty with Russia on Measures for Further Reduction and Limitation of Strategic Offensive Arms," *Senate Foreign Relations Committee*, Executive Report 111-6, October 1, 2010, pp. 24, 28-30, available at <https://www.congress.gov/111/crpt/erpt6/CRPT-111erpt6.pdf>.

⁵⁵ National Nuclear Security Administration, *Fiscal Year 2014 Stockpile Stewardship and Management Plan* (Washington, DC: NNSA, June 2013), pp. 4-1 – 4-4, available at <https://www.hsl.org/?view&did=792382>.

⁵⁶ National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan – Biennial Plan Summary* (Washington, DC: NNSA, March 2016), p. A-7, available at <https://www.hsl.org/?view&did=792376>.

⁵⁷ Perry and Schlesinger, *America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States*, op. cit., p. xvi.

Appendix A. Sources for Tables 1 through 4 (Section VI)

Sources for Table 1: U.S. Nuclear Forces, 2018

Delivery Systems and Nuclear Weapons

Number of SLBMs per Ohio-class SSBN: Department of Defense, “DoD Announces Strategic Force Structure,” News Release No. NR-170-14, April 8, 2014, attachment, “Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty,” available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>.

Approximate number of RVs per Trident D5 or D5 LE SLBM: Derived from Bureau of Arms Control, Verification, and Compliance, Department of State, “New START Aggregate Numbers of Strategic Offensive Arms, fact sheet, July 1, 2016, available at <http://www.state.gov/t/avc/rls/2016/259273.htm>.

Trident D5 and D5 LE payloads: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: DOE/NNSA, March 2015), pp. 1-4, 1-6, available at https://nnsa.energy.gov/sites/default/files/FY16SSMP_FINAL%203_16_2015_reducedsize.pdf.

One RV per Minuteman III ICBM: *Report of the United States of America Pursuant to Actions 5, 20, 21, of the 2010 Nuclear Non-Proliferation Treaty Review Conference Final Document, Updated 2015 Report* (Washington, D.C.: Department of State, April 27, 2015), p. 3, available at <https://www.state.gov/documents/organization/241363.pdf>.

Minuteman III ICBM payload: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: DOE/NNSA, March 2015), pp. 1-4, 1-6, available at https://nnsa.energy.gov/sites/default/files/FY16SSMP_FINAL%203_16_2015_reducedsize.pdf.

Approximate number of ALCM-Bs per B-52H: Maj. Roger Burg, USAF, director of strategic security, Office of the Deputy Chief of Staff for Operations, Plans, and Requirements, Headquarters U.S. Air Force, prepared statement, in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2008*, Part 7, S. Hrg. 110-201, Pt. 7, 110th Cong., 1st sess. (Washington, D.C.: GPO, 2008), p. 56, available at <https://www.gpo.gov/fdsys/pkg/CHRG-110shrg39441/pdf/CHRG-110shrg39441.pdf>; and Department of Defense, “DoD Announces Strategic Force Structure,” News Release No. NR-170-14, April 8, 2014, attachment, “Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty,” available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>.

Warhead for ALCM-B: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: DOE/NNSA, March 2015), p. 1-4, available at https://nnsa.energy.gov/sites/default/files/FY16SSMP_FINAL%203_16_2015_reducedsize.pdf.

Number of bombs per B-2 and types of bombs: U.S. Air Force Long-Range Strike Aircraft White Paper (Washington, D.C.: Department of the Air Force, November 2001), p. A-1, available at http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&docname=GetTRDoc_U2/a433970.pdf; and Department of Energy, National Nuclear Security Administration, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: DOE/NNSA, March 2015), p. 1-4, available at https://nnsa.energy.gov/sites/default/files/FY16SSMP_FINAL%203_16_2015_reducedsize.pdf.

Number of bombs per F-16 and F-15E: Norman Polmar and Robert S. Norris, *The U.S. Nuclear Arsenal: A History of Weapons and Delivery Systems Since 1945* (Annapolis, Md.: Naval Institute Press, 2009), pp. 122, 123.

Types of bombs carried by F-16 and F-15E: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: DOE/NNSA, March 2015), p. 1-4, available at https://nnsa.energy.gov/sites/default/files/FY16SSMP_FINAL%203_16_2015_reducedsize.pdf.

Entry into Service

Years of entries into service for warheads and bombs: National Nuclear Security Administration data cited in Government Accountability Office, *Nuclear Weapons: Actions Needed by NNSA to Clarify Dismantlement Performance Goal*, GAO-14-449 (Washington, D.C.: GAO, April 2014), p. 10, available at <http://gao.gov/assets/670/662840.pdf>.

Year of entry into service for Ohio-class SSBN: Ronald O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress*, R41129 (Washington, D.C.: Congressional Research Service, August 18, 2016), p. 3, available at <https://www.hsdl.org/?view&did=795032>.

Year of entry into service for Trident D5 SLBM: "Trident Fleet Ballistic Missile," *United States Navy Fact File*, January 17, 2009, available at http://www.navy.mil/navydata/fact_display.asp?cid=2200&tid=1400&ct=2.

Year of entry into service for Trident D5 LE SLBM: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 73, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; and Adm. William F. Moran, USN, vice chief of naval operations, prepared statement before the House Armed Services Committee, March 8, 2017, p. 2, available at

<http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-MoranUSNB-20170308.pdf>.

Year of entry into service for Minuteman III ICBM: “LGM-30 Minuteman III,” U.S. Air Force fact sheet, September 30, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104466/lgm-30g-minuteman-iii.aspx>.

Year of entry into service for B-52H bomber: “B-52H Stratofortress,” U.S. Air Force fact sheet, December 16, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104465/b-52-stratofortress.aspx>.

Year of entry into service for ALCM-B: “AGM-86B/C/D Missiles,” U.S. Air Force fact sheet, May 24, 2010, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104612/agm-86bcd-missiles.aspx>.

Year of entry into service for B-2 bomber: “B-2 Spirit,” U.S. Air Force fact sheet, December 16, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104482/b-2-spirit.aspx>; and Northrop Grumman Corporation, “The B-2 Spirit Stealth Bomber Turns 25,” fact sheet, July 9, 2014, p. 2, available at http://www.northropgrumman.com/Capabilities/B2SpiritBomber/Documents/pageDocuments/B-2_25th_Anniversary_Fact_Sheet.pdf.

Year of entry into service for F-16 aircraft: “F-16 Fighting Falcon,” U.S. Air Force fact sheet, September 23, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104505/f-16-fighting-falcon.aspx>.

Year of entry into service for F-15E aircraft: “F-15E Strike Eagle,” U.S. Air Force fact sheet, April 15, 2005, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104499/f-15e-strike-eagle.aspx>.

Projected End of Service

Projected end of service for Columbia-class SSBN: Vice Adm. Joe Mulloy, USN, deputy chief of naval operations for integration of capabilities and resources, “Thoughts on the Future of the Naval Forces,” *Submarine Review*, June 2015, p. 26; and Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 71, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>.

Projected end of service for Trident D5 LE SLBM: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107,

114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 71, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; Thomas Lee, “The History of America’s Undersea Strategic Deterrence: From V-1 to D5,” *Undersea Warfare*, issue no. 60 (Winter 2016), p. 17, available at http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/PDF/USW_Winter_2016.pdf; and General Accountability Office, *Nuclear Weapons Sustainment: Improvements Made to Budget Estimates Report, but Opportunities Remain to Further Enhance Transparency*, GAO-16-23 (Washington, D.C.: GAO, December 2015), p. 13, available at <http://gao.gov/assets/680/674116.pdf>.

Projected end of service for W76 warhead: Lt. Gen. Frank N. Klotz, USAF (ret.), administrator, National Nuclear Security Administration, in House Armed Services Committee, *Fiscal Year 2016 Budget Request for Atomic Energy Defense*, HASC No. 114-27, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2016), p. 90, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg94229/pdf/CHRG-114hhrg94229.pdf>.

Projected end of service for W88 warhead: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), p. 2-6, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf; and Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 73, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>.

Projected end of service for Minuteman III ICBM: Maj. Gen. Garrett Harencak, USAF, assistant chief of staff for strategic deterrence and nuclear integration, Headquarters U.S. Air Force, in House Armed Services Committee, *Fiscal Year 2015 Budget Request for Atomic Energy Defense Activities and Nuclear Forces Programs*, HASC No. 113-107, 113th Cong., 2d sess. (Washington, D.C.: GPO, 2015), p. 168, available at <https://www.gpo.gov/fdsys/pkg/CHRG-113hhrg88452/pdf/CHRG-113hhrg88452.pdf>; and Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, p. 6, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>.

Projected end of service for W78 warhead: National Nuclear Security Administration, “Life Extension Programs,” fact sheet, available at <https://nnsa.energy.gov/ourmission/managingthestockpile/lifeextensionprograms>.

Projected end of service for W87 warhead: National Nuclear Security Administration, “Reducing the Nuclear Weapons Stockpile,” fact sheet, January 1, 2009, available at <https://nnsa.energy.gov/mediaroom/factsheets/reducingstockpile>; National Nuclear Security Administration, “Life Extension Programs,” fact sheet, available at <https://nnsa.energy.gov/ourmission/managingthestockpile/lifeextensionprograms>; and

Government Accountability Office, *Nuclear Weapons: NNSA Has a New Approach to Managing the B61-12 Life Extension, but a Constrained Schedule and Other Risks Remain*, GAO-16-218 (Washington, D.C.: GAO, February 2016), p. 25, available at <http://gao.gov/assets/680/674960.pdf>.

Projected end of service for ALCM-B: Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), pp. 59-60, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; and Government Accountability Office, *Nuclear Weapons Sustainment: Improvements Made to Budget Estimates, but Opportunities Exist to Further Enhance Transparency*, GAO-15-536 (Washington, D.C.: GAO, July 2015), p. 10.

Projected end of service for W80-1 warhead: George H. Miller, director, Lawrence Livermore National Laboratory, written response for the record, in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2012 and the Future Years Defense Program*, Part 7, S. Hrg. 112-80, Pt. 7, 112th Cong., 1st sess. (Washington, D.C.: GPO, 2012), p. 109, available at <https://www.gpo.gov/fdsys/pkg/CHRG-112shrg68090/pdf/CHRG-112shrg68090.pdf>.

Projected end of service for B-52H bomber: Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, p. 8, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>; and Lt. Gen. James M. "Mike" Holmes, USAF, deputy chief of staff (plans and requirements), Headquarters USAF, in House Armed Services Committee, *Air Force Projection Forces Aviation Programs and Capabilities for Fiscal Year 2017*, HASC No. 114-103, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2016), p. 19, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99647/pdf/CHRG-114hhrg99647.pdf>.

Projected end of service for B-2 bomber: Lt. Gen. James M. Kowalski, USAF, commander, Air Force Global Strike Command, "Air Force Global Strike Command," briefing, May 7, 2013, slide 16, available at <http://fas.org/programs/ssp/nukes/nuclearweapons/AFGSC-CommandBrief-May2013.pdf>; and Government Accountability Office, *Nuclear Weapons Sustainment: Improvements Made to Budget Estimates, but Opportunities Exist to Further Enhance Transparency*, GAO-15-536 (Washington, D.C.: GAO, July 2015), p. 10, available at <http://gao.gov/assets/680/671788.pdf>.

Projected ends of service for B61-7, B61-11, and B83-1 bombs: National Nuclear Security Administration, Document #2, "B61-12 LEP Enables Stockpile Reductions," and Madelyn R. Creedon, assistant secretary of defense for global strategic affairs, written response for the record, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), pp. 75, 135, available at <https://www.gpo.gov/fdsys/pkg/CHRG-113hhrg86075/pdf/CHRG-113hhrg86075.pdf>.

Projected ends of service for dual-capable F-16 and F-15E aircraft: Government Accountability Office, *Nuclear Weapons: Ten-Year Budget Estimates for Modernization Omit Key Efforts, and Assumptions and Limitations Are Not Fully Transparent*, GAO-14-373 (Washington, D.C.: GAO, June 2014), p. 13, available at <http://gao.gov/assets/670/664004.pdf>; and Maj. Gen. Garrett Harencak, USAF, assistant chief of staff for strategic deterrence and nuclear integration, Headquarters U.S. Air Force, “United States Strategic Interests and Current Triad Requirements,” briefing, Precision Strike Technology Symposium (PSTS-14), October 23, 2014, slide 5, available at <http://www.dtic.mil/ndia/2014PSTS/Harencak.pdf>.

Projected ends of service for B61-3/4/10 bombs: National Nuclear Security Administration, Document #2, “B61-12 LEP Enables Stockpile Reductions,” and Madelyn R. Creedon, assistant secretary of defense for global strategic affairs, written responses for the record, in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), pp. 75, 135, available at <https://www.gpo.gov/fdsys/pkg/CHRG-113hhrg86075/pdf/CHRG-113hhrg86075.pdf>.

Number

Number of Ohio-class SSBNs operational or in overhaul: Rear Adm. Richard Breckenridge, USN, director, Undersea Warfare (OPNAV N97), “Navy Responds to Debate Over Size of the SSBN Force,” *Navy Live: The Official Blog of the United States Navy*, May 16, 2013, available at <http://navylive.dodlive.mil/2013/05/16/navy-responds-to-debate-over-the-size-of-the-ssbn-force/>; and Ronald O’Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress*, R41129 (Washington, D.C.: Congressional Research Service, August 18, 2016), pp. 5-6, available at <https://www.hsdl.org/?view&did=795032>; and comments by Gen. Kevin P. Chilton, USAF (ret.), former commander, U.S. Strategic Command, December 4, 2016.

Number of deployed Trident D5 and D5 LE SLBMs: Department of Defense, “DoD Announces Strategic Force Structure,” News Release No. NR-170-14, April 8, 2014, attachment, “Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty,” available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>.

Number of W76, W76-1 and W88 warheads on Trident D5 and 05 LE SLBMs: 240 deployed SLBMs x ~4 warheads per SLBM = ~960.

Numbers of deployed and nondeployed Minuteman III ICBMs: Department of Defense, “DoD Announces Strategic Force Structure,” News Release No. NR-170-14, April 8, 2014, attachment, “Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty,” available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>; Maj. Gen. Garrett Harencak, USAF, assistant chief of staff for strategic deterrence and nuclear integration, Headquarters U.S. Air Force, in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2015 and the Future Years Defense Program*, Part 7, S. Hrg. 113-465, Pt. 7, 113th Cong., 2d sess. (Washington, D.C.: GPO, 2015), pp. 39-40,

available at <https://www.gpo.gov/fdsys/pkg/CHRG-113shrg91192/pdf/CHRG-113shrg91192.pdf>; and Robert Burns, "US Will Cut Deployed Nuke Missile Force By 50," Associated Press, April 8, 2014, available at <http://www.washingtontimes.com/news/2014/apr/8/us-will-cut-deployed-nuke-missile-force-50/>.

Number of W78 and W87 warheads on Minuteman III ICBMs: 400 ICBMs x 1 warhead per ICBM = 400 warheads.

Numbers of deployed and nondeployed B-52H bombers: Department of Defense, "DoD Announces Strategic Force Structure," News Release No. NR-170-14, April 8, 2014, attachment, "Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty," available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>.

Number of ALCM-Bs available for deployment: Maj. Roger Burg, USAF, director of strategic security, Office of the Deputy Chief of Staff for Operations, Plans, and Requirements, Headquarters U.S. Air Force, prepared statement in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2008*, Part 7, S. Hrg. 110-201, Pt. 7, 110th Cong., 1st sess. (Washington, D.C.: GPO, 2008), p. 56, available at <https://www.gpo.gov/fdsys/pkg/CHRG-110shrg39441/pdf/CHRG-110shrg39441.pdf> and "Official: ALCM Remains Accurate, Reliable Strategic Deterrent," *InsideDefense.com*, October 17, 2014, available at <https://nukewatch.org/media2/postData.php?id=3175>.

Number of W80-1 warheads for ALCM-Bs: One warhead is assumed available for each missile available for deployment.

Numbers of deployed and nondeployed B-2 bombers: Department of Defense, "DoD Announces Strategic Force Structure," News Release No. NR-170-14, April 8, 2014, attachment, "Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty," available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>.

Maximum of bomb-carrying capacity of the deployed B-2 fleet: 19 bombers x 16 bombs per bomber = 304.

Number of bombs available for F-16 and F-15E dual-capable aircraft: Gary Samore, coordinator for arms control and weapons of mass destruction terrorism, National Security Council, quoted in "Obama Adviser Gary Samore: 'The Ball Is Very Much in Tehran's Court'" (interview), Radio Free Europe/Radio Liberty, April 14, 2011, available at http://www.rferl.org/content/interview_samore_russia_iran_us_policy/3557326.html; and Guy Roberts, NATO deputy assistant secretary general for weapons of mass destruction policy, quoted in Oliver Meier, "U.S. Cuts Tactical Nuclear Weapons in Europe," *Arms Control Today*, Vol. 37, no. 7 (September 2007), available at http://www.armscontrol.org/act/2007_09/TacticalNuclearEurope.

Sources for Table 2: Nuclear Delivery System Sustainment and Modernization Plans

Adapted from General Accountability Office, *Nuclear Weapons: Ten-Year Budget Estimates for Modernization Efforts Omit Key Efforts, and Assumptions and Limitations Are Fully Transparent*, GAO-14-373 (Washington, D.C.: GAO, June 2014), pp. 13-14, available at <http://gao.gov/assets/670/664004.pdf>. The GAO table has been updated to reflect information found in Tables 1 and 4.

Sources for Table 3: Current and Future U.S. Nuclear Missile Warheads and Bombs

Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), p. 1-3, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf; National Nuclear Security Administration, Document #3, “Baseline (3+2) Strategy,” in House Armed Services Committee, *Nuclear Weapons Modernization Programs: Military, Technical, and Political Requirements for the B61 Life Extension Program and Future Stockpile Strategy*, HASC 113-68, 113th Cong., 1st sess. (Washington, D.C.: GPO, 2014), pp. 76, available at <https://www.gpo.gov/fdsys/pkg/CHRG-113hhrg86075/pdf/CHRG-113hhrg86075.pdf>; Arthur T. Hopkins, principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 42, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; and Government Accountability Office, *Nuclear Weapons: NNSA Has a New Approach to Managing the B61-12 Life Extension, but a Constrained Schedule and Other Risks Remain*, GAO-16-218 (Washington, D.C.: GAO, February 2016), p. 25, available at <http://gao.gov/assets/680/674960.pdf>.

Sources for Table 4: Future U.S. Nuclear Forces

Delivery Systems and Nuclear Weapons

Number of SLBMs per Columbia-class SSBN: Undersea Warfare Division (OPNAV N97), *Ohio Replacement SSBN: 21st Century Capability in an Affordable Platform at Responsible Cost*, n.d., available at <http://www.public.navy.mil/subfor/hq/Documents/OHIO%20Replacement%20Trifold.pdf>.

Number of RVs per Trident D5 LE SLBM: Amy F. Woolf, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, RL33640 (Washington, D.C.: Congressional Research

Service, September 27, 2016), p. 21, available at <https://www.fas.org/sgp/crs/nuke/RL33640.pdf>. With special fittings, the D5 SLBM could carry 12 Mk4 reentry vehicles. Department of the Navy, *Vision, Presence, Power: A Program Guide for the U.S. Navy*, 1998 edition (Washington, D.C.: Office of the Chief of Naval Operations, May 1998), available at <http://www.navy.mil/navydata/policy/vision/vis98/vis-p09.html>.

Follow-on SLBM: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 72, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>.

SLBM payloads: Arthur T. Hopkins, principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 42, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; Department of Energy, National Nuclear Security Administration, *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, Report to Congress, DOE/NA-0029 (Washington, D.C.: DOE/NNSA, March 2015), pp. 1-4, 1-6, available at https://nnsa.energy.gov/sites/default/files/FY16SSMP_FINAL%203_16_2015_reducedsize.pdf; and Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), pp. 2-4, 2-5—2-6, 2-8, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf.

Number of RVs per GBSD ICBM: “Request for Information (RFI) #1, Ground Based Strategic Deterrent,” January 23, 2015, p. 1, available at https://www.fbo.gov/index?s=opportunity&mode=form&id=64f0781d91f486ab27724cc75ad95cb0&tab=core&_cview=1.

GBSD ICBM payloads: Arthur T. Hopkins, principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 42, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; and “Request for Information (RFI) #1, Ground Based Strategic Deterrent,” January 23, 2015, p. 1, available at https://www.fbo.gov/index?s=opportunity&mode=form&id=64f0781d91f486ab27724cc75ad95cb0&tab=core&_cview=1.

LRSO cruise missile carried by B-52H bomber: Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 60, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>.

Number of LRSO cruise missile bodies procured: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Report to Congress on the Number of Long-Range Standoff Weapons as Specified by Section 1657 of the National Defense Authorization Act for Fiscal Year 2016* (Washington, D.C.: Department of Defense, March 2016), p.1, available at <http://www.ucsusa.org/sites/default/files/attach/2016/04/FY16-LRSO-cost-reporting-requirement.pdf>.

Number of bombs per B-2 bomber: U.S. Air Force Long-Range Strike Aircraft White Paper (Washington, D.C.: Department of the Air Force, November 2001), p. A-1, available at <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&docname=GetTRDoc.pdf&ADNumber=A433970> .

B61-12 bomb carried by B-2 bomber: Maj. Gen. Scott W. Jansson, USAF, commander, Air Force Nuclear Weapons Center, "Air Force Nuclear Weapons Center Update," briefing, National Defense Industrial Association Gulf Coast Chapter 41st Air Armament Symposium, November 4, 2015, slide titled "B61-12 Tailkit Assembly," available at http://www.ndiagulfcoast.com/events/archive/41st_Symposium/Day2AFNWCJansson.pdf.

LRSO cruise missile carried by B-2 bomber: Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 60, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hrg99651/pdf/CHRG-114hrg99651.pdf>.

B61-12 bomb carried by B-21 bomber: Adm. C.D. Haney, USN, commander, U.S. Strategic Command, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 11, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Haney-Testimony.pdf>.

LRSO cruise missile carried by B-21 bomber: Adm. C.D. Haney, USN, commander, U.S. Strategic Command, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 11, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Haney-Testimony.pdf>.

LRSO cruise missile armed with W80-4 warhead: Adm. C.D. Haney, USN, commander, U.S. Strategic Command, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 12, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Haney-Testimony.pdf>.

<http://www.saffm.hq.af.mil/Portals/84/documents/FY17/AFD-160208-052.pdf?ver=2016-08-24-102137-043>.

Actual of Planned Entry into Service

Year of entry into service for Columbia-class SSBN: Sean Stackley, assistant secretary of the Navy for research, development and acquisition, keynote address at Naval Submarine League 2016 Corporate Member Recognition Days, March 10, 2016, in *Submarine Review*, June 2016, p. 19, available at <http://www.navalsubleague.com/assets/tsrjunewebfinal6.2016.pdf>.

Year of entry into service for Trident D5 LE SLBM: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 73, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; and Adm. William F. Moran, USN, vice chief of naval operations, prepared statement before the House Armed Services Committee, March 8, 2017, p. 2, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-MoranUSNB-20170308.pdf>.

Period of entry into service for Follow-on SLBM: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), pp. 71-72, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; Thomas Lee, "The History of America's Undersea Strategic Deterrence: From V-1 to D5," *Undersea Warfare*, issue no. 60 (Winter 2016), p. 17, http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/PDF/USW_Winter_2016.pdf; and General Accountability Office, *Nuclear Weapons Sustainment: Improvements Made to Budget Estimates Report, but Opportunities Remain to Further Enhance Transparency*, GAO-16-23 (Washington, D.C.: GAO, December 2015), p. 13, available at <http://gao.gov/assets/680/674116.pdf>.

Year of entry into service for W76-1 warhead: National Nuclear Security Administration data cited in Government Accountability Office, *Nuclear Weapons: Actions Needed by NNSA to Clarify Dismantlement Performance Goal*, GAO-14-449 (Washington, D.C.: GAO, April 2014), p. 10, available at <http://gao.gov/assets/670/662840.pdf>.

Years of entries into service for IW-1, -2, and -3: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), pp. 2-4, 2-8, 4-8, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf.

Year of entry into service for GBSD ICBM: Air Force Nuclear Weapons Center Public Affairs, “AF Releases New ICBM Solicitation,” news release, July 29, 2016, available at <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/881075/af-releases-new-icbm-solicitation.aspx>; Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, p. 7, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>.

Years of entries into service for W78 and W87 warheads: National Nuclear Security Administration data cited in Government Accountability Office, *Nuclear Weapons: Actions Needed by NNSA to Clarify Dismantlement Performance Goal*, GAO-14-449 (Washington, D.C.: Government Accountability Office, April 2014), p. 10, available at <http://gao.gov/assets/670/662840.pdf>.

Year of entry into service for B-52H bomber: “B-52H Stratofortress,” U.S. Air Force fact sheet, December 16, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104465/b-52-stratofortress.aspx>.

Year of entry into service for LRSO cruise missile: Arthur T. Hopkins, principal deputy assistant secretary of defense for nuclear, chemical, and biological defense programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 45, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; Madelyn Creedon, principal deputy administrator, National Nuclear Security Administration, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 1, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Creedon-Testimony.pdf>; and Air Force Nuclear Weapons Center Public Affairs, “AF Releases Request for Proposal for Nuclear Air-Launched Cruise Missile Replacement,” news release, July 29, 2016, available at <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/881056/af-releases-request-for-proposal-for-nuclear-air-launched-cruise-missile-replac.aspx>.

Year of entry into service for B-2 bomber: “B-2 Spirit,” U.S. Air Force fact sheet, December 16, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104482/b-2-spirit.aspx>; and Northrop Grumman Corporation, “The B-2 Spirit Stealth Bomber Turns 25,” fact sheet, July 9, 2014, p. 2, available at http://www.northropgrumman.com/Capabilities/B2SpiritBomber/Documents/pageDocuments/B-2_25th_Anniversary_Fact_Sheet.pdf.

Year of entry into service for B61-12 bomb: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), p. 4-8, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf; and Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO,

2017), p. 60, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>.

Period of entry into service for B-21 bomber: Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, prepared statement before the Strategic Forces Subcommittee, House Armed Services Committee, July 14, 2016, p. 9, available at <http://docs.house.gov/meetings/AS/AS29/20160714/105199/HHRG-114-AS29-Wstate-RandR-20160714.pdf>; and remarks by Gen. Rand and Lt. Gen. Arnold W. Bunch, Jr., USAF, military deputy to the assistant secretary of the Air Force (acquisition), “Department of Defense Press Briefing on the Announcement of the Long Range Strike Bomber Contract Award,” October 27, 2015, news transcript, available at <http://www.defense.gov/News/Transcripts/Transcript-View/Article/626146/department-of-defense-press-briefing-on-the-announcement-of-the-long-range-stri>.

Year of entry into service for W80-4 warhead: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), p. 4-8, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf.

Year of entry into service for F-35A dual-capable aircraft: Maj. Gen. Garrett Harencak, USAF, assistant chief of staff for strategic deterrence and nuclear integration, Headquarters USAF, “United States Strategic Interests and Current Triad Requirements,” briefing, Precision Strike Technology Symposium (PSTS-14), October 23, 2014, slide 13, available at <http://www.dtic.mil/ndia/2014PSTS/Harencak.pdf>.

Projected End of Service

Projected end of service for Columbia-class SSBN: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 71, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; and Adm. Benedict, “The Navy’s Contribution to Nuclear Deterrence,” remarks at the AFA-NDIA-ROA Capitol Hill Breakfast Forum, June 19, 2015, National Security Reports transcript, p.4, available at <http://higherlogicdownload.s3.amazonaws.com/AFA/6379b747-7730-4f82-9b45-a1c80d6c8fdb/UploadedImages/Events/Heussy/061915afabenedictfinal.pdf>.

Projected end of service for Trident D5 LE SLBM: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 71, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; Thomas Lee, “The History of America’s Undersea Strategic Deterrence: From V-1 to D5,” *Undersea Warfare*, issue no. 60 (Winter 2016), p. 17, available at http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/PDF/USW_Winter_2016.pdf

f; and General Accountability Office, *Nuclear Weapons Sustainment: Improvements Made to Budget Estimates Report, but Opportunities Remain to Further Enhance Transparency*, GAO-16-23 (Washington, D.C.: GAO, December 2015), p. 13, available at <http://gao.gov/assets/680/674116.pdf>.

Projected end of service for Follow-on SLBM: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 71, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>.

Projected end of service for W76-1 warhead: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), p. vi, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf.

Projected ends of service for IW-1, -2, and 3: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), pp. 2-4, 2-8, 4-8, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf; and National Nuclear Security Administration, “Life Extension Programs,” fact sheet, n.d., available at <https://nnsa.energy.gov/ourmission/managingthestockpile/lifeextensionprograms>.

Projected end of service for GBSD ICBM: Air Force Nuclear Weapons Center Public Affairs, “AF Releases New ICBM Solicitation,” news release, July 29, 2016, available at <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/881075/af-releases-new-icbm-solicitation.aspx>.

Projected end of service for W78 warhead: National Nuclear Security Administration, “Life Extension Programs,” fact sheet, available at <https://nnsa.energy.gov/ourmission/managingthestockpile/lifeextensionprograms>.

Projected end of service for W87 warhead: National Nuclear Security Administration, “Reducing the Nuclear Weapons Stockpile,” fact sheet, January 1, 2009, available at <https://nnsa.energy.gov/mediaroom/factsheets/reducingstockpile>; National Nuclear Security Administration, “Life Extension Programs,” fact sheet, available at <https://nnsa.energy.gov/ourmission/managingthestockpile/lifeextensionprograms>; and Government Accountability Office, *Nuclear Weapons: NNSA Has a New Approach to Managing the B61-12 Life Extension, but a Constrained Schedule and Other Risks Remain*, GAO-16-218 (Washington, D.C.: GAO, February 2016), p. 25, available at <http://gao.gov/assets/680/674960.pdf>.

Projected end of service for B-52H bomber: Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, p. 8, available at

<http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>; and Lt. Gen. James M. “Mike” Holmes, USAF, deputy chief of staff (plans and requirements), Headquarters USAF, in House Armed Services Committee, *Air Force Projection Forces Aviation Programs and Capabilities for Fiscal Year 2017*, HASC No. 114-103, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2016), p. 19, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99647/pdf/CHRG-114hhrg99647.pdf>.

Projected end of service for LRSO cruise missile: Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, p. 10, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>.

Projected end of service for B-2 bomber: Lt. Gen. James M. Kowalski, USAF, commander, Air Force Global Strike Command, “Air Force Global Strike Command,” briefing, May 7, 2013, slide 16, available at <http://fas.org/programs/ssp/nukes/nuclearweapons/AFGSC-CommandBrief-May2013.pdf>; and Government Accountability Office, *Nuclear Weapons Sustainment: Improvements Made to Budget Estimates, but Opportunities Exist to Further Enhance Transparency*, GAO-15-536 (Washington, D.C.: Government Accountability Office, July 2015), p. 10, available at <http://gao.gov/assets/680/671788.pdf>.

Projected end of service for B61-12 bomb: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA, March 2016), pp. vi, 2-4, https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf; and Elizabeth Sherwood-Randall, deputy secretary of energy, prepared statement in House Armed Services Committee, *Nuclear Deterrence in the 21st Century*, HASC No. 114-43, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2016), p. 54, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg95318/pdf/CHRG-114hhrg95318.pdf>.

Projected end of service for B-21 bomber: Remarks by Gen. Robin Rand, commander, Air Force Global Strike Command and Lt. Gen. Arnold W. Bunch, Jr., USAF, military deputy to the assistant secretary of the Air Force (acquisition), “Department of Defense Press Briefing on the Announcement of the Long Range Strike Bomber Contract Award,” October 27, 2015, news transcript, available at <http://www.defense.gov/News/Transcripts/Transcript-View/Article/626146/department-of-defense-press-briefing-on-the-announcement-of-the-long-range-strike-bomber>; and Lt. Gen. James M. “Mike” Holmes, USAF, deputy chief of staff (strategic plans and requirements), Headquarters USAF, and Gen. Bunch, joint prepared statement in House Armed Services Committee, *Air Force Projection Forces Aviation Programs and Capabilities for Fiscal Year 2017*, HASC No. 114-103, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2016), p. 34, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99647/pdf/CHRG-114hhrg99647.pdf>.

Projected end of service for W80-4 warhead: Department of Energy, National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan—Biennial Plan Summary*, Report to Congress, DOE/NA-0041 (Washington, D.C.: DOE/NNSA,

March 2016), p. 4-8,

https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/FY17SSMP%20Final_033116.pdf; and Madelyn Creedon, principal deputy administrator, National Nuclear Security Administration, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 2, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Creedon-Testimony.pdf>.

Projected end of service for F-35A dual-capable aircraft: James Drew, "Lockheed F-35 Service Life Extended to 2070," *FlightGlobal*, March 25, 2016, available at <https://www.flighthglobal.com/news/articles/lockheed-f-35-service-life-extended-to-2070-423536/>.

Number

Number of Columbia-class SSBNs operational or in overhaul: Vice Adm. Terry Benedict, USN, director, Strategic Systems Programs, prepared statement in House Armed Services Committee, *Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces*, HASC No. 114-107, 114th Cong., 2d sess. (Washington, D.C.: GPO, 2017), p. 74, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg99651/pdf/CHRG-114hhrg99651.pdf>; Adm. Benedict, in House Armed Services Committee, *Fiscal Year 2016 Budget Request for Nuclear Forces*, HASC No. 114-38, 114th Cong., 1st sess. (Washington, D.C.: GPO, 2015), p. 13, available at <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg94749/pdf/CHRG-114hhrg94749.pdf>; and Ronald O'Rourke, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress*, R41129 (Washington, D.C.: Congressional Research Service, August 18, 2016), p. 6, available at <https://www.hsdl.org/?view&did=795032>.

Number of deployed SLBMs: 10 operational SSBNs x 16 SLBMs per SSBN = 160 deployed SLBMs.

Number of warheads on SLBMs: 160 deployed SLBMs x 4 RVs per SLBM = 640 warheads; 160 deployed SLBMs x 8 RVs per SLBM = 1,280 warheads.

Number of deployed GBSD ICBMs: Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters U.S. Air Force, prepared statement before the House Armed Services Committee, March 8, 2017, pp. 7-8, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>.

Number of warheads on deployed GBSD ICBMs: 400 deployed ICBMs x 1 RV per ICBM = 400 warheads; 400 deployed ICBMs x multiple RVs per ICBM = ≥400 warheads.

Numbers of deployed and nondeployed B-52H bombers: Department of Defense, "DoD Announces Strategic Force Structure," News Release No. NR-170-14, April 8, 2014, attachment, "Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty," available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>.

Number of LRSO cruise missiles available for deployment: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Report to Congress on the Number of Long-Range Standoff Weapons as Specified by Section 1657 of the National Defense Authorization Act for Fiscal Year 2016* (Washington, D.C.: Department of Defense, March 2016), p.2, available at <http://www.ucsusa.org/sites/default/files/attach/2016/04/FY16-LRSO-cost-reporting-requirement.pdf>; and Maj. Gen. Roger Burg, USAF, director of strategic security, Office of the Deputy Chief of Staff for Operations, Plans, and Requirements, Headquarters U.S. Air Force, prepared statement in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2008*, Part 7, S. Hrg. 110-201, Pt. 7, 110th Cong., 1st sess. (Washington, D.C.: GPO, 2008), p. 56, available at <https://www.gpo.gov/fdsys/pkg/CHRG-110shrg39441/pdf/CHRG-110shrg39441.pdf>; and “Official: ALCM Remains Accurate, Reliable Strategic Deterrent,” *InsideDefense.com*, October 17, 2014, available at <https://nukewatch.org/media2/postData.php?id=3175>.

Numbers of deployed and nondeployed B-2 bombers: Department of Defense, “DoD Announces Strategic Force Structure,” News Release No. NR-170-14, April 8, 2014, attachment, “Fact Sheet on U.S. Nuclear Force Structure under the New START Treaty,” available at <http://archive.defense.gov/Releases/Release.aspx?ReleaseID=16627>.

Number of B-2 B61-12 bombs: 41 bombers x 16 bombs per bomber = 304 bombs.

Number of B-21 bombers: Gen. Stephen W. Wilson, USAF, vice chief of staff, Headquarters USAF, prepared statement before the House Armed Services Committee, March 8, 2017, p. 9, available at <http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF>; Gen. Robin Rand, USAF, commander, Air Force Global Strike Command, “The Land and Air Based Deterrent,” remarks at the AFA-NDIA-ROA Capitol Hill Breakfast Forum, July 28, 2016, transcript, p. 13, available at http://media.wix.com/ugd/a2dd91_157e0d555bf2402590109ee20b6323d3.pdf; unnamed Air Force Global Strike Command spokeswoman, quoted in James Drew, “USAF Basing Revised Bomber Count on ‘Minimum’ of 100 B-21s,” *FlightGlobal*, April 20, 2016, available at <https://www.flightglobal.com/news/articles/usaf-basing-revised-bomber-count-on-minimum-of-100-424433/>; and John A. Tirpak, “It’s Official: Minimum of 100 B-21s,” *Air Force Magazine Daily Report*, March 15, 2017, available at <http://www.airforcemag.com/DRArchive/Pages/2017/March%202017/March%202015%202017/It%E2%80%99s-Official-Minimum-of-100-B-21s.aspx>.

Number of W80-4 warheads for deployed LRSO cruise missiles: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Report to Congress on the Number of Long-Range Standoff Weapons as Specified by Section 1657 of the National Defense Authorization Act for Fiscal Year 2016* (Washington, D.C.: Department of Defense, March 2016), p.2, available at <http://www.ucsusa.org/sites/default/files/attach/2016/04/FY16-LRSO-cost-reporting-requirement.pdf>; Maj. Gen. Roger Burg, USAF, director of strategic security, Office of the Deputy Chief of Staff for Operations, Plans, and Requirements, Headquarters U.S. Air Force, prepared statement in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2008*, Part 7, S. Hrg. 110-201, Pt. 7, 110th Cong., 1st sess. (Washington, D.C.: GPO, 2008), p. 56, available at <https://www.gpo.gov/fdsys/pkg/CHRG-110shrg39441/pdf/CHRG-110shrg39441.pdf>; and Robert

Scher, assistant secretary of defense for strategy, plans, and capabilities, prepared statement before the Energy and Water Development Subcommittee, Senate Appropriations Committee, July 13, 2016, p. 1, available at <http://www.appropriations.senate.gov/imo/media/doc/071316-Scher-Testimony.pdf>.

Appendix B. Summaries of the 1994, 2001, and 2010 Nuclear Posture Reviews

Introduction

Since the end of the Cold War, three overall reviews of the U.S. nuclear posture have been conducted by the executive branch. One was done in 1994 by the Clinton administration, another in 2001 by the Bush administration, and the third in 2010 by the Obama administration. If history is any guide, the next administration will perform its own review. Examining the results of the three previous efforts can provide useful background for the prospective fourth review. Summaries of the past Nuclear Posture Reviews (NPRs) can be used to answer questions about the international conditions taken into account, the key problems addressed, the objectives set for the United States, and the ways and means recommended to achieve those ends. Careful comparison among the summaries can reveal significant changes and continuities from one review to the next. Perhaps most important, reviewing the reviews can aid thinking about what a future NPR should aim to accomplish.

This working paper offers summaries of the NPRs done to date. Each summary is intended to present the findings of its related NPR in an accurate, if abbreviated, manner. Quotations are frequently used to let those responsible for the reviews speak for themselves. Short reference notes that appear in brackets give the sources for quotations. A full list of references, virtually all of which are official sources, can be found at the end of the paper.

The summaries follow a common format to facilitate comparisons, although, aside from one parenthetical observation, no comparisons are made here. The categories for the common format are: 1) security environment; 2) policy and strategy; 3) forces and related programs; 4) command and control; 5) safety and security; 6) defense-industrial infrastructure; and 7) arms control.

The paper originally was prepared as background information for a small group engaged in a broader study effort currently under way at the National Institute for Public Policy. Its appearance as something between an outline and a typical paper reflects its origin. It may be of interest to a wider audience, and thus is being issued as part of the National Institute's Information Series.

1994 Nuclear Posture Review

Security Environment

--“Although the security environment has changed dramatically since the end of the Cold War, there is still great uncertainty about the future, particularly in the Newly Independent States where the process of denuclearization and reduction is underway but by no means completed.” [‘95 DoD Annual Report, 83]

-U.S.-Russian relations are improving, but the possible failure of political and economic reforms in Russia could bring a hostile authoritarian regime to power.

-The Russian conventional threat to Europe has decreased, but a large Russian nuclear arsenal (approximately 25,000 weapons) remains.

-The inadequate safety and security of Russian nuclear weapons pose the dangers of unauthorized use or theft.

--The increased threats to the U.S. and its allies from WMD proliferation and regional conflicts present greater risks than nuclear-armed Russia.

--Nuclear force planning is taking place in the context of rapid and substantial U.S. nuclear reductions that have been ongoing since 1988:

-active stockpile ↓ 59%; deployed strategic warheads ↓ 47%; nonstrategic weapons ↓ 90%; weapons storage locations ↓ 75+%;

-no weapons deployed with U.S. ground forces; no nonstrategic weapons deployed at sea;

-over 15 nuclear weapons system types eliminated, cut back, or never deployed;

-no heavy bombers on day-to-day alert; fewer SSBNs on alert (more on modified alert); no ICBMs or SLBMs targeted on any country day-to-day; command post structure reduced and operations tempo lowered for the airborne element (NEACP, TACAMO, ABNCP);

-primary duty nuclear personnel (those with nuclear access or control) ↓ 70%;

-nuclear program spending ↓ 70%; and

-“significant reduction...in the target base as a result of the change in the circumstances after the Cold War.” [DEPSECDEF Deutch, SASC testimony, 22 Sep 94, 8]

--Constraints on defense spending limit funding for nuclear forces.

Policy and Strategy

--The U.S. will pursue a “lead but hedge” strategy, which will create the conditions that lead to further nuclear reductions and a “safer world,” but hedge against the unlikely reversal of Russian reforms, the return of a hostile authoritarian regime in Moscow, the end of progress in nuclear arms control, and a Russian nuclear buildup.

--Post-Cold War conditions mean nuclear weapons play a smaller role in U.S. security than at any time since the beginning of the nuclear age.

-“U.S. nuclear weapons for years were justified by the potential for a massive conventional attack by the Warsaw Pact through the Fulda Gap which would overwhelm NATO conventional forces. ...No equivalent threat to American vital interests can be identified in the post-Cold War era, and for very few of the existing threats are nuclear weapons appropriate responses.” [‘95 DoD Annual Report, 84-85]

-No new nuclear missions or scenarios are envisioned.

-The U.S. will not use nuclear weapons against a nonnuclear state party to the NPT, except in the case of an attack on the U.S., its forces, or its allies by such a state in league with a nuclear state. (This is a reaffirmation of the 1978 U.S. negative security assurance.)

-Conventional responses to the threat or use of WMD will be pursued, without excluding a deterrent role for nuclear weapons in this regard.

--Deterrence of a *hostile* Russia is “the most stressing case” for U.S. nuclear forces. [‘95 DoD Annual Report, 87]

--U.S. nuclear forces, including a strategic reserve force, may be needed to deter “other potentially hostile powers.” (These other powers are not identified.) [‘95 DoD Annual Report, 87; DEPSECDEF Deutch, HFAC testimony, 5 Oct 94, 36]

--Strategic nuclear forces will be of “sufficient size and capability” to “deter any future hostile foreign leadership with access to strategic nuclear forces from acting against our vital interests and to convince it that seeking a nuclear advantage is futile,” by “hold[ing] at risk a broad range of assets valued by such political and military leaders.” [PDD/NSC-30, 21 Sep 94, 2]

-The nuclear response options needed are “not the massive kind of SIOP options we are so familiar with from the Cold War, but include many options to give the President...a much richer menu of options consistent with a complete change in the Cold War environment and contributing importantly to deterrence by the credibility of these options.” [DEPSECDEF Deutch, SASC testimony, 22 Sep 94, 13]

--The U.S. will continue to extend its nuclear deterrent for the defense of allied countries.

-“The United States does not have a purely national deterrent posture; it extends the deterrent protection of its nuclear arsenal to its allies. A very progressive aspect of U.S. nuclear posture is that it is, in part, an international nuclear posture. The NPR strongly supports continued commitment to NATO and Pacific allies.” [‘95 DoD Annual Report, 83]

-Nonstrategic nuclear forces are an important part of this commitment to allied security.

Forces and Related Programs

--Post-Cold War circumstances permit a much smaller nuclear arsenal.

--Reductions in U.S. forces and programs set an example for other nuclear powers, notably Russia, to follow (although the ‘95 DoD Annual Report also says, “Potential proliferators are more likely to be driven by concerns about neighbors’ capabilities or desire for prestige or regional hegemony than by decisions America makes about its nuclear arsenal.” [p. 85]).

--Strategic nuclear

-The force structure has flexibility to reconstitute (hedge) or further reduce (lead).

-The triad is maintained as a hedge against technical failures or adversary technological breakthroughs that endanger a triad leg (SSBNs, ICBMs, or bombers), and because of the useful attributes of each leg.

SSBNs will carry roughly half of U.S. accountable warheads under START II; “a significant portion” of the force “is at sea at any given time,” where the SSBNs are “virtually undetectable,” making them “the most survivable and enduring element” of the triad; and D5 SLBMs have the accuracy, range, and payload to “hold at risk almost the entire range of strategic targets.”

ICBMs, with their high alert rate and short time of flight, provide a “prompt-response capability”; they have the “ability to strike selectively”; three-warhead Minuteman III missiles downloaded to one warhead apiece offer a “significant upload hedge”; and downloaded Minuteman IIIs “also increase the cost ratio of an adversary attempting a first strike.”

Bombers are survivable when on alert at air bases; they “provide a hedge against a catastrophic failure of either the SSBN or ICBM leg”; and, because of their dual capability, they “can help in conventional contingencies.” [‘95 DoD Annual Report, 88; DEPSECDEF Deutch, HFAC testimony, 5 Oct 94, 56]

-The planned force structure is consistent with START II limits (3,000-3,500 total deployed strategic nuclear warheads; no more than 1,700-1,750 SLBM warheads; and no MIRVed ICBMs).

14 Trident SSBNs (down from 18), each with 24 D5 SLBMs (D5s replace C4s on 4 SSBNs), and 5 RVs per SLBM; SSBN fleet size maintains two-ocean basing (Bangor, WA and Kings Bay, GA); the option of reducing to 10 SSBNs was rejected; the future of the 4 decommissioned SSBNs is not yet decided.

500/450 single-warhead Minuteman III ICBMs at three wings (the partially declassified PDD/NSC-30 says “or 350/300 missiles” at two wings); the option of eliminating ICBMs was rejected.

66 B-52H cruise missile-armed bombers (down from 94 B-52Hs previously planned); 20 B-2 bombers with gravity bombs (no more B-2s are needed for nuclear missions); all 94 B-1B bombers are reoriented to a nonnuclear role; the conventional role of bombers is emphasized.

-The hedge comprises: 1) the nuclear weapons complex and other relevant parts of the defense-industrial infrastructure; 2) “where possible in near term, maintenance of platforms” [DEPSECDEF Deutch, briefing slide, HFAC testimony, 5 Oct 94, 59]; and 3) a stockpile able to support uploading of additional warheads on SLBMs, ICBMs, and bombers. “3” is emphasized in DoD descriptions of the hedge.

-No new strategic nuclear systems are under development or planned.

-No change in the existing readiness and alert status of the nuclear forces is made.

-FY92-FY01 strategic forces (Major Force Program 1) total obligational authority in billions of FY17 constant dollars: FY92: 26.4 FY93: 21.6 FY94: 15.3 FY95: 12.8 FY96: 12.0 FY97: 9.8 FY98: 10.3 FY99: 10.2 FY00: 10.2 FY01: 9.9 [FY17 DoD Green Book, 103-104]

--Nonstrategic nuclear

-The “theater presence” of nonstrategic nuclear forces “reinforce[s] resolve, commitment through visibility” and “makes [the] nuclear weapons role concrete.” “Rapidly deployable” nonstrategic forces can “respond to [an] emergent crisis” and “react early or late.” These forces have the “ability to hold at risk key targets” and to carry out proportionate responses. Their “low profile” “support[s] the nonproliferation regime.” [DEPSECDEF Deutch, briefing slide, SASC testimony, 22 Sep 94, 16]

-Dual-capable aircraft are kept at existing strength in CONUS and Europe; the capability to deploy TLAM-N on SSNs is retained; and the planned nonstrategic nuclear force supports alliance commitments.

-The capability to deploy nuclear weapons on carrier-based aircraft and surface ships is eliminated; this, it is hoped, can encourage Russia to follow suit.

-The options of a “more robust [nonstrategic nuclear force] structure” or elimination of all nonstrategic nuclear forces are rejected. [’95 DoD Annual Report, 89]

-No new delivery systems are under development or planned.

--Nuclear warheads

-No new-design nuclear warheads are under development or planned.

--Missile defense

-“The NPR did not look at the ballistic missile defense program, because that was an area that was carefully and extensively studied in the Bottom-Up Review.” [DEPSECDEF Deutch, SASC testimony, 22 Sep 94, 46]

Command and Control

--“Adequate funding of critical programs” will be continued.

--Remedies for deficiencies in the communication system and in tactical warning/attack assessment capabilities will be pursued.

--Intelligence systems providing “timely information and threat characterization and warning indicators” will be supported.

--“Programs for assured NCA survivability and connectivity” will continue to be supported. [‘95 DoD Annual Report, 89-90; PDD/NSC-30, 21 Sep 94, 2]

Safety and Security

--The highest standards and U.S. leadership in nuclear safety and control will be maintained.

--The equipping of Trident SSBNs with coded locking devices will be accelerated and the devices on Minuteman III ICBMs and B-52H bombers will be upgraded.

--Minuteman III W62 warheads will be retired for lack of certain safety features.

--The number of response teams for nuclear accidents and incidents will be “optimized.” [DEPSECDEF Deutch, briefing slide, HFAC testimony, 5 Oct 94, 70]

--A regular nuclear procedures exercise program in which senior defense officials and military leaders participate will be reestablished.

--The U.S. will encourage Russia to take corresponding actions to improve nuclear safety and security.

Defense-Industrial Infrastructure

--The smaller post-Cold War force and the absence of nuclear testing present challenges in sustaining the infrastructure supporting that force.

--Measures that help sustain the nuclear-related defense-industrial base include: continued production of D5 SLBMs to replace C4 missiles in four Trident SSBNs; replacement of guidance systems and remanufacture of motors for Minuteman III ICBMs; and additional funds allocated to support the base for guidance systems and RVs.

-Work on stealth (e.g., for the F-22) and on commercial aircraft makes funding to support the bomber industrial base unnecessary.

--Sustaining the nuclear weapons infrastructure involves: developing a stockpile surveillance engineering base; maintaining the capability to design, fabricate (or refabricate), and certify existing nuclear weapon types and new warheads; maintaining an S&T base to support nuclear weapons; and DoD and DOE making a prompt decision on a source and production program for the tritium supply to support nuclear weapons.

-No production is required for new-design nuclear warheads.

Arms Control

--START II ratification, NPT indefinite extension, and CTBT negotiation and ratification are endorsed.

--Future options are considered for further and faster reductions in strategic arms: accelerated implementation of START I and II; negotiation of a follow-on agreement to START II; and unilateral U.S. cuts.

--Strong interest is expressed in reducing the Russian advantage in nonstrategic nuclear weapons.

--In addition to treaties, "unilateral and informal bilateral reductions in nuclear weapons play a much greater role in U.S. security." ['95 DoD Annual Report, 10]

--Initiatives considered to address the "more urgent issues" of the safety and security of nuclear weapons and materials include removing ICBM warheads, stockpile data exchanges, acceleration of warhead dismantlements, and storage of Russian weapons or materials under international custody. ['95 DoD Annual Report, 91; DEPSECDEF Deutch, SASC testimony, 22 Sep 94, 24; DEPSECDEF Deutch, briefing slide, HFAC testimony, 5 Oct 94, 73]

2001 Nuclear Posture Review

Security Environment

--In comparison to the Cold War, the security environment is more dynamic and unpredictable.

-The U.S. confronts a range of potential adversaries, including hostile states (regional powers and latent peer competitors), possible coalitions of opposing states, and nonstate actors.

-The leaders of adversary states “generally are subject to few if any institutional restraints,” their “decision-making processes are obscure,” and their “behavior is often unpredictable,” all of which makes the effectiveness of deterrence more uncertain. [‘01 NPR, 6]

-Adversaries could be armed with WMD and ballistic missiles, which could threaten the U.S., its allies and friends, and its forward-deployed forces.

-Multiple crises and conflicts could arise, some of which could be unexpected.

-Under these conditions, “the probability of surprise and ubiquity of uncertainty are dominant strategic considerations for the U.S.” [‘02 DoD Annual Report, 84]

--A number of countries represent potential adversaries.

-Unlike the Soviet Union, Russia is not an enemy. The U.S. seeks a “new strategic framework” with Russia, involving greater cooperation in the security, diplomatic, economic, and other realms.

While Russia is not now a threat, nor is likely to become one in the future, the possibility remains that Russia could change for the worse. Consequently, the U.S. must “determine its nuclear force requirements at a time when a major nuclear power is neither a traditional ally nor an implacable foe.” [‘01 NPR, 6]

-The potential of China to become a hostile nuclear-armed power is also a source of concern. [SECDEF Rumsfeld, SFRC testimony, 17 Jul 02, 111; USD(P) Feith, SASC testimony, 14 Feb 02, 354; NIPP, Planning the Future Nuclear Force, v. 2, C-3]

-“We also in [the NPR] direct the Pentagon to take note of and consider possible threats to the United States from those nations that are seeking to acquire weapons of mass destruction. And the report specifically cited, as the press has reported, Iraq, Iran, Syria, Libya, North Korea.” [VP Cheney, media availability in London, White House transcript, 11 Mar 02]

--There are three general types of contingencies for which U.S. nuclear forces should be sized.

-Immediate: “well-recognized, current dangers,” such as “an attack using WMD on U.S. forces or a key friend or ally in the Middle East.” No immediate contingency involves Russia.

-Potential: “plausible, but not immediate, dangers” that can be anticipated and for which there is adequate warning. Examples include “the emergence of a new, hostile military coalition against the United States or its allies in which one or more members possess WMD and the means of delivery,” and the “re-emergence of a hostile peer competitor.”

-Unexpected: “sudden and unpredicted security challenges,” for example, “a sudden regime change by which an existing nuclear arsenal comes into the hands of a new, hostile leadership group,” and “an adversary’s surprise acquisition of WMD capabilities.” [‘02 DoD Annual Report, 88-89]

Policy and Strategy

--The range of possible opponents, potential conflicts, and uncertainties confronting the U.S. in the post-Cold War security environment requires a capabilities- rather than a threat-based approach to defense planning.

-In contrast to threat-based planning, capabilities-based planning “focuses more on how an adversary might fight and the means it might use than who the adversary might be and where a war might occur.” [‘01 NPR, 8] (The capabilities-based approach is carried over from the 2001 Quadrennial Defense Review of overall U.S. defense strategy and military forces.)

--Under the capabilities-based approach, the nuclear triad of SSBNs, ICBMs, and heavy bombers, along with the nonstrategic nuclear forces, will become part of a “New Triad,” a broader, more diverse portfolio of strategic capabilities comprising nuclear and nonnuclear strike forces, active and passive defenses, and the related R&D and industrial infrastructure. Command and control, planning, and intelligence capabilities tie together the offensive, defensive, and infrastructure elements of the New Triad.

-The New Triad will offer additional and more varied options for countering threats and responding to aggression, including response options developed during the course of a crisis.

--New Triad capabilities, including the nuclear forces, will be shaped and evaluated with reference to four defense policy goals: assure allies and friendly countries of U.S. security commitments; dissuade adversaries from competing militarily with the U.S.; deter coercion or attack against the U.S. or its allies and friends; and decisively defeat an enemy while defending the U.S. and its security partners. (These goals also are from the 2001 QDR.)

--Within the New Triad, nuclear forces “will continue to play a critical role in the defense capabilities of the United States, its allies and friends. They provide credible military options to

deter a wide range of threats, including WMD and large-scale conventional military force. These nuclear capabilities possess unique properties that give the United States options to hold at risk targets important to achieve strategic and political objectives.” [‘01 NPR, 7]

-“The United States must retain sufficient strategic nuclear forces to deter any hostile foreign leadership from using weapons of mass destruction against U.S. vital interests.” [‘01 NPR, 15] (This is a variation on a similar statement associated with the 1994 NPR.)

Forces and Related Programs

--Strategic nuclear

-The changed relationship with Russia—notably that it no longer is an immediate threat—along with anticipated improvements in nonnuclear offensive and defensive capabilities, give the U.S. the opportunity to reduce both its dependence on nuclear weapons and the number of operationally deployed warheads in its nuclear stockpile.

The capabilities-based approach to force planning will provide “a credible deterrent at the lowest level of nuclear weapons consistent with U.S. and allied security” [SECDEF Rumsfeld, ‘01 NPR, ii], the goal set by President Bush in a May 2001 NDU speech.

-Between 2002 and the end of 2012, U.S. operationally deployed strategic nuclear warheads (ODSNWs) will be reduced to a range of 1,700-2,200, from a level of 6,000 START-accountable warheads.

ODSNWs are RVs on ICBMs in their launchers, RVs on SLBMs in their SSBN launch tubes, and nuclear weapons on heavy bombers or stored at bomber bases.

The 1,700-2,200 range reflects the inability to predict future nuclear force requirements with precision and allows flexibility for adjusting to changes in the security environment.

-To support the four QDR/NPR defense policy goals, the ODSNW level and the associated delivery vehicles take into account:

“an assurance-related requirement for U.S. nuclear forces that they be judged second to none;

the force structure needed to provide options to halt the drawdown or re-deployment of warheads to enforce the goals of deterrence and dissuasion;

the number and types of targets to be held at risk for deterrence; and

the forces needed to defeat adversaries across a spectrum of conflicts and scenarios.” [‘01 NPR, 15-16]

-The decrease in ODSNWs will be accomplished through the withdrawal of delivery platforms from nuclear service and the downloading of warheads from remaining platforms.

50 Peacekeeper ICBMs will be retired (silos retained), with their modern W87 warheads replacing W62 warheads on certain Minuteman III ICBMs configured to carry single RVs.

4 Trident SSBNs will be removed from nuclear service.

The capability to reconvert the conventional-only B-1B bombers to nuclear missions will be eliminated.

-The force structure retained comprises:

14 Trident SSBNs, all with D5 SLBMs, operating from two bases;

500 Minuteman III ICBMs, some number with single RVs; and

76 B-52H bombers with cruise missiles and 21 B-2 bombers with gravity bombs.

-To achieve the 1,700-2,200 ODSNW level, an appropriate number of warheads will be downloaded from retained ballistic missiles and removed from storage areas at bomber bases on a schedule subject to periodic review, including assessment of changes in both the security environment and the development of New Triad nonnuclear elements.

-Some downloaded warheads will be retired and dismantled, but a significant number (not determined at the time the NPR was issued) will be kept in the nuclear stockpile as part of a responsive capability.

While the operationally deployed force, which is ready on short notice, is intended to be sufficient for immediate and unexpected contingencies, the responsive capability augments that force to address potential contingencies (see the three contingency types discussed in the Policy and Strategy section) and, like the operationally deployed force, serves the defense policy goals of assure, dissuade, deter, and defeat.

Until a responsive defense-industrial infrastructure is in place, one that, among other things, can produce additional or new types of warheads and delivery means, the responsive capability will be limited to the ability to upload stored warheads on the ballistic missiles and bombers of the operationally deployed force.

The size and composition of the NPR-endorsed operationally deployed force reflect “the need to preserve force structure that can be reconstituted to provide a responsive capability for dissuasion and deterrence of potential contingencies.” [USD(P) Feith, SASC testimony, 14 Feb 02, 379]

In general, uploading will take weeks for bombers, months for SLBMs, and a few years for ICBMs. The NPR implementation plan “directs [the] services to retain sufficient warheads and support equipment to respond to unforeseen events and be able to

augment (upload) nuclear warheads,” and “provides specific timeliness goals for [the] services to plan augmentation capabilities.” [DoD, NPR Implementation Plan, Feb 03, unnumbered last page]

-De-alerting proposals intended to reduce the risk of accidental or unauthorized launches were examined, as required by Congress, but no change in the launch readiness of nuclear forces is announced.

The New Triad “will provide a spectrum of defensive and non-nuclear response options to an accidental or unauthorized launch, allowing the United States to tailor an appropriate response to the specific event and to limit the danger of escalation.” [‘01 NPR, 54]

-Life extension, sustainment, and upgrade programs for existing SLBMs, ICBMs, bombers and bomber-delivered cruise missiles will be continued, and alternatives for follow-on ballistic missiles, SSBNs, and bombers will be studied.

-FY00-FY09 strategic forces (Major Force Program 1) total obligational authority in billions of constant FY17 dollars: FY00: 10.2 FY01: 9.9 FY02: 11.4 FY03: 11.0 FY04: 11.5 FY05: 11.3 FY06: 11.8 FY07: 11.9 FY08: 12.2 FY09: 11.2 [FY17 DoD Green Book, 104]

--Nonstrategic nuclear

-CONUS- and Europe-based dual-capable aircraft are maintained.

-Existing nuclear weapons storage sites in Europe will be maintained through FY04.

-“DoD is considering options and their associated costs to either extend the life of the dual-capable F-16C/Ds and F-15Es or make a block upgrade to the Joint Strike Fighter (JSF) aircraft.” [‘01 NPR, 44]

-TLAM-Ns, removed from ships and SSNs after the 1991 Presidential Nuclear Initiative, will remain in a “reserve status.” [‘02 DoD Annual Report, 86]

--Nuclear warheads

-The decision to retire the W62 (Minuteman III) warhead by 2009 is reaffirmed.

-The stockpile refurbishment plan for the W80 (ALCM, ACM, and TLAM-N warhead), W76 (Trident D5 warhead), and B61 (bomber and DCA warhead) is reaffirmed.

-The “exact quantities and readiness requirements” of the nonstrategic warheads in the nuclear stockpile “are still to be determined.” [NNSA Administrator Gordon, SASC testimony, 14 Feb 02, 338]

-While there are no recommendations to develop new nuclear weapons, the U.S. “must...have the capability to respond to changes in the strategic environment, if need be,

by being able to reconstitute larger force levels with safe and reliable warheads and develop, produce, and certify new or modified nuclear warheads to meet new military requirements.” [NNSA Administrator Gordon, SASC testimony, 14 Feb 02, 341]

--Nonnuclear strike

-“Non-nuclear strike capabilities include advanced conventional weapons systems (long-range, precision-guided weapons and associated delivery means), offensive information operations, and special operations forces (the latter can be used to hunt for mobile missiles or operate against WMD facilities).” ['01 NPR, 10]

-The four Trident SSBNs removed from nuclear service will be modified to become SSGNs armed with conventional cruise missiles.

-Proposed for funding in FY03 are programs for “a fast-response, precision-impact, conventional penetrator for hard and deeply buried targets,” “modification of a strategic ballistic missile system to enable the deployment of a non-nuclear payload,” and “concept development...to explore options for advanced strike systems.” [USD(P) Feith, SASC testimony, 14 Feb 02, 329]

--Defenses

-“Active defenses include ballistic missile defense and air defense. Passive defenses include measures that reduce vulnerability through mobility, dispersal, redundancy, deception, concealment, and hardening; warn of imminent attack and support consequence management activities that mitigate the damage caused by WMD use; and protect against attacks on critical information systems.” ['01 NPR, 10]

-Proposed for funding in FY03 is “an aggressive R&D program for ballistic missile defense” to evaluate “a spectrum of technologies and deployment options.” [USD(P) Feith, SASC testimony, 14 Feb 02, 329]

Command and Control

--“The New Triad is bound together by enhanced command and control (C2) and intelligence systems. ...Improved command and control, planning and intelligence can increase the effectiveness of the elements of the New Triad, both separately and in combination.” ['01 NPR, 15]

--Efforts are underway to “develop secure, wide-band communications between national decision makers, command centers and operational forces”; “develop advanced technology programs for intelligence, e.g., for Hard and Deeply Buried Targets and mobile targets”; and “upgrade STRATCOM’s capability for adaptive planning” to enable “rapid, flexible crisis response that integrates nuclear, conventional, and non-kinetic weapons into our war plans.” [ASD(ISP) Crouch, briefing slide, 9 Jan 02 briefing; CINCSTRAT ADM Ellis, SASC testimony, 14 Feb 02, 384]

Safety and Security

--The topic of the safety and security of nuclear weapons, U.S. and foreign, received less attention in the 2001 NPR than in the previous review. A federal advisory committee established by DoD to perform an independent review of "all activities involved in maintaining the highest standards of nuclear weapons safety, security, control, and reliability" had not completed its assessment in time to inform the work for the NPR. ['01 NPR, 26]

Defense-Industrial Infrastructure

--"The R&D and industrial infrastructure includes the research facilities, manufacturing capacity, and skilled personnel needed to produce, sustain, and modernize the elements of the New Triad as well as the supporting intelligence and command and control capabilities." ['01 NPR, 10]

--The infrastructure is a central element of the New Triad. "In particular, a modern, responsive nuclear weapons sector is indispensable, especially as the size of the operationally deployed nuclear arsenal is reduced." ['01 NPR, 10-11]

--The "technology base and production readiness infrastructure of both DoD and NNSA must be modernized so that the United States will be able to adjust to rapidly changing situations." ['01 NPR, 26]

--The DOD effort to improve the infrastructure for strategic forces includes the funding of technology sustainment programs for "reentry systems, solid rocket motors, guidance systems, and radiation hardened electronic parts," as well as for surveillance and testing to support life extension programs for weapons systems. ['01 NPR, 45]

--"NNSA has initiated efforts to recapitalize deteriorating facilities (or build entirely new facilities), restore lost production capabilities and modernize others, sustain and modernize the R&D base for nuclear weapons, and develop new tools, as required, to assure safety and reliability of the nuclear stockpile." ['01 NPR, 33]

--"Small, advanced warhead concept teams" will be reestablished at the national labs and NNSA headquarters to "carry out theoretical and engineering design work on one or more concepts, including options to modify existing designs or develop new ones." [NNSA Administrator Gordon, SASC testimony, 14 Feb 02, 339; '01 NPR, 35]

--Nuclear test readiness will be increased to reduce the time needed to conduct an underground test from 24-36 months to "something substantially less" (specific time period to be determined). Improved readiness will hedge against a critical safety or reliability problem that cannot be fixed without testing. [ASD(ISP) Crouch and NNSA official Harvey, 9 Jan 02 briefing]

Arms Control

--Nuclear reductions will be achieved without the adversarial negotiations and rigid treaties of the Cold War. The planned U.S. reduction to 1,700-2,200 ODSNWs is a unilateral decision (informed by work for the NPR), reciprocated by Russia, and subsequently codified in the three-page 2002 Moscow Treaty.

--The Moscow Treaty offers considerable flexibility for force planning and reductions: delivery platforms are not limited; Trident SSBNs and B-1B bombers can be converted to nonnuclear roles; nondeployed warheads can be stored rather than destroyed; the implementation deadline is 10 years from the treaty's entry into force; and the withdrawal notification requirement is three months (half the six months often required by other treaties). [CJCS Gen Myers, SFRC testimony, 17 Jul 02, 90-91]

--U.S. compliance with START I will continue and its verification regime will remain in effect.

--Shortly before the NPR is submitted to Congress, the U.S. gives notice that it will withdraw from the ABM Treaty in six months, in order to counter new ballistic missile threats with defenses more capable than what the treaty permits.

--A moratorium on nuclear testing will continue, but the Bush administration does not support CTBT ratification.

--Russian nonstrategic nuclear weapons remain a concern. The U.S. will consult with Russia on providing greater transparency with regard to these weapons.

2010 Nuclear Posture Review

Security Environment

--Since the end of the Cold War, the “threat of global nuclear war has become more remote, but the risk of nuclear attack has increased.” [‘10 NPR, 3]

-With regard to NATO, “the risk of nuclear attack against [Alliance] members is at an historical low” (but the NATO nuclear posture still “contribute[s] to Alliance cohesion and provide[s] reassurance to allies and partners who feel exposed to regional threats”). [‘10 NPR, 32]

--“The most immediate and extreme threat is nuclear terrorism.” [‘10 NPR, 3]

-Al-Qa’ida leaders and other terrorists seek nuclear weapons and, if they were acquired, would use them.

-The vulnerability of nuclear materials to theft and the availability of nuclear-related equipment and technologies raise the risk of terrorist acquisition of a nuclear weapon.

--“Today’s other pressing threat is nuclear proliferation.” [‘10 NPR, 3]

-North Korea and Iran are in violation of their nonproliferation obligations, they have programs for nuclear-capable missiles, and they threaten aggression against their neighbors.

--In addition, the U.S. faces “the more familiar challenge of ensuring strategic stability with existing nuclear powers—most notably Russia and China.” [‘10 NPR, 4]

-Russia “is not an enemy,” “the prospects for military confrontation have declined dramatically,” and Moscow is cooperating with the U.S. in “areas of shared interest, including preventing proliferation and nuclear terrorism.” [‘10 NPR, 4, 15] At the same time, Russia is the only nuclear peer of the U.S. and is modernizing its nuclear forces.

-China and the U.S. “are increasingly interdependent and their shared responsibilities for addressing global security threats, such as WMD proliferation and terrorism, are growing.” But China’s military modernization, including increases in the size and improvements in the capabilities of its nuclear force, worries countries in Asia. Lack of transparency about its nuclear strategy, programs, and forces “raises questions about China’s future strategic intentions.” [‘10 NPR, 5]

--There is also a danger of “geopolitical surprise.” (This term appears several times in the NPR report with reference to a “hedge” of nondeployed warheads.)

Policy and Strategy

--“Five key objectives of our nuclear weapons policies and posture [are]:

1. Preventing nuclear proliferation and nuclear terrorism;
2. Reducing the role of U.S. nuclear weapons in U.S. national security strategy;
3. Maintaining strategic deterrence and stability at lower nuclear force levels;
4. Strengthening regional deterrence and reassuring U.S. allies and partners; and
5. Sustaining a safe, secure, and effective nuclear arsenal.” [‘10 NPR, 2]

-“For the first time, preventing nuclear proliferation and nuclear terrorism is now at the top of America’s nuclear agenda.” [President Obama, NPR statement, 6 Apr 10]

--“The long-term goal of U.S. policy is the complete elimination of nuclear weapons.”

Implementing the measures recommended by the NPR will “bring us significant steps closer to the President’s vision of a world without nuclear weapons.” [‘10 NPR, 48]

--Contemporary conditions warrant reduction in the role and number of U.S. nuclear weapons.

-“The massive nuclear arsenal we inherited from the Cold War era of bipolar military confrontation is poorly suited to address the challenges posed by suicidal terrorists and unfriendly regimes seeking nuclear weapons.” [‘10 NPR, 6]

-“Since the end of the Cold War, the United States and Russia have reduced operationally deployed strategic nuclear weapons by about 75 percent, but both still retain many more nuclear weapons than needed for deterrence.” [‘10 NPR, 19]

--The role of nuclear weapons can be reduced by shifting more of the burden for deterrence and defense to nonnuclear capabilities, and by adopting a new declaratory policy concerning nuclear use.

-Along with the end of the Cold War rivalry, the overall superiority of U.S. conventional forces, the improvements in U.S. missile defenses, and the advances in U.S. “counter-WMD capabilities” make possible a reduced role for nuclear weapons in deterring nonnuclear attacks, as well as further reductions in the number of nuclear weapons.

As part of “regional security architectures,” these same nonnuclear military means will be increasingly important in assuring allies and partners of U.S. security commitments.

-A change in U.S. declaratory policy also will reduce the nuclear role.

"The United States will not use or threaten to use nuclear weapons against non-nuclear weapons states that are party to the Nuclear Non-Proliferation Treaty and in compliance with their nuclear non-proliferation obligations." ['10 NPR, 15] (This is a revision of the long-standing U.S. negative security assurance.)

States in this category that used chemical or biological weapons against the U.S., its allies, or its partners "would face the prospect of a devastating conventional military response," and the "national leaders or military commanders" behind the attack "would be held fully accountable." ['10 NPR, 16]

Adverse changes in the existing threat from biological weapons or in U.S. counter-BW capabilities could result in the modification of this policy.

For nuclear weapons states and states not in compliance with their nuclear nonproliferation obligations, "there remains a narrow range of contingencies in which U.S. nuclear weapons may still play a role in deterring conventional or CBW attack" against the U.S., its allies, or its partners. This narrow range would involve "extreme circumstances" in which "vital interests" were at stake. ['10 NPR, 16]

The new assurance excludes Russia and China (as nuclear weapons states) and North Korea and Iran (as noncompliant states).

The new declaratory policy is intended to 1) assure compliant states that they face no nuclear threat from the U.S., 2) encourage those states to join with the U.S. in nonproliferation efforts, 3) send a deterrent message to noncompliant states that "all options are on the table" [SECDEF Gates, NPR briefing, 6 Apr 10], and 4) give those states an incentive to comply with their nuclear nonproliferation obligations.

-The NPR "closely considered the option of establishing deterrence of nuclear attack as the sole purpose of nuclear weapons, and concluded that the conditions for...making such a declaratory policy don't exist today." [PDUSD(P) Miller, HASC testimony, 14 Apr 10, 14]

"Allies and friends around the world...indicated that such a radical shift in U.S. approach could be unsettling to them. And so we went with this [revised] negative security assurance." [State Dept. Special Advisor Einhorn, NPR briefing, 7 Apr 10]

"We obviously are not prepared to do 'no first use' or 'sole purpose' because that could raise questions about our commitment to use the full range of our military power to protect our friends." [White House Coordinator for Arms Control and WMD Samore, Carnegie conference, 22 Apr 10]

But the U.S. "will work to establish conditions"—including further improvements in nonnuclear capabilities and reduction in the CBW threat—"under which a [sole-purpose] policy could be safely adopted." ['10 NPR, 16]

-Nuclear weapons retain an important role in the security of the U.S., its allies, and its partners.

"The fundamental role of U.S. nuclear weapons, which will continue as long as nuclear weapons exist, is to deter nuclear attack on the United States, our allies, and partners." [10 NPR, 15]

In the absence of conditions necessary for a sole-purpose policy, "Nuclear weapons continue to play an important role in deterring non-nuclear attack, including conventional or chemical-biological attack arising from a nuclear weapons state." [PDUSD(P) Miller, HASC testimony, 14 Apr 10, 15]

Nuclear weapons "will continue to play an essential role in deterring potential adversaries, reassuring allies and partners around the world, and promoting stability globally and in key regions." [10 NPR, 6]

--Improved U.S.-Russian relations means "strict numerical parity" is less "compelling" than it was during the Cold War. But it will be important for Russia to join the U.S. in further nuclear reductions because "large disparities in nuclear capabilities could raise concerns on both sides and among U.S. allies and partners, and may not be conducive to maintaining a stable, long-term strategic relationship," particularly at significantly lower force levels. [10 NPR, 30]

--To help prevent nuclear terrorism, the U.S. reaffirms its commitment "to hold fully accountable any state, terrorist group, or other non-state actor that supports or enables terrorist efforts to obtain or use weapons of mass destruction, whether by facilitating, financing, or providing expertise or safe haven for such efforts." [10 NPR, 12]

Forces and Related Programs

--Strategic nuclear

-After a "wide range" of alternative strategic force postures were examined, including options that eliminated a leg of the nuclear triad, "a smaller Triad" was endorsed as the posture that "will best maintain strategic stability at reasonable cost, while hedging against potential technical problems or vulnerabilities." [10 NPR, 21]

Each triad leg has advantages that warrant its retention in the force structure as a whole.

SSBNs are the most survivable triad element. Their SLBMs are not vulnerable to air defenses.

ICBMs have "extremely secure command and control, high readiness rates, and relatively low operating costs." Like SLBMs, they are not vulnerable to air defenses. Single-warhead ICBMs are stabilizing. The ICBM force offers "a hedge against any future vulnerability of U.S. SSBNs." [10 NPR, 23]

Bombers, unlike ballistic missiles, "can be visibly forward deployed, as a signal to strengthen deterrence of potential adversaries and assurance of allies and partners."

[‘10 NPR, 24] They provide a hedge that rapidly can be put in place in the event technical problems afflict one of the other triad legs or if “geopolitical uncertainties” pose new dangers. [‘10 NPR, 24] In addition, bombers can be used in a conventional role.

-The strategic force structure under the New START treaty was determined according to four requirements:

“Supporting strategic stability through an assured second-strike capability;

Retaining sufficient force structure in each leg to allow the ability to hedge effectively by shifting weight from one Triad leg to another if necessary due to unexpected technological problems or operational vulnerabilities;

Retaining a margin above the minimum nuclear force structure for the possible addition of non-nuclear prompt-global strike capabilities (conventionally-armed ICBMs or SLBMs) that would be accountable under the Treaty; and

Maintaining the needed capabilities over the next several decades or more, including retaining a sufficient cadre of trained military and civilian personnel and adequate infrastructure.” [‘10 NPR, 20-21]

-The New START-compliant baseline force structure is composed of:

14 Trident SSBNs, with the launch tubes on each submarine reduced from 24 to 20, and no more than 240 SLBMs deployed at any time;

up to 420 Minuteman III ICBMs, each with a single RV; and

up to 60 deployed nuclear-capable B-52H and B-2 bombers. [unclassified White House fact sheet on the classified Report in Response to NDAA FY10 Section 1251: New START Framework and Nuclear Force Structure Plans, 13 May 10]

(The New START central limits are: 700 deployed ICBMs, SLBMs, and nuclear-capable heavy bombers; 1,550 accountable nuclear warheads on deployed ICBMs, SLBMs, and nuclear-capable heavy bombers; and 800 deployed and nondeployed ICBM launchers, SLBM launchers, and nuclear-capable heavy bombers.)

-“Depending on future force structure assessments and how remaining SSBNS age in the coming years, the United States will consider reducing from 14 to 12 Ohio-class [Trident] submarines in the second half of this decade.” [‘10 NPR, 22])

-The size of the “technical hedge” in the nuclear stockpile will be “significantly” reduced, but some number of nondeployed warheads will be retained to upload on existing SLBMs, ICBMs, or bombers in the event of technical problems with certain delivery vehicles or warheads, or in response to “geopolitical surprise.” “Preference will be given to upload capacity for bombers and strategic submarines.” [‘10 NPR, 22, 25]

-The current alert posture of the strategic force will be maintained: a “significant number” of SSBNs always at sea in the Atlantic and Pacific oceans; “nearly all” ICBMs routinely on alert; and bombers off “full-time alert.” [‘10 NPR, 22, 25]

Reducing SSBN and ICBM alert rates “could reduce crisis stability by giving an adversary an incentive to attack before ‘re-alerting’ was complete.” [‘10 NPR, 26]

-The NPR endorses Navy R&D activities to develop a replacement for the Ohio-class SSBN, Air Force efforts to extend the service life of the Minuteman III to 2030; and Air Force studies for follow-on ICBMs, bombers, and air-launched cruise missiles.

-FY08-FY16 strategic forces (Major Force Program 1) total obligational authority in billions of constant FY17 dollars: FY08: 12.2 FY09: 11.2 FY10: 11.0 FY11: 13.1 FY12: 13.5 FY13: 11.7 FY14: 12.1 FY15: 11.9 FY16: 13.3 [FY17 DoD Green Book, 104]

--Nonstrategic nuclear

-The F-35 Joint Strike Fighter will replace F-16s in the dual-capable aircraft role.

-The B61 bomb will undergo a full-scope life extension program “to ensure its functionality” with the F-35, and to make safety, security, and use control improvements in the bomb. [‘10 NPR, 27]

-Nuclear capability for the F-35 and life extension for the B61 will “keep open all options” for future NATO decisions regarding the “requirements of nuclear deterrence and nuclear sharing.” [‘10 NPR, 27-28]

-The TLAM-N will be retired as “redundant” because of the similar ability of forward-deployable dual-capable fighters and heavy bombers to assure allies, to deter states that threaten allies, and, along with ICBMs and SLBMs, to carry out strikes against aggressors. [‘10 NPR, 28]

--Nuclear warheads

-No new nuclear warheads will be developed. No life extension programs will be undertaken to give existing warheads new military capabilities or to adapt them for new military missions. [‘10 NPR, 39] Examples of new nuclear warheads are “enhanced radiation weapons, electromagnetic pulse weapons, and nuclear-explosive driven x-ray weapons.” [NNSA Administrator D’Agostino, SASC testimony, 22 Apr 10, 39]

-LEPs “will only use nuclear components based on previously tested designs.” [‘10 NPR, 39]

-To ensure warhead safety, security, and reliability, the full range of life-extension options will be considered: “refurbishment of existing warheads, reuse of nuclear components from different warheads, and replacement of nuclear components.” “Strong preference” will be given to refurbishment and reuse options. [‘10 NPR, 39]

-The NPR endorses full-rate production for the W76 SLBM warhead, full-scope life extension of the B61 bomb, and study of LEP options for the W78 ICBM warhead, including possible use of the life-extended warhead on SLBMs. ['10 NPR, 39]

-“The United States has made the decision not to design and produce new nuclear warheads; however, we will preserve our capability for doing so...should national security require it in the future.” [NNSA Administrator D’Agostino, SASC testimony, 22 Apr 10, 56; see also PDUSD(P) Miller, HASC testimony, 14 Apr 10, 30]

--Nonnuclear strike

-Some B-52H bombers will be converted to a conventional-only role.

-“The United States will...develop non-nuclear prompt global strike capabilities,” but only as a “limited,” “niche capability” oriented toward “regional threats while not undermining strategic stability with Russia or China.” ['10 NPR, 33, 34; CJCS ADM Mullen, SFRC testimony, 18 May 10, 85; DUSD(P) Miller, SFRC testimony, 16 Jun 10, 275; PDUS(P) Miller, SASC testimony, 22 Apr 10, 9]

--Missile defense

-Ballistic missile defense policy, strategy, and capabilities are addressed in the DoD *Ballistic Missile Defense Review Report* (February 2010).

Command and Control

--The Secretary of Defense directs “a number of initiatives to further improve the resiliency of the NC3 [Nuclear Command, Control, and Communication] system and the capabilities for the fully deliberative control of the force in time of crisis.” These initiatives include:

“modernizing ‘legacy’ single-purpose NC3 capabilities to meet current and projected challenges”;

“continuing to invest in secure voice conferences for NC3”; and

conducting a DoD-led interagency study to “determine the investment needed and organizational structure best suited to further strengthening NC3 capabilities.” ['10 NPR, 26]

--A key aim of NC3 investments is to “further reduce the risk of false warning or misjudgments related to nuclear use” and “maximize Presidential decision time in a nuclear crisis.” ['10 NPR, x, 47]

--More survivable basing for a follow-on ICBM also would help maximize decision time and “further reduce any incentives for prompt launch.” ['10 NPR, x]

Safety and Security

--To prevent nuclear terrorism, the U.S. is “committed to improving nuclear security worldwide.” Efforts to ensure the security and control of nuclear materials and weapons include:

expanding international cooperation to strengthen “nuclear security standards, practices, and international safeguards”;

“remov[ing] and secur[ing] high-priority vulnerable nuclear materials around the world” and “complet[ing] the repatriation of U.S.- and Russian-origin highly enriched uranium from research reactors worldwide” (Global Threat Reduction Initiative);

accelerating the installation of “nuclear security upgrades at Russian weapons complex sites” and “expand[ing] cooperation to new high priority countries” (International Nuclear Material Protection and Cooperation Program);

securing and eliminating WMD and related delivery means through cooperative threat reduction programs (e.g., Nunn-Lugar); and

improving national and international capabilities to detect and interdict nuclear smuggling. [‘10 NPR, 11-12]

--NPR-endorsed life extension programs provide opportunities to increase the safety and security of U.S. warheads, for example, “by switching all conventional high explosive (CHE) primaries with insensitive high explosive (IHE) primaries to increase the safety margins and deploying certain intrinsic surety systems in the stockpile to better meet today’s security challenges.” [LANL Director Anastasio, SFRC testimony, 15 Jul 10, 403]

Defense-Industrial Infrastructure

---“Today’s nuclear weapons complex...has fallen into neglect,” with “oversized and costly-to maintain facilities built during the 1940s and 1950s” and a scientific and engineering workforce that has been “underfunded and underdeveloped.” [‘10 NPR, 40]

--Rebuilding and modernizing the complex is necessary to 1) ensure a “safe, secure, and effective” stockpile without nuclear testing or new warheads, 2) reduce the size of the warhead hedge for responding to technical problems or geopolitical surprise, thereby moving the U.S. along the path toward zero nuclear weapons, 3) dissuade adversaries from “believing they can permanently secure an advantage by deploying new nuclear capabilities,” and 4) “assure non-nuclear allies and partners they need not build their own [nuclear weapons]” because the reliability of each U.S. weapon type has been well certified. [‘10 NPR, 41]

--To help renew the nuclear infrastructure, DoD is transferring nearly \$5 billion to DOE over FY11-FY15 to fund, among other efforts:

“design and initial construction of the Chemistry and Metallurgy Research Replacement Nuclear Facility at Los Alamos and the Uranium Processing Facility at Oak Ridge”;

“increased plutonium manufacturing capacity at the PF-4 facility at Los Alamos”; and

“a revitalized warhead surveillance effort and associated science and technology support.” [PDUS(P) Miller, SASC testimony, 22 Apr 10, 57; see also ‘10 NPR, 42]

--New nuclear production facilities will have “some modest capacity...to surge production in the event of significant geopolitical ‘surprise.’” ['10 NPR, 41]

--Between FY10 and FY20, a total of \$80 billion is planned to be spent to “sustain and modernize the nuclear weapons complex” [unclassified White House fact sheet on the classified Report in Response to NDAA FY10 Section 1251: New START Framework and Nuclear Force Structure Plans, 13 May 10]

--“DoD is also studying emerging challenges in the defense industrial base. As commitments are made to life extend or replace current weapons, challenges are likely to emerge that could impair needed progress. Steps can be taken now to mitigate some of these risks.” ['10 NPR, 24]

-The production capabilities and design teams for solid rocket motors, for example, are essential to keep the Air Force Minuteman III ICBM and the Navy Trident D5 SLBM in service through 2030 and 2042, respectively. To help sustain this part of the defense-industrial base, “a research and development program is being initiated that focuses on commonality between the Military Departments and joint scalable flight test demonstrations.” ['10 NPR, 25]

Arms Control

--The U.S. will follow a three-fold approach to countering the most pressing nuclear threats—nuclear proliferation and nuclear terrorism:

“bolster the nuclear non-proliferation regime, and its centerpiece, the NPT, by reversing the nuclear ambitions of North Korea and Iran, strengthening International Atomic Energy Agency safeguards and enforcing compliance with them, impeding illicit nuclear trade, and promoting the peaceful use of nuclear energy without increasing proliferation risks”;

“secure all vulnerable nuclear materials in four years”; and

“pursue [other] arms control efforts...as a means of strengthening our ability to mobilize broad international support” to strengthen the nonproliferation regime and secure nuclear materials. ['10 NPR, vi-vii]

--The U.S. will not conduct nuclear testing and will “seek ratification and entry into force of the Comprehensive Nuclear Test Ban Treaty and prompt commencement of negotiations on a verifiable Fissile Material Cutoff Treaty.” [‘10 NPR, 46]

--The U.S. “will meet its commitment under Article VI of the NPT to pursue nuclear disarmament and will make demonstrable progress over the next five to ten years.” [‘10 NPR, 16]

--The Obama administration will seek ratification of, and then implement, the New START Treaty.

-“The NPR was tied to the New START process. Indeed our explicit guidance from the president was that the first phase of the Nuclear Posture Review would focus on providing guidance to the New START negotiators, in terms of the requirements of strategic stability, at a lower number.” [“Senior defense official,” NPR background briefing, 6 Apr 10]

-Within the New START limits, the U.S. can preserve the nuclear triad for strategic stability; continue to field nuclear forces sufficient for an “assured devastating second-strike capability”; maintain the capacity and nondeployed warheads for uploading strategic delivery vehicles if circumstances warrant; keep open the option of deploying a suitable number of nonnuclear ICBMs or SLBMs; and, in general, “retain the power to determine the composition of our force structure, allowing the United States complete flexibility to deploy, maintain, and modernize our strategic nuclear forces in a manner that best protects our national security interests.” [DUSD(P) Miller, SFRC testimony, 16 Jun 10, 274; SECDEF Gates, SFRC testimony, 18 May 10, 44]

--“The U.S. is committed to the long-term goal of a world free of nuclear weapons. The President has directed a review of potential future reductions in U.S. nuclear weapons below New START levels.” [‘10 NPR, 29]

-“Non-strategic nuclear weapons, together with the non-deployed nuclear weapons of both sides, should be included in any future reduction arrangements between the United States and Russia.” [‘10 NPR, 27]

--“Following substantial further nuclear force reductions with Russia, [the U.S. will] engage other states possessing nuclear weapons, over time, in a multilateral effort to limit, reduce, and eventually eliminate all nuclear weapons worldwide.” [‘10 NPR, 47]

--The U.S. will “pursue high-level dialogues with Russia and China to promote more stable, transparent, and non-threatening strategic relationships between those countries and the United States.” [‘10 NPR, 46]

--“The conditions that would ultimately permit the United States and others to give up their nuclear weapons without risking greater international instability and insecurity are very demanding,” including

“resolution of regional disputes that can motivate rival states to acquire and maintain nuclear weapons”;

“success in halting proliferation of nuclear weapons”;

“much greater transparency into the programs and capabilities of key countries of concern”;

“verification methods and technologies capable of detecting violations of disarmament obligations”; and

“enforcement measures strong and credible enough to deter such violations.”

“Clearly, such conditions do not exist today. But we can—and must—work actively to create those conditions.” [‘10 NPR, 48-49]

References

1994 Nuclear Posture Review

William J. Clinton, "U.S. Nuclear Posture and Policy on Nuclear Arms Control Beyond the START I and START II Treaties," Presidential Decision Directive/NSC-30, September 21, 1994, partially declassified version, available at <http://clinton.presidentiallibraries.us>

John M. Deutch, deputy secretary of defense; Ashton B. Carter, assistant secretary of defense for international security policy; and Walter Slocombe, deputy under secretary of defense for policy, October 5, 1994 testimony in House Foreign Affairs Committee, *U.S. Nuclear Policy*, 103d Cong., 2d sess. (Washington, D.C.: GPO, 1995)

John M. Deutch, deputy secretary of defense; and Adm. William A. Owens, USN, vice chairman, Joint Chiefs of Staff, September 22, 1994 testimony in Senate Armed Services Committee, *Briefing on Results of the Nuclear Posture Review*, S. Hrg. 103-870, 103d Cong., 2d sess. (Washington, D.C.: GPO, 1994)

"DoD Review Recommends Reduction in Nuclear Force," Department of Defense News Release, September 22, 1994

Office of the Under Secretary of Defense (Comptroller), *National Defense Budget Estimates for FY 2017* (Washington, D.C.: Department of Defense, March 2016) ("Green Book"), Table 6-5

William J. Perry, secretary of defense, *Annual Report to the President and the Congress* (Washington, D.C.: GPO, February 1995), Part IV, "Nuclear Posture Review"

"Press Conference with Secretary of Defense William J. Perry; General Shalikashvili, Chairman, JCS; Deputy Secretary of Defense John Deutch; Mr. Kenneth H. Bacon, ATSD-PA, Thursday, September 22, 1994," Department of Defense News Release No. 546-94

"Remarks Prepared for Delivery by Secretary of Defense William J. Perry to the Henry L. Stimson Center, 20 September 1994," Department of Defense News Release No. 535-94

2001 Nuclear Posture Review

Dick Cheney, vice president, "The Vice President Participates in a Media Availability with British Prime Minister Tony Blair," White House transcript, March 11, 2002, available at <http://georgewbush-whitehouse.archives.gov/vicepresident/news-speeches/speeches/vp20020311.html>

J.D. Crouch, assistant secretary of defense for international security policy; and John R. Harvey, director, Office of Policy, Planning, Assessment and Analysis, National Nuclear Security

Administration, "Special Briefing on the Nuclear Posture Review," Department of Defense transcript and briefing slides, January 9, 2002

Douglas J. Feith, under secretary of defense for policy; Gen. John A. Gordon, USAF (ret.), administrator, National Nuclear Security Administration; Adm. James O. Ellis, Jr., USN, commander in chief, U.S. Strategic Command, February 14, 2002 testimony in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 2003, Part 1*, S. Hrg. 107-696, Pt. 1, 107th Cong., 2d sess. (Washington, D.C.: GPO, 2003)

Nuclear Posture Review, Report to the Congress in Response to Sections 1041 (as Amended) and 1042 of the Floyd B. Spence National Defense Authorization Act for Fiscal Year 2001, PL 106-398 (Washington, D.C.: Department of Defense, December 2001), partially declassified version, available at http://www.dod.mil/pubs/foi/Reading_Room/NCB/06-F-1586_Nuclear_Posture_Review.pdf

Nuclear Posture Review: Implementation Plan, DoD Implementation of the December 2001 Nuclear Posture Review Report to the Congress (Washington, D.C.: Department of Defense, February 2003), partially declassified version, available at http://www.dod.mil/pubs/foi/Reading_Room/NCB/Nuclear_Posture_Review_Implementation_Plan_Feb2003.pdf

Office of the Under Secretary of Defense (Comptroller), *National Defense Budget Estimates for FY 2017* (Washington, D.C.: Department of Defense, March 2016) ("Green Book"), Table 6-5

Keith Payne, study director, et al., *Planning the Future U.S. Nuclear Force, Vol. II: Foundation Report* (Fairfax, VA: National Institute for Public Policy, October 2009), Appendix C, "Sizing the Nuclear Force: The 2001 Nuclear Posture Review (NPR)"

Donald H. Rumsfeld, secretary of defense, *Annual Report to the President and the Congress* (Washington, D.C.: Department of Defense, 2002), Chapter 7, "Adapting U.S. Strategic Forces"

Donald H. Rumsfeld, secretary of defense; and Gen. Richard B. Myers, USAF, chairman, Joint Chiefs of Staff, July 17, 2002 testimony in Senate Foreign Relations Committee, *Treaty on Strategic Offensive Reduction: The Moscow Treaty*, S. Hrg. 107-622, 107th Cong., 2d sess. (Washington, D.C.: GPO, 2002)

2010 Nuclear Posture Review

"2010 Nuclear Posture Review (NPR) Fact Sheet," Department of Defense, April 6, 2010

General James Cartwright, vice chairman of the Joint Chiefs of Staff; Thomas D'Agostino, under secretary for nuclear security and administrator, National Nuclear Security Administration, Department of Energy; Robert Einhorn, special advisor for nonproliferation and arms control, Department of State; Bradley Roberts, deputy assistant secretary of defense for nuclear and missile defense policy, Council on Foreign Relations meeting on the Nuclear Posture Review, Washington, D.C., April 8, 2010, Federal News Service transcript

Gen. Kevin P. Chilton, USAF, commander, U.S. Strategic Command; Thomas P. D'Agostino, under secretary for nuclear security and administrator, National Nuclear Security Administration, Department of Energy; James N. Miller, principal deputy under secretary of defense for policy; and Ellen O. Tauscher, under secretary of state for arms control and international security, April 14, 2010 testimony in House Armed Services Committee, *The United States Nuclear Weapons Policy and Force Structure*, H.A.S.C. No. 111-150, 111th Cong., 2d sess. (Washington, D.C.: GPO, 2010)

Secretary of Defense Robert Gates, Joint Chiefs of Staff Chairman Navy Adm. Michael Mullen, Secretary of State Hillary Clinton, and Secretary of Energy Steven Chu, DoD news briefing, April 6, 2010, Department of Defense (Federal News Service) transcript

Robert Gates, secretary of defense, May 18, 2010 testimony; Adm. Michael Mullen, USN chairman, Joint Chiefs of Staff, May 18, 2010 testimony; Dr. James N. Miller, Jr., deputy under secretary of defense for policy, June 16, 2010 testimony; Gen. Kevin P. Chilton, USAF, commander, U.S. Strategic Command, June 16, 2010 testimony; and Dr. Michael R. Anastasio, director, Los Alamos National Laboratory, July 15, 2010 testimony in Senate Foreign Relations Committee, *The New START Treaty (Treaty Doc. 111-5)*, S. Hrg. 111-738, 111th Cong., 2d sess. (Washington, D.C.: GPO, 2010)

PSUSD for Policy Jim Miller, JCS Vice Chairman Marine Corps General James Cartwright, Administrator, National Nuclear Security Administration Thomas D'Agostino, Under Secretary of State for Arms Control and International Security Ellen Tauscher, "Special Briefing on New Nuclear Posture Review from the Pentagon," April 6, 2010, Department of Defense (Federal News Service) transcript and briefing slides

James N. Miller, principal under secretary of defense for policy; Gen. Kevin P. Chilton, USAF, commander, U.S. Strategic Command; Ellen O. Tauscher, under secretary of state for arms control and international security; and Thomas P. D'Agostino, administrator, National Nuclear Security Administration, Department of Energy, April 22, 2010 testimony in Senate Armed Services Committee, *Nuclear Posture Review*, S. Hrg. 111-824, 111th Cong., 2d sess. (Washington, D.C.: GPO, 2011)

Dr. James Miller, principal deputy under secretary of defense for policy; Thomas P. D'Agostino, under secretary for nuclear security and administrator, National Nuclear Security Administration, Department of Energy; and Robert J. Einhorn, special advisor, nonproliferation and arms control, Department of State, "DoD's Nuclear Posture Review Rollout Briefing," Washington Foreign Press Center, April 7, 2010, transcript

"The New START Treaty: Maintaining a Strong Nuclear Deterrent," White House fact sheet, May 13, 2010 (unclassified fact sheet on the classified *Report in Response to NDAA FY10 Section 1251: New START Framework and Nuclear Force Structure Plans (U)*)

Nuclear Posture Review Report (Washington, D.C.: Department of Defense, April 2010)

Office of the Under Secretary of Defense (Comptroller), *National Defense Budget Estimates for FY 2017* (Washington, D.C.: Department of Defense, March 2016) (“Green Book”), Table 6-5

Gary Samore, coordinator for arms control and weapons of mass destruction, proliferation, and terrorism, the White House, remarks, “International Perspectives on the Nuclear Posture Review,” Carnegie Endowment for International Peace, April 22, 2010, Federal News Service transcript

“Senior Defense Department official,” “Background Briefing on the Nuclear Posture Review from the Pentagon,” April 6, 2010, Department of Defense (Federal News Service) transcript and briefing slides

“Statement by President Barack Obama on the Release of the Nuclear Posture Review,” White House Press Release, April 6, 2010