Spending on US Strategic Nuclear Forces: Plans & Options for the 21st Century

by

Steven M. Kosiak

Center for Strategic and Budgetary Assessments

2006

ABOUT THE CENTER FOR STRATEGIC AND BUDGETARY ASSESSMENTS

The Center for Strategic and Budgetary Assessments is an independent, non-partisan policy research institute established to promote innovative thinking and debate about national security strategy and investment options. CSBA's goal is to enable policymakers to make informed decisions in matters of strategy, security policy, and resource allocation.

CSBA provides timely, impartial and insightful analyses to senior decision makers in the executive and legislative branches, as well as to the media and the broader national security establishment. CSBA encourages thoughtful participation in the development of national security strategy and policy, and in the allocation of scarce human and capital resources. CSBA's analysis and outreach focuses on key questions related to existing and emerging threats to US national security. Meeting these challenges will require transforming the national security establishment, and we are devoted to helping achieve this end.

CSBA is directed by Dr. Andrew F. Krepinevich and funded by foundation, corporate and individual grants and contributions, and government contracts.

1730 Rhode Island Ave., NW
Suite 912
Washington, DC 20036
(202) 331-7990
http://www.csbaonline.org

Contents

Executive Summary

The United States currently possess an arsenal of about 3,950 "operationally deployed" strategic nuclear warheads. These weapons are deployed on intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and long-range bombers. These weapon systems are capable of striking targets located anywhere on the globe, and causing enormous destruction. The explosive power of the individual warheads carried by these systems ranges from as little as 0.3 kilotons (equivalent to 300 tons of TNT) to as much as 1.2 megatons (equivalent to 1.2 million tons of TNT). Under Bush Administration plans, the number of operationally deployed strategic nuclear weapons will be reduced to 1,700-2,200 warheads by the end of 2012.

In addition to these operationally-deployed strategic nuclear weapons, the United States today has some 1,300 other active (i.e., ready to use) strategic nuclear weapons, as well as 500 active non-strategic (i.e., short-range) nuclear weapons, and 4,250 inactive nuclear warheads. Thus, altogether the United States currently has some 10,000 nuclear weapons.

For 2006, the Department of Defense (DoD) has been provided about $15.5 billion (fiscal year 2006 dollars) to modernize, operate and support its nuclear offensive strategic forces. In addition, the Department of Energy (DoE), which develops, produces and maintains the nuclear warheads themselves, has been provided $17 billion for defense-related activities (excluding $1.1 billion for DoE non-proliferation programs). Other related programs and activities, including non-strategic nuclear forces, ballistic missile defenses, air defenses, nuclear command, control, communications, and intelligence (C3I) capabilities, and various (DoE and other) non-proliferation activities, have been budgeted roughly $21.7 billion. Thus, altogether, annual funding for nuclear-related forces and activities currently amounts to about $54 billion.

Future Nuclear Offensive Strategic Forces

Under the terms of the 2002 Moscow Treaty, the United States and Russia have agreed to reduce their nuclear arsenals to 1,700-2,200 operationally deployed strategic nuclear warheads by the end of 2012. In addition, the Bush Administration apparently plans to keep some 3,800-4,300 other nuclear warheads, including a "responsive" reserve of 2,400-2,900 active strategic nuclear weapons, 500 active non-strategic nuclear weapons and 700 inactive nuclear weapons. This would bring the total stockpile to some 6,000 nuclear weapons.

In terms of strategic nuclear delivery systems, the administration plans to make some modest reductions over the next few years. Under the latest plan, announced as part of the the 2006 Quadrennial Defense Review (QDR), the number of SSBNs would be kept at 14; however, the size of the Minuteman ICBM force would be cut from 500 to 450, and the number of long-range bombers would be reduced from 95 to 77—with the retirement of 38 B-52H bombers (leaving a primary authorized aircraft strength of about 48 nuclear-capable bombers). The QDR also proposed that 24 Trident II (D-5) missiles carried aboard the SSBN fleet be equipped with conventional warheads.

Under the administration's plans, all three legs of the strategic nuclear triad would be modernized over the next several decades. The Air Force plans to begin fielding a replacement for the Minuteman III ICBM in 2018, while the Navy plans to begin procuring a new SSBN in 2022. Current plans for the SLBM force are less clear. However, it may be necessary for the Navy to begin production of replacement missiles—either additional D-5s or a new SLBM—by around 2030, or possibly sooner.

In recent years, DoD has discussed the possibility of fielding a new bomber early as 2015, as late as 2037, or sometime in between. In the latest QDR, the administration set a target date of 2018 to start fielding a new long-range bomber. This aircraft would make use of relatively near-term technologies. But is unclear whether it would be manned or unmanned, or whether it will be nuclear-capable, or a dedicated conventional bomber. The latest plan also calls for the Air Force to field a more advanced long-range strike capability in the 2035 timeframe.

The United States could choose a wide range of different paths for its nuclear offensive strategic forces. However, based on what is known of current plans and discussions of future approaches, the following five options—with estimated average annual costs for DoD of $9.7 billion to $30.7 billion—reasonably captures the range of approaches most likely to be pursued.

- **Option 1 (2,200/4,600 active strategic nuclear warheads): The "Current Plan."** This option is based on the Bush Administration's latest plans for nuclear offensive strategic forces—to the extent those plans have been specified and described publicly. Generally, where DoD's long-term plans are unclear, it is assumed that the United States would strive to maintain, through 2035, roughly the same number of weapon systems (e.g., ICBMs, SSBNs and bombers) and warheads it is projected, in current plans, to maintain in the near-term. Under this option the United States would maintain an arsenal of 2,200 operationally deployed strategic nuclear warheads (the high end of the 1,700-2,200 warhead range projected by the administration for 2012). In addition, it would maintain a stockpile of 2,400 other active nuclear warheads, including 200 spares and a responsive reserve of 2,200 warheads. Thus, consistent with current projections for 2012, the United States would retain—after tapping its responsive reserve—the ability to deliver as many as 4,400 strategic nuclear warheads. Implementing this option would cost an average of about $30.7 billion a year over the next three decades.

- **Option 2 (2,200/4,250 active strategic nuclear warheads): The "Current Plan"-Minus.** This option is identical to Option 1 in terms of ICBM and SLBM/SSBN force structure, warhead levels and modernization plans. It differs from Option 1 only in its inclusion of smaller and less capable nuclear-capable bomber forces. Specifically, under this option, the Air Force would forego the production and fielding of a new, near-term bomber (or, alternatively, the new aircraft would be acquired, but it would be a dedicated conventional bomber like the B-1B). In addition, the new bomber fielded in the 2035 timeframe would be less capable (and less costly) than the advanced bomber included in Option 1. As in Option 1, under this option the United States would sustain an operationally deployed force of 2,200 active strategic nuclear

weapons. However, in this case (reflecting the smaller bomber force), the United States would have a total stockpile of about 4,250 active strategic nuclear warheads, some 350 fewer than in Option 1. This option would cost an average of $22.7 billion a year through 2035.

- **Option 3 (1,700/2,950 active strategic nuclear warheads): Cut Force Structure.** Under this option, the United States would reduce the size of its nuclear force structure substantially below both today's levels, and the levels projected in Options 1 and 2. It would, however, still be able to satisfy the floor set by the Bush Administration for the number of nuclear weapons to be operationally deployed with US strategic forces. Specifically, under this option the US military would sustain an operationally deployed force of 1,700 strategic nuclear weapons between 2012 and 2035—compared to 2,200 nuclear weapons (the ceiling set by the administration) in Options 1 and 2. In addition, the United States would maintain about 1,250 other active strategic nuclear weapons, about 1,100 of which would constitute a responsive reserve, and some 150 of which would be spares. Ultimately, the US nuclear offensive strategic force structure would consist of 300 ICBMs, 11 SSBNs and 40 (primary authorized aircraft, PAA) nuclear-capable long-range bombers. This option would cost an average of $18.2 billion a year through 2035.

- **Option 4 (1,000/1,050 active strategic nuclear warheads): Cut Force Structure, Buy Smaller Replacement Systems.** The United States would cut its nuclear offensive strategic forces deeply under this option—measured in terms of platforms and delivery vehicles, as well as nuclear warheads. In this option, about 1,000 strategic nuclear weapons would be operationally deployed, on a day-to-day basis, and another 50 weapons would be kept as spares—for a total stockpile of some 1,050 active strategic nuclear weapons. In contrast to all of the previous options, in this option no additional warheads would be maintained as a responsive reserve. The United States would modernize its nuclear forces on essentially the same schedule envisioned in the previous options. However, reflecting the smaller active warhead stockpile maintained in this option, the individual platforms and delivery vehicles procured in this option would generally be smaller and capable of carrying fewer nuclear

warheads than even those systems procured in the previous options. This option would require average annual funding of about $13.5 billion over the next 30 years.

- **Option 5 (1,000/1,050 active strategic nuclear warheads): Cut Force Structure Deeply, Replace Only SSBNs.** In this option, like the last one, the United States would reduce the size of its nuclear force structure to about 1,000 operationally deployed strategic nuclear warheads, plus 50 spares—but, again, maintain no responsive reserve. In contrast to all of the previous options, however, under this option the United States would preserve only one leg of its strategic nuclear triad, its SLBM/SSBN force—generally thought to be the most survivable leg of the triad. It would maintain a fleet of 10 SSBNs. As in each of the previous options, the Navy would begin procuring a new SSBN in 2022. This option would require average annual funding of about $9.7 billion.

Cost of Dual-Capable Bombers

The above estimates may overstate the cost of sustaining US nuclear offensive strategic forces to some extent because they implicitly attribute the full cost of developing, procuring, operating and supporting dual-capable bombers entirely to nuclear offensive strategic forces. During the Cold War, this may have been, to some degree, understandable and justified. Although long-range bombers were used in conventional roles during those years, for most of that period nuclear deterrence was widely considered to be the preeminent mission for those bombers. Moreover, the new bombers developed and procured during the Cold War—including the B-52H, B-1B, and B-2A—were designed first and foremost with the nuclear mission in mind.

But if what drives the United States to acquire and maintain a substantial long-range, dual-capable bomber force in the future is largely, or primarily, its conventional strike capabilities, allocating the total cost of acquiring and supporting these aircraft to the strategic nuclear strike mission could be misleading. In that case, arguably what should be allocated to this mission would be only the marginal cost to DoD of equipping these bombers and training their crews so that, in addition to carrying out conventional missions, they can also carry out nuclear strikes. And, these costs are likely to be relatively modest. If the cost

of dual-capable bomber forces are excluded, the annual cost to DoD of sustaining the five options described in this report would range from $9 billion to $19 billion.

Department of Energy and Nuclear Warhead Costs

The estimates for the five options discussed above do not include costs associated with developing, producing, maintaining, and (eventually) dismantling and disposing of the actual nuclear warheads used to equip US nuclear offensive strategic forces. These costs are borne primarily by DoE. According to Bush Administration plans, funding for DoE defense activities is projected to average about $15.4 billion a year over the next five years. Assuming this level of funding would be needed to maintain the administration's planned stockpile of roughly 6,000 active nuclear warheads over the long run (i.e., through 2035), this may also represent a reasonable estimate of the DoE costs associated with Option 1.

Maintaining a smaller warhead level would lead to some DoE savings. However, the savings associated with lower stockpile numbers alone may to be relatively modest. This is because the lion's share of DoE costs are related to overhead, environmental cleanup, R&D and other activities that are relatively insensitive to the number of warheads in the stockpile. Reasonable estimates of how much might be saved each year by reducing the stockpile to 1,000 nuclear warheads, for example, range from as little as $200 million to as much as $1 billion. On the other hand, by consolidating DoE's weapons laboratories and other such measures, it might be possible for DoE save an additional $500 million a year or more. If, along with these cuts, DoE were to follow a "minimal" stewardship philosophy—focused more on maintaining the current stockpile and less on maintaining a large weapons design and manufacturing capability—it might be possible to achieve total savings of some $2.5 billion annually, or possibly more.

The Cost of Other Nuclear-Related Programs and Activities

Nuclear offensive strategic forces and the DoE nuclear weapons complex that supports those forces represent the largest and most costly

components of US nuclear forces, but they do not constitute the only US nuclear or nuclear-related forces. Other related programs and activities include nuclear offensive theater forces, nuclear-related C3I activities, and ballistic missile defenses, strategic air defenses, and (DoE and other) non-proliferation programs. Taken together, the cost of these programs and activities currently amounts to about $21.7 billion a year. As in the case of nuclear offensive strategic forces, the cost of many of these programs and activities are projected to grow in coming years.

Factors Likely to Shape Future Plans

Plans for US nuclear offensive strategic forces are likely to be shaped by a wide variety of different factors over the next three decades, including:

- **Strategy:** During the Cold War, debates over nuclear strategy involved differing views on a wide range of issues, including: the relative effectiveness and morality of targeting an adversary's nuclear and other military forces versus population centers; the value of nuclear arsenals in terms of global perceptions of national power and prestige; the relative merit of "first-strike" (i.e., preemptive) versus "second-strike" (i.e., retaliatory) capabilities and doctrines; the number and types of nuclear forces need to deter an adversary; and the "usability" of nuclear weapons. Although some important things have changed over the past 15 years, many of these same questions remain today. And debates over these same or similar questions are likely to continue to influence plans for US nuclear forces in coming decades.

- **Nuclear Forces of Other Countries:** Future plans for US nuclear offensive strategic forces are also likely to be influenced by trends in the size and shape of other countries' nuclear forces. Today, the US and Russian nuclear arsenals are far larger than the nuclear forces of any other country. Concerns that another country might attempt to challenge the United States tend to focus on Russia and China. It is possible that either country could try to increase the size of its nuclear arsenal in coming years—Russia because it will likely retain a large reserve of nuclear warheads, and China because of its growing economy. However, Russia is far weaker economically than was the Soviet Union of the Cold War, and it may find it difficult, over the long run, to even maintain the smaller nuclear arsenal Russia is pro-

jected to have in 2012. For its part, despite the rapid growth of its economy, and increased military spending, China has not, to date at least, substantially increased the size of its nuclear strategic forces. China's nuclear forces capable of striking targets in the United States have, for many years, been held steady at some two dozen single-warhead missiles.

- **Fiscal Pressures:** Like any other area of the federal budget, and defense programs more generally, decisions concerning the future size and shape of US nuclear offensive strategic forces will be determined in part by the amount of money available to fund those programs and activities. US funding for defense has grown substantially since the late 1990s. However, the overall fiscal picture confronting the United States has worsened dramatically in the past five years. It seems likely that the federal government will run deficits totaling some $4 trillion or more over the coming decade. Moreover, the fiscal picture is projected to get much worse in the years beyond 2015, driven in large part by the growing number of retirees and rising health care costs. It is certainly possible that, notwithstanding these large and rising deficits, spending on defense will be spared any substantial reductions—or even that it will continue to be increased over the long term—permitting the implementation of relatively expansive plans for US nuclear offensive strategic forces. On the other hand, the magnitude of the looming deficit problem may create strong pressures to reduce defense spending, or at least slow its rate of growth. And these kinds of pressures on the overall defense budget could, in turn, create incentives to develop more affordable plans for US offensive strategic forces.

- **Competition from other DoD Priorities:** To execute DOD's current long-term defense plan, the Congressional Budget Office (CBO) estimates that average annual funding for DoD would have to be increased by some $75 billion or more (exclusive of war costs) above the level currently projected for 2011 (the last year included in DoD's latest budget plan)—assuming, as seems likely, that DoD will continue to experience historical rates of cost growth in weapons acquisition programs and operations and support activities. If fiscal constraints preclude such a large and sustained increase in funding for defense, it may be difficult to protect plans for nuclear offensive strategic forces from cuts. Indeed, it is possible that they could be required

to take a disproportionately large share of any cuts. During the Cold War, programs and activities needed to support US nuclear offensive strategic forces were given a high—and often the highest—priority by DoD planners. However, since the end of the Cold War, DoD's focus has shifted far more to non-nuclear "general purpose" forces.

- **Strategic Defenses:** Some advocates of strategic defenses argue that the development and eventual fielding of effective defenses might allow the United States to further reduce the size of its offensive nuclear forces. This, they argue, is because the fielding of defenses would make US nuclear forces more secure (i.e., less vulnerable to preemptive attack) and potential adversaries would be dissuaded and deterred, not only by the threat posed by US nuclear offensive forces, but also by the prospect that the United States could protect itself from such an attack. Conversely, critics worry that due to myriad technical and operational obstacles, strategic defenses—at least unconstrained defenses—are almost certain to prove ineffective. Worse yet, they argue, such defenses may well fuel a nuclear arms race—as potential adversaries feel compelled to buildup their nuclear capabilities to ensure that they can overwhelm, or at least pierce, any defensive system. In this case, the pursuit of strategic defenses could make further reductions in nuclear offensive strategic forces less likely.

- **Conventional Capabilities and Offensive Strategic Forces:** A major—and to some extent—unsolvable, complication with attempting to project future plans for nuclear offensive strategic forces concerns the fact that some offensive strategic forces are equipped, trained and capable of carrying out conventional strikes as well, and in the future conventional offensive strategic forces may increasingly be capable of effectively substituting for nuclear forces. Today, and for the past 50 years, long-range bombers have constituted the only US offensive strategic weapon system that is capable of delivering conventional strikes, and is assigned conventional missions. However, in recent years, the idea of arming ICBMs and SLBMs with conventional warheads has also gained considerable traction. Just how much improvements in conventional capabilities are likely to allow for this kind of substitution, and how quickly such improved capabilities are likely to be developed and fielded, is

difficult to predict and debatable. However, to the extent that advances in conventional offensive strategic strike capabilities could reduce the US military's dependence on nuclear weapons, these advances could lead DoD to reduce the size of its strategic nuclear arsenal. On the other hand, such advances might be used simply to expand the range of strategic targets that could be struck by US forces or to give US decision-makers greater flexibility in determining how to threaten, or strike, such targets.

Choosing an Option

Differing assumptions about the various factors noted above could be consistent with more than one view of the appropriate future path for US nuclear offensive strategic forces. If one believes, as do many within the Bush Administration, that the United States must maintain a large and modern nuclear arsenal to effectively dissuade Russia, China and other countries from attempting to compete with the United States, then Option 1 might be appropriate. Conversely, if one believes that deterrence remains the core mission of nuclear offensive strategic forces, then Option 4 or 5 might appear appropriate. On the other hand, fiscal constraints, the development of effective strategic defenses, or significant progress in the development and fielding of conventional offensive strategic forces could also lead one to choose one of the options involving smaller nuclear forces.

Conclusions

It would be premature, at this point, to make decisions concerning each and every aspect of the United States' future nuclear offensive strategic forces. However, it may be appropriate, or even urgent, that some decisions concerning these forces be made relatively soon. In any event, now is clearly the time to begin to think seriously about the future of US nuclear offensive strategic forces.

Given the long lead times involved in the acquisition of modern weapons systems, decisions made over the next 5-10 years may well—for better of for worse—largely determine how we will modernize much of the US nuclear arsenal through 2035. There is also a danger that if we

do not begin to think through our options for these forces today, future opportunities will, by default, be foreclosed. As a result, commitments made to other kinds of forces and weapons programs could crowd out future investments in nuclear offensive strategic forces.

Conversely, there is a danger that, absent a discussion now, substantial resources will—as a result of traditional bureaucratic interests and inertia, rather than analysis—be devoted to modernizing a nuclear triad that is of a size and shape that may be neither affordable, nor necessary, to meet US long-term security requirements. Once weapon systems enter the acquisition process, they begin to gain a momentum that makes these programs increasingly difficult to stop, or even modify. Thus, waiting until plans for modernizing US nuclear offensive strategic forces are further along to begin to debate the merits of different options is likely to result in a much more constrained, limited and, to some extent, empty debate.

I. Introduction

The goal of this report is to provide a range of estimates for how much the United States might have to spend on nuclear offensive strategic forces in coming years, based on a variety of different assumptions about the size, shape and type of forces that are likely to be required. The focus of this report is on plans and options for US intercontinental ballistic missile (ICBM) forces, submarine-launched ballistic missile/nuclear-powered ballistic missile submarine (SLBM/SSBN) forces and nuclear-capable long-range bombers. These three elements, commonly referred to as the nuclear "triad," currently constitute the means of delivery for all US strategic nuclear weapons, and they appear likely to remain the main (if not only) means of delivery for these weapons for the foreseeable future.

This report attempts to look out relatively far into the future—30 years, from 2006 through 2035. It was necessary to examine such a broad span of years in order to capture the key, upcoming decisions the Department of Defense (DoD) will have to make concerning US nuclear offensive strategic programs and forces. Perhaps for similar reasons, in its 2004 report, the Defense Science Board (DSB) Task Force on Future Strategic Strike Forces also decided look out over the next 30 years.[1] The difficulty of accurately projecting plans, forces and costs so many years into the future, however, means that the estimates derived in this analysis should be understood to represent only relatively rough approximations of likely future costs.

[1] Office of the Undersecretary of Defense for Acquisition, Technology and Logistics, *Report of the Defense Science Board on Future Strategic Strike Forces* (Washington, DC: DoD, February 2004).

The "New Triad"

In early 2002, the Bush Administration released the results of its Nuclear Posture Review (NPR). Among other things, this review attempted to provide a new lens through which to view nuclear strategy, requirements and posture. Specifically, the NPR suggested that US policymakers and planners think in terms of a "New Triad." As defined in the NPR, this New Triad comprises three elements.[2]

- **Offenses:** This category consists of both nuclear and non-nuclear strike capabilities. The former includes the three legs of the strategic nuclear triad, and shorter-range nuclear systems, while the latter includes conventional precision-guided munitions (PGMs) and their means of delivery, as well as offensive information operations (e.g., attacks on computer systems).

- **Defenses:** These encompass active defenses (e.g., defenses designed to intercept ballistic missiles), passive defenses (e.g., the use of concealment and mobility) and defensive information operations.

- **Infrastructure:** This comprises the laboratories, factories and workforces that develop, produce and support US offensive and defensive forces, including the nuclear weapons complex run by the DoE.

This report focuses on the first of these elements of the New Triad—offensive capabilities—and the strategic nuclear component of these capabilities in particular. The various options described in this report could be consistent with a range of different assumptions concerning how extensively and effectively conventional capabilities might, today and in the future, be capable of substituting for nuclear capabilities. But no attempt is made in this study to project the degree to which, over the long run, such substitution might be possible. On the other hand, this report does address a parallel issue: the extent to which strategic weapon systems that have traditionally been focused on nuclear missions might, increasingly, be equipped with conventional weapons and assigned conventional missions, as well as the cost implications of this trend for US nuclear offensive strategic forces.

---

[2] Kurt Guthe, *The Nuclear Posture Review: How is the "New Triad" New?* (Washington, DC: CSBA, 2002), p. 3.

This report does not attempt to explore the different approaches to defenses—and strategic defenses in particular—that could be pursued in coming years, or how trends in this area could affect requirements for nuclear offensive strategic forces. As in the case of conventional offensive strategic capabilities, the various options discussed in this study could be consistent with a range of different assumptions about developments in this area. Nor does this report consider in detail plans or funding requirements for non-strategic nuclear forces. The limited discussion of infrastructure capabilities included in this study is focused primarily on the requirements of the nuclear weapons complex under differing assumptions about strategic nuclear warhead levels.

Organization of Report

This report is organized into four main parts. Chapter One provides an introductory overview and discussion of US nuclear offensive strategic forces, plans and options for the future. This includes a description of existing US forces, the Bush Administration's plans for nuclear forces and warhead levels through 2012, and a brief discussion of a number of factors that are likely to shape plans for nuclear offensive strategic forces in coming years—such as the strategy pursued by US policymakers, developments among other nuclear powers, fiscal constraints, competition from other DoD priorities, plans for strategic defenses, and trends in conventional offensive strategic forces.

Chapter Two describes five different options for US nuclear offensive strategic forces that reasonably bound the different approaches that might be pursued over the next three decades. They assume that the United States will maintain some 1,000 to 4,600 active strategic nuclear warheads. The latter is the level currently projected for 2012 under the Bush Administration's plans, while the former figure is consistent with a number of proposals that have been made to implement far deeper cuts in the US nuclear arsenal. The numbers and types of offensive strategic weapons platforms and delivery vehicles included in each option is driven primarily by the need to accommodate the various nuclear warhead levels specified for each option.

Chapter Three provides an estimate for the cost to DoD of each of the five options described in Chapter Two. The estimates are expressed on an annualized basis (i.e., they represent the average annual cost of implementing each option). They are provided both for the entire 2006-

35 period, and separately for the first and second 15 years of that period. Expressing the estimates in this way provides a clearer picture of future funding requirements, since under some of the options described in this report costs differ substantially between these two periods.

This chapter also includes a discussion of how the expansion of conventional offensive capabilities—to include not only conventionally-armed and dual-capable long-range bombers, but conventionally-armed ICBMs, SLBMs and other offensive strategic systems—might affect the various options for nuclear offensive strategic forces generated in this report, including the projected cost of those options. In addition, this chapter briefly discusses possible future funding requirements for DoE's nuclear weapons complex.

Finally, this chapter provides a rough estimate of current US funding levels for a number of programs and activities related to—but distinct from—nuclear offensive strategic forces, including nuclear offensive theater forces, nuclear command, control and communications (C3I) activities, and strategic and theater defenses. This estimate is offered to provide a better sense of the context in which nuclear offensive strategic forces must compete for funding, as well as some of the budgetary tradeoffs involving these forces that could be made in coming years. Lastly, this report includes an appendix that provides a detailed discussion of the methodology used to estimate the cost of the various options described in this study.

II. Overview

At the beginning of 2006, the US nuclear arsenal included some 3,950 "operationally deployed" strategic nuclear weapons.[3] The term "operationally deployed" means nuclear warheads deployed on ICBMs and SLBMs at sea (but excluding warheads associated with SSBNs in overhaul), and nuclear weapons loaded on heavy bombers or stored in weapons storage areas on bomber bases.[4] In addition to these operationally deployed warheads, the United States had some 6,000 other nuclear weapons, for a total of about 10,000 nuclear warheads. These other warheads included about 1,250 additional active (i.e., ready to use) strategic nuclear weapons associated with weapon systems in overhaul, used as spares (e.g., as part of the maintenance pipeline), or kept in secure storage and available to be returned to the operationally deployed force. The stockpile also included about 500 active non-strategic nuclear warheads (associated with tactical aircraft and nuclear versions of the Tomahawk sea-launched cruise missile), and 4,250 inactive nuclear warheads.[5]

The existing US nuclear offensive strategic arsenal is, today, deployed among the three legs of the US strategic nuclear triad roughly as follows (see Table 1):

ICBMs: The United States currently deploys a force of 500 Minuteman III ICBMs, located at bases in North Dakota, Montana and Wyoming. The Minuteman III missile was first deployed in 1970, and has a range of some

[3] This estimate was derived by the author based on Robert Norris and Hans Kristensen, "US Nuclear Forces, 2006," *Bulletin of the Atomic Scientists*, January/February 2006, pp. 1-5; and Thomas Cochran, Robert S. Norris and Hans Kristensen, "Too Many, Too Slow: The Bush Administration's Stockpile Reduction Plan," Natural Resources Defense Council (NRDC).

[4] Bureau of Arms Control, "Annual Report on Implementation of the Moscow Treaty, 2005," May 20, 2005, p. 2.

[5] Norris and Kristensen, p. 2. Inactive nuclear weapons have had their Tritium removed. Tritium is used as a component of nuclear weapons to greatly boost the yield of both fission and thermonuclear (fusion) warheads.

8,000 nautical miles.[6] Each Minuteman III missile is capable of carrying as many as three nuclear warheads. Each of these warheads has an explosive yield ranging from 170 kilotons to 335 kilotons. Altogether, this force of ICBMs is estimated to be armed with a total of about 1,220 nuclear warheads, with each missile carrying an average of 2.2 warheads.[7]

SSBN/SLBMs: The United States deploys a force of 14 Ohio-Class "Trident" SSBNs. These large, 18,800-ton submarines were first deployed in 1981. Each Trident SSBN is equipped with 24 Trident II (D-5) SLBMs, for a total of 336 missiles.[8] The Trident II missile was first deployed in 1990. It has a range of more than 4,000 nautical miles, and can carry eight nuclear warheads.[9] These warheads have explosive yields of 100-455 kilotons. Currently, this force of SSBNs is estimated to carry a total of about 2,016 nuclear warheads, including 1,728 normally operationally deployed (i.e., excluding the missiles and warheads carried aboard the two SSBNs typically undergoing overhaul).[10]

Bombers: The United States currently possess a fleet of about 115 active long-range, nuclear-capable bombers. This fleet includes 21 B-2A bombers and 94 B-52H bombers. This inventory supports a primary aircraft authorization (PAA) strength of 16 B-2As and 44 B-52Hs. Both of these aircraft are capable of flying round-trip combat missions of around 3,000 miles, without refueling, and traveling essentially global distances, with refueling (one of the main missions of the US Air Force's fleet of 600 tanker aircraft is to support these bombers through aerial refueling). These two bombers are both "dual-capable" systems. That is, they can be used either to deliver conventional munitions or nuclear weapons. The Air Force also has some 67 active B-1B bombers (plus additional B-1Bs in inactive status), which are presently equipped only to carry out conventional strikes.

---

6 Thomas B. Cochran, William Arkin, Milton M. Hoenig, *Nuclear Weapons Databook, Vol. 1, US Nuclear Forces and Capabilities* (Washington, DC: Natural Resources Defense Council, NRDC, 1984), p. 116.

7 Cochran et al, "Too Many, Too Slow."

8 The last Trident I (C-4) missiles were withdrawn from service in October 2005. Norris and Kristensen, p. 3.

9 The range of ICBMs and SLBMs is dependent, in part, on the weight of its payload (e.g., the number of warheads carried). The Trident II D-5 missile, for example, reportedly has a range of up to 6,000 nautical miles with a reduced payload. *Nuclear Weapons Databook*, p. 145.

10 Norris and Kristensen, p. 2.

Table 1: US Strategic Nuclear Forces, 2006

Type	Launchers	WH/L	Op.-Dep. Active WHs	Other Active WHs	Total Active WHs
ICBMs					
Minuteman III					
Mk 12	150	1	150		150
Mk-12	50	3	150	30	180
Mk-12A	300	2-3	750	35	785
Subtotal	**500**		**1,050**	**65**	**1,115**
SLBMs					
Trident II D-5					
Mk-4 & 5	336	6	1,728	388	2,116
Subtotal	**336**		**1,728**	**388**	**2,116**
Bombers (PAA/Total)					
B-2A	16/21	Up to 16	255	300	555
B-52H	44/94	Up to 20	900	550	1,450
Subtotal	**60/115**		**1,155**	**850**	**2,005**
Total	**896/951**		**3,933**	**1,303**	**5,236**

Source: CSBA based on DoD and NRDC data.

The B-2A and the B-52H, however, differ in several important respects. First fielded in 1994, the B-2A is the Air Force's newest and most capable bomber. It has an extremely stealthy design, making it difficult for air defenses to detect or track and allowing it to penetrate deep into even heavily defended enemy air space. By contrast, the B-52H, first deployed in 1961, is the Air Force's oldest bomber, and is limited to using standoff weapons when operating in high threat environments. Each B-2A bomber is capable of carrying as many as 16 nuclear weapons, while each B-52H bomber can be equipped with as many as 20 nuclear-armed air-launched cruise missiles. Altogether, the US bomber force is currently assigned an estimated 1,150 operationally deployed warheads, including some 250 nuclear bombs and 900 nuclear-armed air-launched cruise missiles (ALCMs) and advanced cruise missiles (ACMs).[11] This works out to an average of about 16 bombs per B-2A and 16 ALCMs or ACMs per B-52H.[12]

[11] Cochran et al, "Too Many, Too Slow."
[12] Estimate are based on PAA strengths of the two aircraft.

Today's US nuclear arsenal is much smaller than the nuclear arsenal the United States possessed during the Cold War. In 1989, for example, the US strategic nuclear arsenal contained a total of some 12,800 active strategic nuclear warheads, including about 2,440 on ICBMs, 5,150 on SSBN/SLBMs and 5,190 on bombers.[13] Although the US strategic nuclear arsenal is now smaller than it was during the Cold War, it remains roughly the same size as the Russian nuclear arsenal, which has also fallen significantly from its (Soviet) Cold War levels. Today, Russia is estimated to have an operational nuclear arsenal consisting of about 3,800 active strategic warheads, as well as some 3,400 active non-strategic nuclear weapons.[14]

Both the US and Russian nuclear arsenals are far larger than the nuclear forces of any other country. In addition to the United States and Russia, six or seven other countries are thought to possess nuclear weapons. These include: the declared nuclear powers, China, France, Britain, India, and Pakistan; Israel, which is widely assumed to have nuclear weapons; and North Korea, which is suspected of having a small number of nuclear weapons. The size of these arsenals range from as few as one or two (if any) in the case of North Korea, to perhaps as many as 400 in the case of China. The vast majority of the nuclear weapons in these other stockpiles are short- or intermediate-range nuclear weapons. China, for example, possesses only some 18 warheads deployed on ICBMs capable of reaching the United States.

Table 2 compares the nuclear arsenal of the United States with estimates of the arsenals of the other declared and undeclared nuclear powers. The figures include not just strategic, but theater and tactical nuclear weapons, as well as (in the case of the United States and Russia, at least) some nuclear weapons in both active and inactive reserve. They represent rough estimates of the nuclear arsenals possessed by each of these countries around 2006.

---

[13] NRDC, "Table of US Strategic Offensive Force Loadings, 1945-2012," at www.nrdc.org/nuclear/nudb/data1.asp.

[14] Robert S. Norris and Hans M. Kristensen, "Russian Nuclear Forces, 2005," *Bulletin of Atomic Scientists*, March/April 2005, pp. 70-72. The word "operational," in this case, refers to a somewhat different category of nuclear weapons than does the term "operationally deployed," as used by the Bush Administration and DoD.

Table 2: Comparison of US and Foreign Nuclear Arsenals, Circa 2006[15]

Country	Nuclear Warheads
United States	5,750/10,000*
Russia	7,200/16,000*
United Kingdom	200
France	350
China	80-400
India	40-50
Pakistan	24-48
Israel	75-200
North Korea	0-2, possibly more

* For the United States, the first figure includes all active strategic and non-strategic nuclear warheads (including spares and those in the responsive reserve), while for Russia it includes only operational active warheads. In both cases, the second figure includes all active and non-active warheads.

Plans Through 2012

Under the terms of the 2002 Moscow Treaty, the United States and Russia have agreed to reduce their strategic nuclear arsenals to 1,700-2,200 operationally deployed warheads by the end of 2012. In addition to these operationally deployed warheads, the Bush Administration apparently plans to keep some 2,400-2,900 additional active strategic nuclear weapons.[16] The vast majority of these additional warheads would be held in reserve, but the total would also include several hundred warheads associated with SSBNs in overhaul and perhaps 200 spares. Excluding these spares, but including the warheads associated with SSBNs in overhaul, this would give the United States a "responsive" reserve of some 2,200-

[15] Sources: Natural Resources Defense Council (NRDC) in *Bulletin of Atomic Scientists*, Nuclear Notebook, "US Nuclear Forces, 2006," January/February 2006, p. 73; "Russian Nuclear Forces, 2005," March/April 2005, p. 70; "British Nuclear Forces, 2005," November/December 2005, pp. 77-79; "French Nuclear Forces, 2005," July/August 2005, pp. 73-75; "Chinese Nuclear Forces, 2005," November/December 2003, pp. 77-80; "India's Nuclear Forces, 2005," September/October 2005, pp. 73-75; "Pakistan's Nuclear Forces, 2001," January/February 2002, p. 70; "Israeli Nuclear Forces, 2002," September/October 2003, p. 73; "North Korea Korea's Nuclear Program, 2005," May/June 2005, pp. 64-67; and Jeffrey Lewis, "The Ambiguous Arsenal," *Bulletin of Atomic Scientists*, May/June 2005, pp. 52-59.,

[16] See Cochran et al, "Too Many, Too Slow" and Guthe, p. 22.

2,700 warheads.[17] Thus, the United States would have a "responsive force" consisting of some 4,400 strategic nuclear warheads, and a total of some 4,600 nuclear warheads (see Table 3).

The administration's plan also calls for maintaining an additional 500 active non-strategic weapons and 900 inactive nuclear weapons. This would bring the total US nuclear weapons stockpile to some 6,000 warheads by the end of 2012.[18]

According to the Bush Administration's 2002 NPR, the operationally deployed force of strategic nuclear weapons is meant to cover immediate and unexpected contingencies, while the responsive force is intended to cover potential contingencies. The responsive force would be created (or "reconstituted") by "uploading" the additional nuclear weapons onto existing ballistic missiles and bombers (which would not normally be armed with their maximum weapons load). Thus, the responsive force would differ from the operationally deployed force in terms of numbers of nuclear warheads, but not numbers of ICBMs, SLBMs/SSBNs or bombers. The process of reconstituting the responsive force could take weeks, months or more than a year, depending on the number and types of warheads uploaded.[19]

Table 3: US Nuclear Warheads, 2006 and 2012

	2006	2012
Operationally Deployed Strategic Warheads	3,950	1,700-2,200
Other Active Strategic Warheads	1,300	2,400-2,900
Active Strategic Warheads (subtotal)	**5,250**	**4,600**
Active Non-Strategic Warheads	500	500
Active Warheads (subtotal)	**5,750**	**5,100**
Inactive Warheads	4,250	900
Total Warheads	10,000	6,000

Source: CSBA based on NRDC, DoD and DoE data.

[17] The warheads associated with SSBNs in overhaul are included in this definition of a responsive reserve since, during an extended crisis, it might be possible either to deploy SSBNs that would otherwise be in overhaul, or to remove the warheads from these boats and upload them onto missiles carried aboard deployable SSBNs. It is possible that some number of spare warheads could also be drawn upon (i.e., made part of the responsive reserve).

[18] Cochran et al, "Too Many, Too Slow."

[19] Guthe, p. 4.

As part of the 2006 QDR, the administration proposed that modest cuts be made over the next several years in two of the three legs of the offensive nuclear strategic triad. Under the latest plan, the number of SSBNs would be kept at 14; however, the size of the Minuteman ICBM force would be cut from 500 to 450, and the number of long-range bombers would be reduced from 95 to 77—with the retirement of 38 B-52H bombers (leaving a force of 21 B-2A bombers and 56 B-52H bombers). Consistent with this reduction in the total B-52H inventory, the PAA strength of the nuclear-capable bomber force would reportedly decline to 48 aircraft (16 B-2As and 32 B-52Hs). The QDR also proposed that 24 Trident II (D-5) missiles carried aboard the SSBN fleet be equipped with conventional warheads.

The administration has been less clear concerning the numbers and types of strategic nuclear warheads and delivery vehicles it believes the United States should maintain over the longer term. The administration has, however, indicated that all three legs of the strategic nuclear triad will be modernized over the next several decades. The Air Force plans to begin fielding a replacement for the Minuteman III ICBM in 2018, while the Navy plans to begin procuring a new SSBN around 2022. Current plans for the SLBM force are less clear. The Navy expects to keep the D-5 missile in service until the last Trident SSBN is retired around 2042. The new SSBNs entering service after 2022 could be equipped with either the D-5 missile, or a new missile design. In either case, however, it may be necessary for the Navy to begin production of replacement missiles—either additional D-5s or a new SLBM—by around 2030, or possibly sooner.

In recent years, DoD has discussed the possibility of fielding a new bomber beginning as early as 2015, as late as 2037, or sometime in between. In the latest QDR, the administration set a target date of 2018 to start fielding a new long-range bomber. The Air Force has not yet decided on a specific design for this new bomber, or decided key questions concerning, for example, whether the new aircraft will be manned or unmanned, or conventional-only or dual-capable. And it has given only a rough idea of the number of these new bombers that would be acquired. It has, however, indicated that the new aircraft will make use of relatively near-term technologies to ensure that it can meet its ambitious goal of an initial operational capability (IOC) in 2018. The latest plan also calls for the Air Force to field a more advanced long-range strike capability that would take advantage of improvements in "speed,

range, accuracy, connectivity, and survivability in the 2035 timeframe."[20] The specifics for this capability are even less clear than in the case of the bomber proposed for 2018.

Factors Likely to Shape US Plans for Offensive Strategic Forces

Plans for US offensive strategic forces are likely to be shaped by a wide variety of factors over the next three decades. These include the strategy pursued by US policymakers, developments among other nuclear powers, fiscal constraints, competition from other DoD priorities, progress in the development of strategic defenses, and trends in conventional offensive strategic forces. A thorough analysis evaluating the relative merits of these different factors, suggesting how they should be weighted by policymakers, or predicting how they are likely to play themselves out, is well beyond the scope of this report. Given the critical role these factors are likely to play in determining the size, shape and cost of US nuclear offensive strategic forces in coming decades, however, it is worth describing and discussing these factors at least briefly.

Strategy

One of the most important considerations likely to impact the number and types of strategic nuclear forces sustained by the United States in coming decades is the strategic assumptions that lie behind these forces. During the Cold War, the United States maintained an enormous strategic nuclear arsenal. In 1989, at the end of the Cold War, the United States possessed some 12,800 strategic nuclear warheads. This extensive arsenal was maintained in the belief that the United States had to have enough nuclear weapons to deter and, if deterrence failed, defeat the Soviet Union—which was armed with a comparably large nuclear arsenal.

During the Cold War, debates over nuclear strategy involved differing views on a wide range of issues, including: the relative effectiveness and morality of targeting an adversary's nuclear and other military forces versus population centers; the value of nuclear arsenals in terms of global perceptions of national power and prestige; the relative merit of "first-strike" (i.e., preemptive) versus "second-strike" (i.e., retaliatory) capabilities and doctrines; the relative priority that should be placed

[20] Air Force, FY 2007 Budget Request Backup Slides, February 2006.

on preparing to win, vice attempting to avert, a nuclear war; the number and types of nuclear forces needed to deter an adversary; and the "usability" of nuclear weapons.

Answers to these and other questions had significant implications for the size and types of nuclear forces the United States maintained during the Cold War. Although some important things have changed over the past 15 years, many of these same questions remain today. Debates over these same or similar questions are likely to continue to influence plans for US nuclear forces in coming decades. The Bush Administration, as noted above, has proposed reductions in the size of the US strategic nuclear arsenal. It has also argued that the United States needs to substantially change the nuclear strategies it pursued (and debated) during the Cold War.

As noted earlier, the administration has argued that US strategic military capabilities will, in the future, increasingly depend on DoD's ability to effectively develop, sustain and integrate a New Triad consisting of nuclear and non-nuclear offensive capabilities, defensive means, and defense-industrial infrastructure—rather than simply the traditional nuclear triad of ICBMs, SLBMs/SSBNs and bombers.

According to the 2002 NPR, this New Triad must be designed and sized to accomplish four broad objectives: 1) assure friends and allies of US security commitments, 2) dissuade adversaries from competing with the United States, with nuclear forces or other "asymmetrical threats" (e.g., chemical and biological weapons), 3) deter coercion or attack against the United States and its friends and allies, and 4) decisively defeat an enemy, and protect the United States and its friends and allies, in the event of war.[21] The Bush Administration has concluded that an arsenal consisting of 1,700-2,200 operationally deployed warheads, and a responsive reserve of 2,400-2,900 warheads, would be needed to confidently meet these objectives, at least through 2012.

The administration has not stated which of these broad goals, or particular contingencies, has played the most important part in determining the size of the nuclear forces projected in its plans. However, it appears that among the most critical factors driving the numbers included in the proposed responsive force is the desire to establish a

[21] DoD, "Findings of the Nuclear Posture Review," January 9, 2002, slide 7.

"formidable entry barrier" to dissuade any potential adversary from attempting to challenge US nuclear superiority.[22]

Critics of the Bush Administration have raised questions about some of the goals and assumptions underlying its proposed approach, or argued that those objectives—to the extent they are desirable and realistic—could be achieved with much smaller nuclear forces than are currently projected in the administration's plans. For example, in a 2005 study, Sidney D. Drell and James E. Goodby questioned the NPR's assumption that large military forces are likely to prove effective at dissuading other countries from challenging the US militarily:

> History does not support the notion that superior force in itself is sufficient to dissuade a weaker state from strengthening its defenses. Recent experiences in Korea, the Middle East, and South Asia does not support it either. Instead of restraint, an arms race is typically the result.[23]

The authors also questioned the NPR's assumptions about dissuasion in the case of China in particular:

> Increasing US operationally deployed forces [by uploading nuclear warheads from the responsive reserve] to dissuade China from building the kinds of forces it thinks are necessary to achieve its regional goals would probably have an effect opposite to the one intended.[24]

In fact, Drell and Goodby suggest that making reductions in US nuclear forces deeper than those projected in the Bush Administration's current plans could be more effective at dissuading China from initiating a major buildup in nuclear forces.[25]

In any event, Drell and Goodby argue that deterrence remains the core mission for US nuclear forces, and that an arsenal consisting of about 1,000 strategic nuclear warheads—including an operationally deployed force of 500 warheads, and another 500 warheads in a

---

[22] Guthe, p. 24.
[23] Drell and Goodby, p. 7.
[24] Ibid.
[25] Ibid., p. 11.

responsive reserve—would be sufficient to deter Russia, China or any other likely competitor.[26]

The Natural Resources Defense Council (NRDC) reached a similar conclusion in a 2001 report.[27] According to the NRDC analysis, an arsenal consisting of 1,300 strategic nuclear warheads targeted against Russian nuclear forces could achieve high levels of damage against those forces and cause 11 million to 17 million casualties.[28] This capability, concluded the NRDC, should be sufficient to deter Russia (and thus presumably any of the lesser nuclear powers) from ever attacking the United States. Moreover, the NRDC estimated that a "limited" countervalue attack (aimed at Russian cities, rather than nuclear and other military forces), carried out with only some 200 nuclear warheads, could inflict about 50 million casualties—suggesting that even a nuclear arsenal consisting of 200 warheads might provide a sufficient deterrent.[29]

The Bush Administration's interest in the possibility of developing new nuclear weapons has also drawn criticism. Administration officials have argued that new and improved nuclear capabilities could be critical for certain missions, including strikes against deeply buried underground bunkers. Conversely, critics of these plans argue both that such new capabilities would be of dubious, if any, value and that US plans to develop new nuclear weapons—especially if they involved a resumption of nuclear testing—would be widely seen as a repudiation of the nuclear non-proliferation treaty (NPT) and broader efforts to reduce the perceived value of nuclear weapons.

Resolving the debates over nuclear strategy and force levels touched on above is far beyond the scope of this report. And to some extent these issues are unresolvable. For example, at the end of the day, there is no objective way to determine how many nuclear weapons it would take to accomplish the goals—of assuring, dissuading, deterring, and defeating—laid out in the NPR. However, as this brief discussion suggests, views about these and other questions of strategy can greatly

---

[26] Ibid., pp. 14-15.
[27] Matthew G. McKinzie, Thomas B. Cochran, Robert S. Norris, and William Arkin, *The US Nuclear War Plan: A Time For Change* (Washington, DC: NRDC, June 2001).
[28] Ibid., pp. x-xi.
[29] Ibid.

influence one's views concerning the numbers and types of nuclear forces the United States should maintain over the long run.

Nuclear Forces of Other Countries

Future plans for US nuclear offensive strategic forces are also likely to be influenced by trends in the size and shape of other countries' nuclear forces. As noted earlier, currently Russia has nuclear forces roughly comparable in size to those of the United States. And it is committed, like the United States, to reducing the size of its operationally deployed offensive strategic nuclear arsenal to some 1,700-2,200 warheads by 2012. It is also, like the United States, expected to maintain a large number of nuclear warheads in reserve. All of the other nuclear powers currently have much smaller arsenals. But, of course, one or more of these countries could, over the next few decades, attempt to significantly, or perhaps even dramatically, expand the size of its nuclear forces. Moreover, new nuclear powers could emerge in coming years.

Concerns that another country might attempt to challenge the United States by expanding its nuclear arsenal generally tend to focus on Russia and China. Russia is far weaker economically and militarily than was the Soviet Union of the Cold War. And Russia may find it extremely difficult to even cover the cost of maintaining the smaller nuclear forces it is projected to have in 2012—let alone find the resources needed to expand the size of its nuclear arsenal. On the other hand, because Russia is likely to retain a large reserve of nuclear warheads for many years to come, the possibility that it could fairly rapidly increase the size of its nuclear forces at some point in the future cannot, perhaps, be ruled out.

In contrast to Russia, China has an enormous population, and a robust and growing economy. As such, it may have the long-term potential—should it decide to do so—to develop and field much larger nuclear forces than it has today. That said, despite the rapid growth of its economy, and increased military spending, China has not substantially increased its nuclear strategic forces. China's nuclear forces capable of striking targets in the United States have, for many years, been held steady at some two dozen single-warhead missiles.[30] And their military modernization efforts have focused largely on non-nuclear forces and improving the survivability of their nuclear forces.

[30] Drell and Goodby, p. 6.

The goal of this brief discussion is not to suggest that either Russia or China is likely to engage in a major buildup of nuclear forces, but only to suggest that what these countries, and other nuclear powers, do with regard to their nuclear forces may well impact on US plans for its own strategic offensive nuclear forces. Of course, precisely how the United States would respond to a substantial expansion of foreign nuclear capabilities would depend, among other things, on the nuclear strategy it decided to pursue. Likewise, the number and types of nuclear forces acquired by other countries could be influenced, in part, by the size and types of nuclear forces maintained by the United States.

Fiscal Constraints

Like any other area of the federal budget, and defense programs more generally, decisions concerning the future size and shape of US offensive strategic forces will be determined in part by the amount of money available to fund those programs and activities. US funding for defense has grown substantially since the late 1990s. Between 1998 and 2006, funding for defense increased by 29 percent in real (inflation-adjusted) terms,[31] exclusive of funding for military operations. Under the administration's most recent plan, funding for defense is projected to continue to grow through 2009, and then decline slightly over the next two years. However, the overall fiscal picture confronting the United States has worsened dramatically in the past several years, raising questions as to whether the increases projected over the next few years are realistic—and especially whether funding for defense is likely to increase over the longer term.

In January 2001, the Congressional Budget Office (CBO) projected, in its baseline forecast (which assumes essentially no changes in tax or spending policies) that the federal government would run surpluses totaling some $5.6 trillion between 2002 and 2011.[32] By contrast, in January 2006, CBO forecast deficits totaling $726 billion between 2007 and 2016.[33] Moreover, this estimate almost certainly understates the magnitude of the fiscal problem the United States faces. As CBO acknowledges, its baseline estimate makes a number of assumptions

[31] Unless otherwise noted, all changes in funding noted in this report are expressed in real terms.

[32] CBO, *The Budget and Fiscal Outlook: Fiscal Years 2002-2011* (Washington, DC: CBO, January 2001), p. 2.

[33] CBO, *An Analysis of the President's Budget Proposals for Fiscal Year 2006* (Washington, DC: CBO, March 2006), p. 5.

that may be unrealistic—for example, that the tax cuts set to expire in 2010 will not be extended, and that spending on domestic discretionary programs (which includes most homeland security-related programs) will grow no faster than the rate of inflation. Making more realistic assumptions about these and other factors could push deficit levels to $4 trillion or more over the coming decade.[34]

As bad as the deficit picture appears to be over the coming decade, it is likely to get far worse in the years beyond 2016. The retirement of the baby boomer generation beginning toward the end of this decade, and accelerating in later years, will have major impacts on both federal spending (e.g., for Social Security and Medicare) and revenue. As a result, the Office of Management and Budget (OMB) projects that the deficit will grow from about one percent of gross domestic product (GDP) in 2015 to 2.2 percent in 2030, and 6.9 percent in 2060.[35] Others have estimated that deficits could exceed 14 percent of GDP by 2030 and 35 percent by 2050.[36]

The generally bleak fiscal outlook described above does not, of course, necessarily mean that funding for defense will stop growing, let alone that it will be cut, over the next three decades. It is certainly possible that, notwithstanding these large and rising deficits, spending on defense will be spared any substantial reductions—or even that it will continue to be increased over the long term—permitting the implementation of relatively expansive plans for US offensive strategic forces. On

[34] According to CBO, enactment of the President's proposed budget would push total federal deficits to some $2.137 trillion over the FY 2005-16 period, and keep the government in the red throughout the entire decade. Ibid. In addition, according to CBO, the combination of increasing discretionary spending at the rate of growth of GDP and reforming the alternative minimum tax (AMT), would increase deficit totals for the decade by another $2.3 trillion. CBO, *The Budget and Economic Outlook: Fiscal Years 2007 to 2016* (Washington, DC: CBO, January 2006), pp. 14-15.

[35] Office of Management and Budget (OMB), Fiscal Year 2006 Budget of the US Government, Analytical Perspectives (Washington, DC: US Government Printing Office, 2005), p. 209.

[36] These figures were taken from, CBO, *The Long-Term Budget Outlook* (Washington, DC: CBO, December 2005), p. 58. That report considered six different possible future deficit scenarios. Under this scenario, CBO assumed, among other things, that Medicare and Medicaid spending would continue to grow at their historical rates and federal revenues would remain (as a percentage of GDP) at their average rate of the past 30 years. See, also, Center on Budget and Policy Priorities, Committee for Economic Development and Concord Coalition, "Mid-Term and Long-Term Deficit Projections," September 29, 2003, p. 15.

the other hand, the magnitude of the looming deficit problem may create strong pressures to reduce defense spending, or at least slow its rate of growth. And these kinds of pressures on the overall defense budget could, in turn, create incentives to develop more affordable plans for US offensive strategic forces.

Competition from other DoD Priorities

In addition to the fiscal pressures that seem likely to affect federal programs generally, US nuclear offensive strategic forces may be affected by a variety of budgetary pressures within DoD. To execute DOD's current long-term defense plan, CBO estimates that DoD's budget would have to be increased substantially over the FY 2012-24 period—assuming, as seems likely, that DoD will continue to experience historical rates of cost growth in weapons acquisition programs and operations and support (O&S) activities.[37] Specifically, CBO's estimate suggests that, over the longterm, fully implementing DoD's current plan would require providing at least $75 billion a year more (exclusive of war costs) than is currently projected for 2011 (the last year included in DoD's latest Future Years Defense Program).

If fiscal constraints preclude such a large and sustained increase in funding for defense, cuts will have to be made to defense plans and programs. It is possible that, even in such a constrained budgetary environment, US nuclear offensive strategic forces would fare well. But they might well be required to absorb some of the necessary cuts. And it is perhaps more likely that they would be required to take a disproportionately large share of any cuts.

During the Cold War, programs and activities needed to support US nuclear offensive strategic forces were given a high—and often the highest—priority by DoD planners. However, since the end of the Cold War, DoD's focus has shifted far more to non-nuclear "general purpose" forces. And under current plans, all of these forces—which include Air Force tactical (i.e., short-range) fighter units, Army and Marine Corps divisions, and Navy aircraft carriers and other warships—are to be substantially modernized, at great cost, over the coming decades. Among the largest and most costly of these programs are the tri-service F-35

[37] Adam Talaber, *The Long-Term Implications of Current Defense Plans and Alternatives: Summary Update for Fiscal Year 2005* (Washington, DC: CBO, October 2005), p. 2.

fighter program, the Army's Future Combat System (FCS) and the Navy's DD(X) destroyer and Virginia-class submarine programs.

To the extent that US forces continue to be involved in large-scale counter-insurgency operations in the future, DoD planners may also tend to discount the importance or relevance of nuclear offensive strategic forces when making funding decisions. Moreover, as is the case with all force structure components and weapons programs, there is the danger that rising military personnel and operations and support costs will crowed out investments in nuclear offensive strategic forces.

Strategic Defenses

Another important consideration that could affect future plans for US nuclear offensive strategic forces are developments in strategic defenses. Strategic defenses include active systems intended to intercept ballistic missiles, cruise missiles or aircraft armed with nuclear weapons—or possibly other the weapons of mass destruction (e.g., chemical and biological weapons). For the past two decades the greatest efforts in this area have focused on the development of a national ballistic missile defense (NMD) system that would be capable of protecting the United States from attack by an adversary's ICBM and SLBM forces.

In 2005, the United States deployed a very modest NMD capability consisting of 16 ground-based interceptors located at Fort Greeley, Alaska, and two interceptors at Vandenberg Air Force Base in California. DoD's long-term plans for NMD, and strategic defenses more broadly, are very uncertain. However, DoD is pursuing the development of a layered defense that would be capable of intercepting ballistic missiles in each phase of their flight—boost, midcourse and terminal. To be effective, these defense would also eventually have to be combined with greatly improved air and cruise missile defenses.

The NPR asserts that defenses are one of the three legs of the New Triad that will, in the future, increasingly comprise US strategic military capabilities. Some advocates of strategic defenses argue that the development and eventual fielding of effective defenses might allow the United States to further reduce the size of its nuclear offensive strategic forces. Among other things, this is because, in this case, US nuclear forces would be more secure (i.e., less vulnerable to preemptive attack) and potential adversaries would be dissuaded and deterred, not only

by the threat posed by US nuclear offensive forces, but also by the prospect that the United States could protect itself from such an attack.

Conversely, critics worry that strategic defenses—at least unconstrained defenses—are almost certain to prove ineffective, since such a system would likely be vulnerable to countermeasures (including decoys, chaff and other penetration aids) and, to succeed, would need to have an extremely low leakage rate. Worse yet, they argue, such defenses may well fuel a nuclear arms race—as potential adversaries feel compelled to buildup their nuclear capabilities to ensure that they can overwhelm, or at least pierce, any defensive system. In this case, far from facilitating further reductions, the deployment of defensive systems could, indirectly, create pressures to further increase the size of US nuclear offensive strategic forces.

The pursuit of strategic defenses could also impact on plans for nuclear offensive strategic forces in another way. In a world of increasingly tight fiscal constraints, and other DoD priorities, US policymakers and planners may, to some extent, have to choose whether to give top priority to the development and fielding of strategic defenses or offensive strategic forces.

Conventional Capabilities and Offensive Strategic Forces

A major—and to some extent—unsolvable, complication with attempting to project future plans for nuclear offensive strategic forces concerns the fact that some offensive strategic forces are equipped, trained and capable of carrying out conventional strikes as well, and in the future conventional offensive strategic forces may increasingly be capable of substituting for nuclear forces. As the Defense Science Board (DSB) Task Force on Future Strategic Strike Forces noted in 2002:

> Throughout the Cold War, strategic was virtually synonymous with nuclear. This is no longer so. While we could previously execute some military operations only with nuclear weapons, we can now execute many of these with highly-precise conventional weaponry.[38]

[38] DSB, p. 2-2.

Just how much improvements in conventional capabilities may allow for this kind of substitution, and how quickly such improved capabilities are likely to be developed and fielded, is difficult to predict and debatable. However, to the extent that advances in conventional offensive strategic strike capabilities could reduce the US military's dependence on nuclear weapons, these advances could lead DoD to reduce the size of its strategic nuclear arsenal.

On the other hand, it is far from clear that advances in conventional offensive strategic forces, even if they could allow for a significant substitution of conventional for nuclear capabilities, necessarily would. It is possible that, instead, the enhanced capabilities would be used simply to expand the range of strategic targets that could be struck by US forces or to give US decision-makers greater flexibility in determining how to threaten, or strike, such targets. According to the DSB Task Force on Future Strategic Forces, for example, one of the primary benefits of improving non-nuclear offensive strategic capabilities would be to "maximize the set of non-nuclear strategic strike options available to the president in peacetime, crisis, or conflict."[39]

Today, and for the past 50 years, long-range bombers have constituted the only US offensive strategic weapon system that is capable of delivering conventional strikes, and is assigned conventional missions. The ability of long-range bombers to successfully conduct strategic warfare using conventional weapons has improved dramatically over the past two decades as a result of the great progress that has been made in the development and deployment of PGMs, as well as intelligence, surveillance, reconnaissance, communications and related capabilities—sometimes referred to as "C4ISR" assets.[40] These capabilities are likely to improve still further in coming years. Since the end of the Cold War, the idea of arming ICBM and SLBMs with conventional warheads has also gained considerable traction. And, as noted earlier, in the latest QDR, the administration has proposed arming a small number of Trident II SLBMs with conventional warheads.

Long-Range Bombers

Although long-range bombers have, since 1945, been assigned nuclear roles, they have also frequently been used to conduct conventional

[39] DSB, p. 2-2.

[40] C4ISR literally stands for command, control, communications, intelligence, surveillance and reconnaissance.

bombing missions. Indeed, US long-range bombers have been used to carry out conventional strikes—sometimes on a massive scale—in all of the major conflicts in which the US military has been involved since the beginning of the nuclear age, including the Korean and Vietnam Wars, both wars against Iraq, and the war in Afghanistan.

As noted earlier, the B-1B is now assigned an exclusively conventional role, while the B-2A and B-52H bombers are dual-capable systems. It is unclear whether the United States will continue to field both conventional and dual-capable bombers over the next 30 years. If improvements in PGM and C4ISR capabilities allow the United States to rely more on air-delivered conventional munitions for strategic strikes, and reduce its reliance on air-delivered nuclear weapons, it could decide to reduce the number of dual-capable bombers in its inventory (consistent with the smaller number of nuclear weapons to be assigned to bombers), and maintain or possibly even expand its fleet of dedicated conventional bombers. Alternatively, it could decide to maintain the same number of dual-capable bombers, or even conceivably increase their numbers (spreading the smaller nuclear arsenal over the same, or even a larger, number of aircraft), and reduce or even eliminate its fleet of dedicated conventional bombers.

Given these two possibilities, even assuming that the conventional capabilities of long-range bombers are substantially improved in coming years and US planners decide to take advantage of these improvements to substitute conventional for nuclear strike capabilities (rather than to simply expand overall strategic strike capabilities), it is difficult to predict what the impact of such advances would be on the size and shape of US long-range bomber forces, and nuclear-capable bomber forces in particular. On the other hand, the impact could be significant.

ICBMs

In recent years, proposals have also been made to expand US conventional strategic strike capabilities by placing conventional munitions atop ICBMs. Advocates of this idea argue that the United States needs to create a "prompt" and "global" conventional strike capability, for possible use against a range of targets, including enemy command and control facilities, or weapons of mass destruction (WMD) launch or storage sites. Such a capability could be provided through a number of different means. But the simplest near-term solution might be to equip some number of ICBMs with conventional warheads. In 2004, the DSB Task Force

on Future Strategic Strike Forces recommended, that the United States retain the 50 Peacekeeper ICBMs recently removed from their silos—and retired from their nuclear mission—and equip the missiles with conventional warheads.[41] This would give the United States a "30-minute response capability for [conventional] strategic strike worldwide."[42]

There are, however, a number of limitations and potentially dangerous pitfalls associated with the use of conventionally-armed ICBMs. Most importantly, there is the danger that another nuclear-armed state might observe the launch of such a missile and mistake it for a nuclear attack by the United States. In order to reduce the likelihood of such a—possibly catastrophic—misunderstanding, the DSB suggested that US conventionally-armed ICBMs be deployed in two separate sites located far away from existing (nuclear-armed) ICBM fields. Specifically, the DSB recommended deploying the conventionally-armed Peacekeeper ICBMs at Vandenberg Air Force base in California and Cape Canaveral, Florida.

Whether segregating conventionally-armed ICBMs from nuclear-armed ICBMs by deploying them at different sites would be sufficient to ally concerns that their use could inadvertently trigger a nuclear conflict is debatable—especially in the absence of verification measures that could give other countries extremely high confidence, even during times of crisis, that US conventionally-armed ICBMs were, indeed conventionally-armed. Another potential problem with the use of conventionally-armed ICBMs is that, depending on where the target is located, it may well be necessary for the missile to overfly one or more other countries (almost certainly including Canada, but also quite possibly Russia or even China) before reaching the adversary's state.

In any event, even assuming that these serious operational complications could be overcome or avoided, it is unclear whether the United States would ever find it worthwhile to deploy more than a relatively modest force of conventionally-armed ICBMs. ICBMs represent an exceedingly costly means of delivery, and are capable of carrying only a relatively small payload.[43]

---

41 DSB, p. 1-8.

42 Ibid.

43 Since the Peacekeeper missiles have already been procured and will otherwise be retired, the costs would be relatively modest in this case. However, assuming the United States were to decide to maintain a conventional ICBM capability over the long term (the Peacekeeper's service life is currently projected to keep the missile usable until 2020 and possibly beyond), it would

According to the DSB, a single Peacekeeper missile, which is by far the largest US ICBM, could be equipped to carry a single 9,000 pound kinetic energy weapons (e.g., for targeting underground bunkers) or up to four or five 2,000 pound conventional munitions.[44] By comparison, a single B-2A bomber can carry about 40,000 pounds of conventional munitions on a single mission. Even with the accuracy now possible with precision-guided conventional munitions, such a payload represents a fairly modest capability. Notwithstanding the high cost and likely very limited lethality of a conventionally-armed ICBM, there may be some very high value, time urgent targets, that could be effectively destroyed, or at least temporarily disabled by a strike by such a missile. But, the number of such targets may be small. As Barry Watts concludes:

> A prompt global response capability constitutes, at best, a niche capability . . . . the situations in which it will be imperative to get from launch to impact-on-target in 35 minutes, or even two hours, are likely to occur rarely—once in a blue moon.[45]

It is also important to note that, under the basing plan suggested by the DSB at least, the United States would posses both conventional and nuclear ICBMs, but not ICBMs that are dual-capable in the sense that B-52H and B-2A bombers are dual-capable. In the case of the B-52H and the B-2A, and future dual-capable bombers, the same bomber can be armed either with conventional or nuclear weapons—allowing DoD to cover both conventional and nuclear target sets with literally the same bomber. By contrast, under the DSB proposal, the ICBM force would consist of two separate and distinct components, one made up of nuclear-armed missiles and the other, conventionally-armed missiles. In other words, each individual ICBM would be either a dedicated nuclear missile, or a dedicated conventional one. This might make the acquisition and use of conventionally-armed ICBMs appear substantially less cost-effective than otherwise would be the case.

Nevertheless, it is possible that conventionally-armed ICBMs could prove effective and even cost-effective weapons for some missions,

---

eventually have to acquire new ICBMs specifically for this mission, which could entail substantial costs.

[44] Ibid., p. 5-3.

[45] Barry D. Watts, *Long-Range Strike: Imperatives, Urgency and Options* (Washington, DC: Center for Strategic and Budgetary Assessments, 2005), p. 68

especially if DoD were able to develop a relatively low-cost launcher. On the other hand, as in the case of improved conventional bomber capabilities, it is far from clear that the development and fielding of substantial conventional ICBM capabilities would—even if it could—result in a reduction in nuclear ICBM forces, rather than simply an expansion of US strategic strike options and capabilities.

SLBMs/SSBNs

Another relatively near-term option for achieving a prompt global conventional strike capability would be to place conventional warheads on SLBMs. The Bush Administration has recommended this approach. As part of the 2006 QDR, it proposed equipping 24 Trident II SLBMs, deployed aboard the US SSBN fleet, with conventional warheads.

Arming SLBMs with conventional warheads would have at least two potentially important advantages over arming ICBMs with conventional warheads. First, the overflight issue might prove significantly less troublesome, since submarines have much more flexibility in terms of their launch locations. Second, since submarines can deploy in oceans all around the world, they might be better able to achieve global coverage. Against these advantages, there is, however, at least one potentially critical disadvantage.

In contrast to the situation with ICBMs, since SSBNs are mobile and hidden from sight, there may be no practical way the United States could provide other nuclear-armed states with even a modest degree of confidence that the missiles launched from an SSBN were equipped with conventionally-armed, rather than nuclear-armed, SLBMs.

As a result of this concern, the DSB Task Force on Future Strategic Strike Forces suggested that instead of pursuing a conventional SLBM capability (at least in the near-term), the United States should focus efforts on acquiring a submarine-launched intermediate-range ballistic missile (SLIRBM) that would be initially deployed aboard guided-missile submarines (SSGNs) and, later, possibly surface ships.[46] As envisioned by the DSB study, this SLIRBM would carry a single 2,000-pound warhead and have a range of 1,500 miles.[47] The existing US SSGN fleet consists of four converted Trident SSBNs equipped with 1,000-mile range Tomahawk land-attack cruise missiles. Accord-

[46] DSB, p. 5-12.
[47] Ibid.

ing to the DSB study, this SLIRBM would be small enough so that as many as three missiles could be deployed inside a single Trident II missile tube.[48]

Because such an SLIRBM would have a shorter range, and fly a different flight trajectory than an SLBM, but (like an SLBM) have fewer overflight issues than an ICBM, the DSB task force concluded that it would be less susceptible to "misinterpretation from other nations."[49] However, as in the case of the proposed geographic separation of conventionally- and nuclear-armed ICBMs, it is unclear whether deploying conventional warheads on SLIRBMs, rather than SLBMs, would sufficiently mitigate these concerns. In any case, in the 2006 QDR the Bush Administration decided to pursue the near-term deployment of a small number of conventionally-armed Trident II SLBMs, rather than await the development and fielding of a conventionally-armed SLIRBM.

As with conventionally-armed ICBMs, even if concerns about the potentially escalatory consequences of using conventionally-armed SLBMs or SLIRBMs could be eliminated, it is unclear whether acquiring more than a small "niche" capability would be worthwhile. Likewise, as in the case of both bombers and ICBMs, it is unclear whether providing a conventional SLBM or SLIRBM capability would facilitate reductions in the size of the US SLBM force, or simply result in an expansion of overall strategic strike capabilities.

C4ISR Capabilities

The extent to which future improvements in conventional offensive strategic strike capabilities might allow for a significant substitution of conventional for nuclear capabilities will depend not only on the degree of progress made in bombers and PGMs, as well as conventionally-armed ICBMs, SLIRBMs (and possibly SLBMs), but on advances in C4ISR capabilities.

No matter how effective the weapon system, targets can only be successfully destroyed or disabled if they can be found and identified in a timely manner, and strikes against them properly assessed. The DSB Task Force on Future Strategic Strike Forces has noted a number of serious deficiencies in C4ISR assets that will have to be overcome if the effectiveness of US conventional strategic strike capabilities is to be

[48] DSB, p.
[49] Ibid., 5-12.

significantly enhanced. According to the DSB, these deficiencies include the following:

- Intelligence organizations cannot find all of the strategic target sets and are not able to identify and track targets that are known to exist;
- Surveillance and reconnaissance systems lack persistence, penetration, and identification capability;
- Operational effects assessment [i.e., bomb damage assessment] is often too little, too late; and
- The tasking, processing, exploitation, and dissemination . . . process cannot keep up with the data and inhibits fusion and integrated tasking.[50]

Both nuclear and conventional strike capabilities are to some extent dependent on effective C4ISR. However, because of the enormous yield—relative to conventional weapons—of nuclear weapons, the requirements for effective C4ISR are inherently much higher in the case of conventional weapons. As a result, the extent to which improvements in conventional strategic strike capabilities might allow for a substitution of conventional for nuclear capabilities will depend heavily and critically on DoD's success at achieving major improvements and in some cases (e.g., mobile targets) breakthroughs in C4ISR capabilities.

[50] DSB, p. 1-7.

IV. Options

This chapter describes five different options for nuclear offensive strategic forces that the United States might pursue over the next three decades. These options barely scratch the surface in terms of the (essentially infinite) variety of approaches that could, in theory, be pursued. However, taken together, they reasonably bound the different kinds of options that, in practice, are likely to be pursued.

The options described in this chapter assume that, over the long term, the United States would maintain a stockpile ranging from as few as about 1,000 to as many as 4,600 active strategic nuclear warheads, the level currently projected for 2012. It is certainly possible that over the next 30 years the US stockpile of active strategic nuclear warheads will shrink below 1,000 or rise above 4,600 (see Table 4). However, most discussions of future force levels appear to fall within this range.

In addition to spanning a range of nuclear warhead levels, the five options for future nuclear offensive strategic forces described below reflect differences in the size and shape of the force structures that might be pursued, and the types of new weapon systems that could be acquired to modernize each leg of the triad. However, under all but Option 4, it is assumed that the United States would continue to maintain all three legs of its traditional strategic nuclear triad. And, as is true today, in all of the options the greatest number of warheads would be deployed aboard the US SSBN fleet—indeed, in Option 5, the entire US strategic nuclear arsenal would be deployed aboard the SSBN fleet.

Table 4: Active Strategic Nuclear Warheads Under Alternative Options

	Operationally-Deployed	Reserve, Overhaul and Spare	Total
2006	3,950	1,300	**5,250**
Option 1	2,200	2,400	**4,600**
Option 2	2,200	2,050	**4,250**
Option 3	1,700	1,250	**2,950**
Option 4	1,000	50	**1,050**
Option 5	1,000	50	**1,050**

Source: CSBA.

Option 1 (2,200/4,600 active strategic nuclear weapons): The "Current Plan"

This option is based on the Bush Administration's latest plans for nuclear offensive strategic forces—to the extent those plans have been specified and described publicly. In instances where those plans are unclear or unsettled, the term "current plan" refers to the author's best judgments as to the administration's and Services' intentions for those forces. Generally, where DoD's long-term plans are unclear, it is assumed that the United States would strive to maintain, through 2035, roughly the same number of weapon systems (e.g., ICBMs, SSBNs and bombers) and warheads it is projected, in current plans, to maintain in the near-term.

Under this option, the United States would, over the long term, maintain an arsenal of 2,200 operationally deployed strategic nuclear warheads (representing the high end of the 1,700-2,200 warhead range projected by the administration for 2012). In addition, the United States would maintain 2,400 other active strategic nuclear warheads. Of these additional warheads, about 200 would be spares, while the remaining 2,200 would constitute a responsive reserve—made up both of reserve warheads kept in storage and warheads aboard SSBNs in overhaul. Thus, consistent with current projections for 2012, in this option the United States would retain a total stockpile of about 4,600 active strategic nuclear weapons. This would include a responsive force capable—after

uploading reserve warheads—of delivering some 4,400 strategic nuclear warheads.[51]

The following discussion provides a brief overview of the force structure and modernization plans assumed for the three legs of the triad under this option.

ICBMs: The United States would, as called for in the QDR, reduce the size of its ICBM force from 500 to 450 missiles. Each of these ICBMs would be capable of carrying as many as three warheads. Normally, however, each missile would be equipped with a single warhead. In addition to the 450 operationally deployed warheads in this force, the United States would maintain another 950 active ICBM warheads as a responsive reserve (900) and as spares (50). If the responsive reserve were tapped, the number of nuclear warheads in the ICBM force could be increased to some 1,350, with each missile carrying its maximum load of three warheads. To sustain this force, around 2015, the Air Force would begin procuring a new ICBM that, like the existing Minuteman III missile, would be capable of carrying up to three warheads. Consistent with current plans, this would support an initial operational capability (IOC) for the new missile of 2018. Between 2015 and 2030, it is assumed that a total of some 650 of these new "Minuteman IV"[52] missiles would be purchased (450 to be deployed in Minuteman III silos and 200 for spares and testing).

SSBNs/SLBMs: The Navy would maintain the same number of SSBNs (14) it has today. Assuming that two SSBNs would typically be in port undergoing overhaul, this would equate to an operationally deployed force of 12 SSBNs. Initially, this force would be made up of Trident SSBNs, each equipped with 24 Trident II SLBMs. In 2022, however, the Navy would begin procuring a new SSBN to replace the Trident submarines, which will be reaching the end of their service lives. It is assumed in this option that the new SSBN would be a smaller submarine than the current Trident boat, capable of carrying 16 rather than 24 SLBMs. This seems consistent with current Navy plans, which emphasize the

[51] As noted earlier, as defined in this analysis, the responsive reserve excludes spare warheads, but includes those assigned to SSBNs in overhaul, since—with sufficient warning time—it might be possible either to deploy those submarines (i.e., by accelerating or deferring the overhaul), or to remove the warheads from any boats in overhaul and upload them onto missiles carried aboard operationally deployed SSBNs.

[52] This designation, like others used in this analysis to identify and denote new weapon systems, was created by the author.

need to acquire a relatively affordable replacement SSBN, as well as the projected reduction in overall nuclear warhead levels. It also seems consistent with the possibility—currently being explored by the Navy—of basing the new SSBN design on a modified version of the Virginia-class attack submarine, which is a much smaller boat than the Trident SSBN.[53] These new medium-size SSBNs (SSBN-XM) would be procured at the rate of one boat per year between 2022 and 2035, with the first boat entering service around 2027 and the last around 2040, when the last Trident SSBN would be retired.

It is assumed that these new SSBNs would be equipped with a new missile (SLBM-X).[54] Like the Trident II missile, the SLBM-X would be capable of carrying up to eight nuclear warheads. Altogether, the Navy would procure 424 of these new SLBMs over the 2023-2035 period (224 to be deployed aboard the 14 new SSBN-XMs and about 200 for spares and testing). It is also assumed, consistent with the recommendations in the QDR, that the Navy would deploy conventional warheads, initially, on 24 Trident II missiles[55] and, subsequently, on 24 SLBM-Xs.

Under this option, by 2012, the number of operationally deployed nuclear warheads in the US SSBN fleet would be reduced to about 1,350

---

[53] To accommodate SLBMs, the *Virginia*-class design would be modified with an SLBM "plug" inserted in the boat's midsection, resulting in a substantially longer hull. This approach was used to deploy the first (Polaris) SLBMs in the early 1960s. Acquiring a modified version of the *Virginia*-class attack submarine to fulfill the SSBN role would probably be less expensive than designing an entirely new SSBN. However, it would be difficult to design such a boat to accommodate the Trident II missile because of its great size and, particularly, length. It is possible that the Navy could get around this problem by designing a plug for a *Virginia*-class SSBN that would cant the missiles (i.e., use angled tubes). But if that proves infeasible or impractical, the Navy would have to develop and procure a new, smaller SLBM to equip its new SSBN. Alternatively, the Navy could develop and procure an entirely new SSBN design that could accommodate the Trident II SLBM.

[54] Navy plans concerning a replacement SLBM are unsettled. The Navy plans to keep the Trident II missile in service until around 2040, when the last Trident SSBN is scheduled to be retired. If the new SSBNs procured beginning in 2022 could accommodate the Trident II missile, it might be possible to defer the acquisition of a new SLBM beyond 2023. However, given the projected service life of the Trident II missile, even in that case it would probably be necessary to begin production of either additional Trident II missiles (beyond those included in the Navy's current plan) or a new-design SLBM by around 2030.

[55] Ann Scott Tyson, "Pentagon Seeks to Fund New Force of Conventional-Warhead Missiles," *The Washington Post*, March 8, 2006, p. A12.

and would remain at this level through 2035. Prior to the introduction of the SSBN-XM around 2027,[56] these warheads would be used to arm 264 Trident II missiles carried aboard 12 operationally deployed Trident SSBNs (suggesting an average of about 5 warheads per missile), with the remaining 24 missiles carried aboard these boats being armed with conventional warheads. Once the smaller SSBN-XM had fully replaced the Trident SSBN, the total number of missiles carried aboard the operationally deployed SSBN fleet would fall from 288 to 192. Assuming that 24 of those missiles (two per SSBN) would continue to be armed with conventional warheads, this would leave 168 missiles (14 per SSBN) armed with nuclear warheads. Since each missile would be capable of carrying at least eight nuclear warheads, however, this smaller force would still be capable of carrying some 1,350 nuclear warheads.

In addition, to these operationally deployed warheads, the United States would maintain another 550 active SLBM warheads as a responsive reserve (450) and as spares (100).[57] Drawing upon this responsive reserve would increase the number of nuclear warheads deployed aboard SSBNs to nearly 1,800.

Bombers: Consistent with the QDR, under this option, the number of B-52H bombers would be reduced from today's PAA strength of 44 to 32 over the next few years, while the B-2 force would be maintained at today's level of 16 PAA.[58] In addition, again consistent with the QDR, the Air Force would start procuring a new long-range bomber in 2015 (to support an IOC of 2018), and another, more technologically-advanced, long-range strike system in 2030 (to support an IOC of 2035).

As noted earlier, the Air Force has not yet announced precisely how many of these new bombers it plans to procure. However, the QDR did give some indication of the number of the first of these new bomb-

[56] This schedule assumes that the first of these new SSBNs would be delivered and deployed five years after funding for the boat is appropriated.

[57] Since the SBLM-X missile would normally be fully armed with eight nuclear warheads, once the new SSBN-XM and SLBM-X had fully replaced the existing fleet of Trident SSBNs and Trident II SLBMs, drawing upon the responsive reserve would involve replacing conventional warheads with nuclear warheads on the 24 missiles normally deployed with conventional warheads, and, if possible, deploying on patrols the two SSBNs normally in port undergoing overhauls.

[58] As recommended in the QDR, the total number of B-52H bombers would decline from 94 to 56, while the total number of B-2A bombers would be kept at today's level of 21.

ers that might be fielded. According to the QDR, the Air Force "has set a goal of increasing its long-range strike capabilities by 50 percent by 2025." This suggests that roughly 100 of the first of these new bombers would be procured, and this is the production total assumed in this option. This total would, in turn, be sufficient to support a PAA strength of some 66 bombers over the long term.

The Air Force has indicated that the new bomber to be fielded beginning in 2018 would be a penetrating bomber (vice a standoff-bomber like the B-52H), and that it would make use of near-term technologies. But, as noted earlier, it has not yet decided whether it will be a dedicated conventional bomber, or a nuclear-capable system, or whether it will be manned or unmanned. Nor has the Air Force yet stated whether the aircraft will be subsonic or supersonic, or how large it will be.[59]

It is assumed in this option that the new bomber would be nuclear-capable. It is also assumed that this new bomber would be manned, subsonic and substantially smaller than the B-2A or the B-52H bombers. While it is certainly possible that this aircraft would be unmanned, it seems more likely—at least assuming the aircraft is to be nuclear-capable—that it would be manned.[60] Nor is the possible reluctance of US military planners, policymakers and the public to use unmanned aircraft to carry out nuclear missions the only reason to suspect that a manned aircraft might be more likely. Other considerations that may make the manned option more likely include: the dominance of pilots in Air Force leadership positions; the high cost of a next-generation bomber (compared to those unmanned systems deployed to date); and the need to rely on near-term technologies in designing the aircraft. Likewise, the need to hold down costs—especially given the relatively large number of aircraft to be procured—and rely on near-term technologies, as well

[59] For a discussion of various bomber and other long-range strike options, see Robie Samanta Roy and David Arthur, *Alternatives for Long-Range Ground-Attack Systems* (Washington, DC: CBO, March 2006).

[60] In any event, from a cost perspective, it is unclear whether it would make a significant difference whether the aircraft were manned or unmanned. Although advocates of unmanned aircraft sometimes argue that such aircraft are less expensive both to acquire and to operate than manned aircraft, it is unclear the extent to which, or even whether, this is true. Some argue that when survivability, payload capacity, speed, targeting capabilities, and other design criteria and performance characteristics are held constant cost differences between manned and unmanned systems may be nonexistent, or unmanned systems may even be less cost-effective.

as other considerations, are likely to drive the Air Force to choose a subsonic design for this aircraft.

The new, near-term (B-XM) bomber acquired under this option would have a payload capacity of about 20,000 pounds, roughly half that of the B-2A bomber, and would be capable of carrying up to eight nuclear weapons (rather than 16). It is assumed that this new bomber would be smaller than existing bombers for several reasons. First, the relatively large number of these aircraft to be procured and deployed might suggest that smaller payloads would be sufficient. Second, all else being equal, a smaller bomber would be more stealthy, and thus more survivable, and less costly to acquire and support. Third, given the dramatic improvements being made in the miniaturization of conventional PGMs, a reduced payload capacity might do little to compromise the bomber's conventional strike capabilities.[61]

Under this option, the US bomber fleet would normally be assigned about 425 nuclear weapons. Initially, once the planned reductions in the B-52H fleet were completed (over the next few years), this operationally deployed stockpile would be assigned to a force consisting of 16 B-2As and 32 B-52Hs. While these aircraft can carry maximum payloads of, respectively, 16 nuclear bombs and 20 nuclear cruise missiles, in this option each aircraft would normally be assigned an average of 8-9 nuclear weapons. Once the fleet of new B-XM bombers reached its target of 66 PAA, around 2030, these 425 operationally deployed nuclear weapons would be spread among a total PAA strength of 114 long-range bombers, including 16 B-2A, 32 B-52H and 66 B-XM bombers, with each aircraft assigned an average of only 3-4 nuclear weapons.

In addition to the 425 bomber-delivered nuclear weapons in the operationally deployed stockpile, under this option, another roughly 825 active nuclear bombs and cruise missiles would be kept as a responsive reserve (775) and as spares (50). Drawing upon this responsive reserve would allow each bomber to be loaded to close to its maximum capacity, and raise the bomber fleet's total weapons load to some 1,250 nuclear weapons.

---

[61] Given these advances in PGM capabilities, Barry Watts has argued that "munitions payloads of 40-50,000 pounds [comparable to the B-2A's payload] are no longer necessary . . . . Payloads of 10-20,000 pounds will probably suffice." Watts, pp. 69-70. This suggests that a future bomber with a payload one-half or even one-quarter the size of the B-2A's could still prove highly effective in conventional roles.

Under this option, consistent with the QDR, the Air Force would begin fielding a new, more advanced, long-range strike capability around 2035. It is assumed that this new system would replace the B-2A bomber, which (at least according to some Air Force estimates) would be reaching the end of its service life around 2040.[62] Likewise, it is assumed that the B-2A would be replaced on roughly a one-for-one basis. Specifically, under this option (as well as Options 2, 3 and 4), the Air Force would procure a total 25 new bombers over the 2030-35 period. This total would include a sufficient number of backup aircraft for training, testing, maintenance, and peacetime attrition, to ensure that 16 of these new bombers could, over the long run, be kept flying on a day-to-day basis.[63] It is also assumed that this new bomber, like the B-2A it would be replacing, would be nuclear-capable.

In terms of the kind of system that would be acquired, plans for this capability are even less settled than they are for the bomber projected for 2018. Under this option, it is assumed that the new bomber purchased beginning in 2030 would be a relatively large, supersonic penetrating bomber (B-XLS). Like the B-2A, the B-XLS would be capable of carrying as many as 16 nuclear bombs.

All existing US bombers and other combat aircraft—with the sole exception of the new F-22 fighter—are capable of cruising only at subsonic speeds. High speed can improve an aircraft's performance in a variety of ways. Among other things, it can improve the aircraft's survivability in enemy airspace, increase the rate at which sorties can be generated, and enhance its ability to strike fleeting targets, such as mobile missile launchers. However, the ability to cruise at supersonic speeds also typically takes a heavy toll on aircraft range, payload and persistence (the ability to loiter in over an area for an extended period). Thus, designing a supersonic bomber that would both be capable of flying long-range missions and have a large payload capacity (like the B-2A), would represent a major, and likely very costly, effort.

It is also assumed in this option that DoD would begin buying a new air-launched cruise missile beginning in 2025. This seems con-

[62] See, "US Air Force White Paper on Long Range Bombers," March 1, 1999, p. 21.

[63] In the existing B-2A fleet, a total of only 21 aircraft are available to support a PAA strength of 16 aircraft. This is a lower ratio of total-to-PAA strength than is typical for combat aircraft. Thus, it is assumed in this analysis that the Air Force would procure a slightly larger number replacement aircraft (21 vice 16, even though the goal would still be to support a PAA strength of 16 bombers.

sistent with current plans, which call for extending the service lives of the existing inventory of ALCMs and ACMs until around 2030.[64] Under this option, a total of 1,000 of these missiles would be procured between 2025 and 2035. This should be sufficient to ensure that the 32 B-52H bombers kept operationally deployed in this option could be equipped with close to their full complement of air-launched cruise missiles through 2035. In this option (as well as Option 2, 3 and 4), it is assumed that the Air Force would not begin procuring a replacement for the B-52H until sometime after 2035 (beyond the period covered in this report).[65]

Table 5: US Nuclear Offensive Strategic Launchers Under Alternative Options

	2006	Option 1	Option 2	Option 3	Option 4	Option 5
ICBMs						
MM III	500					
MM IV		450	450			
SICBM				300	150	
Subtotal	**500**	**450**	**450**	**300**	**150**	**0**
SSBNs/SLBMs						
Trident	14/336					10/160
SSBN-XM		14/224	14/224	11/132		
SSBN-XS					8/96	
Subtotal	**14/336**	**14/224**	**11/224**	**11/132**	**8/96**	**10/160**
Bombers (PAA)						
B-2A	16					
B-XLS		16				
B-XL			16	16		
B-XM		66			16	
B-52H	44	32	32	24	14	
Subtotal	**60**	**114**	**48**	**40**	**30**	**0**

Source: CSBA

[64] DSB, pp. 5-3 to 5-4.

[65] This schedule seems consistent with the economic service lives the Air Force assumes for B-52H bombers (see, "US Air Force White Paper on Long Range Bombers," March 1, 1999, p. 21).

Option 2 (2,200/4,250 active strategic nuclear warheads): "Current Plan"-Minus

This option is identical to Option 1 in terms of ICBM and SLBM/SSBN force structure, warhead levels and modernization plans. It differs from Option 1 only in its inclusion of smaller and less capable nuclear-capable bomber forces. As in Option 1, under this option the United States would sustain an operationally deployed force of 2,200 active strategic nuclear weapons. However, in this option, the United States would have a total stockpile of about 4,250 active strategic nuclear warheads, some 350 fewer than in Option 1.

As in Option 1, under this option, the Air Force would reduce the number of B-52H bombers to a PAA strength of 32 aircraft over the next several years, and maintain this force, along with its existing fleet of 16 B-2A bombers, through 2035. But, in contrast to Option 1, under this option, the Air Force would either forego entirely production of a new, near-term bomber (Option 1's B-XM), or the new aircraft would be a dedicated conventional bomber (like the B-1B). As in Option 1 (as well as Options 3 and 4), in this option the Air Force would still buy a replacement for the B-2A beginning in 2030, and procure a total of 25 aircraft over the 2030-35 period.

However, in this case the new bomber would be a subsonic penetrating bomber, capable (like the B-2A) of carrying up to 16 nuclear bombs. Although the ability to cruise at supersonic speeds can improve an aircraft's survivability, and may offer other advantages, it is unclear whether the acquisition of such a bomber (assumed in Option 1) would represent a necessary, or even prudent, investment. It may be possible to improve substantially the survivability of subsonic bombers by, among other things, arming them with air-to-air missiles. Moreover, the greater endurance and loiter time possible with subsonic aircraft may well make such aircraft more effective at finding and striking mobile targets.[66] And acquiring such a subsonic bomber, which might resemble the B-2A, would likely prove substantially easier and less costly. Also as in Option 1, the Air Force would begin procuring a new air launched cruise missile in 2025, and a replacement for the B-52H sometime after 2035.

In 2018 and beyond, the number of nuclear-capable bombers would be smaller in this option than in Option 1—since, in contrast to

[66] See, for example, Watts, pp. 57-58.

Option 1, under this option the Air Force would forego the acquisition of the new B-XM bomber. But this smaller bomber force would normally be equipped with 425 nuclear bombs and cruise missiles; the same number as in Option 1. In this case, the 425 operationally deployed nuclear bombs and cruise missiles would be deployed aboard the 16 B-2As and 32 B-52Hs in the US bomber fleet through 2035 (rather than—as in Option 1—only through 2018, after which they would be spread across the new B-XM fleet as well).

The smaller bomber force included in this option would not, however, be capable of delivering as many nuclear weapons as the bomber force in Option 1 after uploading nuclear bombs and cruise missiles held in the responsive reserve. Under this option, if the Air Force's B-2A and B-52H fleets were uploaded to their maximum capacities (respectively, 16 and 20 weapons per bomber), the number of nuclear weapons this force could deliver would be increased from 425 to 900 (compared to 1,250 in Option 1). Under this option the United States would maintain a total stockpile of about 950 nuclear bombs and cruise missiles, including 425 operationally deployed weapons, a responsive reserve of 475 weapons, and 50 spares.

Option 3 (1,700/2,950 active strategic nuclear warheads): Cut Force Structure

Under this option, the United States would reduce the size of its nuclear force structure, measured in terms of ICBMs, SSBNs/SLBMs and bombers, substantially below both today's levels, and the levels projected in Options 1 an 2. It would, however, still be able to satisfy the floor set by the Bush Administration for the number of nuclear weapons to be operationally deployed with US strategic forces. Specifically, under this option the US military would sustain an operationally deployed force of 1,700 strategic nuclear weapons between 2012 and 2035—compared to 2,200 nuclear weapons (the ceiling set by the administration) in Options 1 and 2.

In addition, the United States would maintain about 1,250 other active strategic nuclear weapons, about 1,100 of which would constitute a responsive reserve, and some 150 of which would be spares. Thus, under this option the United States would retain a total stockpile of about 2,950 active strategic nuclear weapons, including a responsive force capable—

after uploading reserve warheads—of delivering some 2,800 strategic nuclear warheads. This would be about 1,650 and 1,250 warheads fewer than would be sustained in Options 1 and 2, respectively.

In terms of the types (though not necessarily quantities) of new weapon systems to be procured, it differs from Option 2 in only one respect: the new SSBN would be a smaller boat capable of carrying 12, rather than 16 missiles. The following discussion provides a brief overview of the force structure and modernization plans assumed for the three legs of the triad under this option.

ICBMs: The United States would reduce the size of its ICBM force, from 500 today to 300. As with today's ICBM force, and as in Options 1 and 2, each of these ICBMs would be capable of carrying as many as three warheads. However, again as in the previous two options, these missiles would normally be equipped with a single warhead. In addition to the 300 operationally deployed warheads in this force, the United States would maintain another 650 active ICBM warheads, including a responsive reserve of some 600 warheads and 50 spares. Tapping this reserve would allow the United States to triple the number of nuclear warheads in its ICBM force—increasing its ICBM arsenal to some 900 warheads. As in Options 1 and 2, the Air Force would begin procuring a new three-warhead-capable Minuteman IV ICBM around 2015. Between 2015 and 2030, a total of some 490 of these new ICBMs would be purchased (300 to be deployed in Minuteman III silos and 190 for spares and testing).[67]

SSBNs/SLBMs: The Navy would reduce the size of its SSBN fleet from 14 today, and under Options 1 and 2, to 11 boats. Excluding the two SSBNs that would typically be in overhaul, this would provide for an operationally deployed force of nine SSBNs. As in the previous two options, the Navy would begin procuring a new SSBN in 2022 and a new SLBM, to equip these new boats, in 2023. However, as noted earlier, rather than buying a new, medium-size SSBN (SSBN-XM) designed to carry 16 missiles, under this option the Navy would buy a smaller SSBN (SSBN-XS) designed to carry 12 missiles.

[67] The number of missiles required for spares and testing in this option (and subsequent options) is assumed to decline only slightly from the previous option because most of these missiles would be needed for testing, and the number of missiles needed for testing is essentially insensitive to the size of the deployed force.

As in Options 1 and 2, the new missile to be procured would be the eight-warhead capacity SLBM-X. In this case, the Navy would procure a total of 300 of these new SLBMs over the 2023-2035 period (132 to be deployed aboard the 11 new SSBN-XSs and about 168 for spares and testing). Consistent with the QDR, and the previous two options, in this option the Navy would deploy conventional warheads on an average of two missiles per operationally deployed SSBN, for a total force of 18 conventional SLBMs.

Under this option, by 2012, the number of operationally deployed nuclear warheads in the SSBN fleet would be cut to 720 and would be held at this level through 2035. Prior to the introduction of the SSBN-XS around 2027, these warheads would be used to arm 198 Trident II missiles carried aboard nine operationally deployed Trident SSBNs (suggesting an average of about 3-4 warheads per missile), with the remaining 18 missiles carried aboard these boats being armed with conventional warheads. Once the smaller SSBN-XS had fully replaced the Trident SSBN, the total number of missiles carried aboard the operationally deployed SSBN fleet would fall from 216 to 108. Assuming that 18 of those missiles would be armed with conventional warheads, and the remaining 90 missiles would be loaded to capacity, this fleet would continue to support an operationally deployed force of 720 warheads.

In addition to these operationally deployed warheads, the United States would maintain roughly another 386 active SLBM warheads as a responsive reserve (336) and as spares (50). Drawing upon this responsive reserve would increase the number of nuclear warheads deployed aboard SSBNs to over 1,050.

Bombers: Under this option, the Air Force would reduce the PAA strength of its nuclear-capable bomber force to 40. This smaller force would consist of 16 penetrating bombers and 24 standoff bombers. In other words, it is assumed that the penetrating bomber force would be maintained at today's level, while the standoff bomber force would be cut by slightly more than half.[68] As in Option 2, the Air Force would either forego entirely production of a new, near-term bomber (Option 1's

[68] It is assumed in all of the options in this report that the Air Force would maintain a force of nuclear-capable bombers (Options 1-4) and that this force would continue to include both penetrating and standoff bombers. Since today's level of 16 (PAA) B-2A bombers is probably close to the minimum number of bomber aircraft (of a particular type) that the Air Force would consider acquiring and supporting, it is assumed in this option and Option 4 (which also includes

B-XM), or the new aircraft would be a dedicated conventional bomber. And as in Options 1, 2 and 4, in this option the Air Force would still buy a replacement for the B-2A beginning in 2030, and procure a total of 25 aircraft over the 2030-35 period.

The B-2A replacement procured in this option would be the same subsonic B-XL bomber included in Option 2. The 16 penetrating bombers and 24 B-52H standoff bombers fielded in this option would normally be assigned a total of 680 nuclear weapons, close to the maximum number of nuclear weapons this force could carry. Since there would be little spare payload capacity in this force, no additional active warheads would be kept in reserve—though a small number of spares would be maintained. As in each of the previous options, the Air Force would begin procuring a new air-launched cruise missile in 2025. Under this option, reflecting the relatively small standoff bomber force, it would buy a total of only some 750 of these missiles between 2025 and 2035.

Option 4 (1,000/1,050 active strategic nuclear warheads): Cut Force Structure Deeply, Buy Smaller Replacement Systems

The United States would cut deeply its nuclear offensive strategic forces under this option—measured in terms of platforms and delivery vehicles, as well as nuclear warheads. In this option, about 1,000 strategic nuclear weapons would be operationally deployed, on a day-to-day basis, and another 50 weapons would be kept as spares—for a total stockpile of some 1,050 active strategic nuclear weapons. In contrast to all of the previous options, in this option no additional warheads would be maintained as a responsive reserve. The United States would modernize its nuclear forces on essentially the same schedule envisioned in the previous options. However, it would do so with a set of programs substantially different from those pursued in Options 1, 2 or 3. Reflecting the smaller active warhead stockpile maintained in this option, the individual platforms and delivery vehicles procured in this option would generally be smaller and capable of carrying fewer nuclear warheads than even those systems procured in the previous options.

---

a smaller bomber force) that any cuts in bomber force structure would be made to the B-52H (standoff) fleet, rather than the penetrating bomber fleet.

As in each of the previous options, however, all three legs of the US nuclear triad would continue to be maintained under this option. The following discussion provides a brief overview of the force structure and modernization plans assumed for each leg of the triad under this option.

ICBMs: The United States would reduce the size of its ICBM force from 500 to 150. As in the first three options, each of these ICBMs would normally be equipped with a single warhead. A small number of warheads would also be kept as spares. However, unlike the earlier options, since the United States would maintain no responsive reserve in this option, it would be incapable of uploading any additional warheads onto this force. As in the previous options, the Air Force would begin procuring a replacement for the Minuteman III in 2015. However, rather than buying a Minuteman IV ICBM, capable of carrying as many as three warheads, under this option the Air Force would buy a smaller ICBM capable of carrying only a single warhead. Between 2015 and 2030, a total of some 330 of these new small ICBMs (SICBMs) would be purchased (150 to be deployed in Minuteman III silos and 180 for spares and testing).

SSBNs/SLBMs: The Navy would reduce the size of its SSBN fleet from 14 to 8 boats. Excluding the two SSBNs that would normally be in overhaul, this would be sufficient to sustain an operationally deployed force of six SSBNs. As in each of the previous options, the Navy would begin procuring a new SSBN in 2022 and a new SLBM, to equip these boats, in 2023. The new SSBN would be the same system procured in Option 3—the 12-missile SSBN-XS. As in each of the other options described in this report, the new missile would be the eight-warhead SLBM-X.

The Navy would procure one SSBN-XS per year over the 2022-29 period, and a total of about 250 of the new SLBM-Xs over the 2023-2035 period (96 to be deployed aboard the eight new SSBN-XSs and about 150 for spares and testing). In this option, in contrast to the previous three options, the Navy would not implement the QDR's recommendation to deploy conventionally-armed SLBMs. Instead, all of the SLBMs in this option would be deployed with nuclear warheads.

Under this option, by 2012, the number of operationally deployed nuclear warheads in the SSBN fleet would be cut to 576 and would be held at this level through 2035. Prior to the introduction of the SSBN-XS around 2025, these warheads would be used to arm 144 Trident II mis-

siles carried aboard six operationally deployed Trident SSBNs (suggesting an average of 4 warheads per missile). Once the smaller SSBN-XS had fully replaced the Trident SSBN, the total number of missiles carried aboard the operationally deployed SSBN fleet would fall from 144 to 72. Assuming each of these missiles carried its maximum load of eight warheads, this fleet would continue to support an operationally deployed force of 576 warheads. Another 50 warheads would be kept as spares.

In contrast to each of the previous options, in which some number of extra warheads would kept as a responsive reserve, in this case, the operationally deployed stockpile would include all deliverable active warheads.[69]

Bombers: The Air Force would reduce the PAA strength of its nuclear-capable bomber force to 32 aircraft under this option. This fleet would consist of 16 penetrating bombers and 16 standoff bombers. This force would be equipped with a total of some 288 nuclear weapons, or an average of nine weapons per bomber—with, again, a small number of spares, but no additional active warheads held in reserve. To sustain this force, as in each of the previous options, the Air Force would procure 25 new bombers between 2030 and 2035, to replace the B-2A, and begin buying a new standoff bomber sometime after 2035. In contrast to Option 1, but as in Options 2 and 3, under this option the Air Force would either forego entirely the production of a near-term bomber, or make the aircraft a dedicated conventional bomber.

In this case, the new bomber to be procured starting in 2030 would be the relatively small (eight warhead capacity), subsonic B-XM—the same aircraft that, under Option 1, the Air Force would begin fielding in 2018. As noted earlier, making a future bomber substantially smaller could reduce costs, while not necessarily compromising its conventional strike capabilities. As in each of the previous options, the Air Force would begin procuring a new air-launched cruise missile in 2025. Under this option, reflecting the relatively small standoff bomber force, it would buy a total of only some 400 of these missiles between 2025 and 2035.

[69] It is assumed in this option and Option 5 that SSBNs in overhaul would automatically have their warheads transferred to operationally deployable SSBNs. Thus, in contrast to Options 1, 2 and 3, in Options 4 and 5 the SSBNs in overhaul would not, in any sense, comprise part of a responsive reserve.

Option 5 (1,000 active/1,050 strategic nuclear warheads): Cut Force Structure Deeply, Replace only SSBNs

In this option, like the last one, the United States would reduce the size of its nuclear force structure and maintain about 1,000 strategic nuclear weapons operationally deployed, on a day-to-day basis, plus 50 spares—with no responsive reserve. In contrast to all of the previous options, however, under this option the United States would preserve only one leg of its strategic nuclear triad, its SBLM/SSBN force. As noted earlier, the SLBM/SSBN force is widely thought to be the most survivable leg of the triad.

Under this option, as in Option 4, the Navy would reduce the size of its SSBN fleet from 14 today, to 10 boats. Excluding the two SSBNs that would normally be in overhaul, this would be sufficient to sustain an operationally deployed force of eight SSBNs. As in each of the other options, the Navy would begin procuring a new SSBN in 2022 and a new SLBM, to equip these boats, in 2023. The new SSBN procured in this option would be the same system procured in Options 1 and 2—the 16-missile SSBN-XM. As in each of the other options described in this report, the new missile would be the eight-warhead SLBM-X.

The Navy would procure one SSBN-XM per year over the 2022-31 period, and a total of about 335 new SLBM-Xs missiles over the 2023-2035 period (160 to be deployed aboard the 10 new SSBN-XSs and about 175 for spares and testing). As in Option 4, all of the SLBMs deployed in this option would be armed with nuclear warheads.

Under this option, by 2012, the number of operationally deployed nuclear warheads in the SSBN fleet would be cut to about 1,000 and would be held at this level through 2035. Prior to the introduction of the SSBN-XM around 2027, these warheads would be used to arm 192 Trident II missiles carried aboard eight operationally deployed Trident SSBNs (suggesting an average of 5 warheads per missile). Once the smaller SSBN-XM had fully replaced the Trident SSBN, the total number of missiles carried aboard the operationally deployed SSBN fleet would fall from 192 to 128. Assuming each of these missiles carried its maximum load of eight warheads, this fleet would continue to support an operationally deployed force of some 1,000 warheads. Another 50

warheads would be kept as spares.[70] As in Option 4, there would be no possibility of uploading additional warheads onto this force, since the missiles would be armed at or near capacity and because there would, in any case, be no active warheads held in reserve.

Choosing an Option

Which of these long-term options for US offensive strategic forces will or should be pursued is likely to depend on one's views concerning, among other things, the half dozen different factors discussed at the end of Chapter 1. No attempt is made in this report to attach a specific set of assumptions concerning these various factors to each of the options described in this analysis. Doing so would be difficult because some assumptions, or combination of assumptions, about these factors might be consistent with more than one of these options.

If one believes, as do many within the current administration, that the United States must maintain a large and modern nuclear arsenal to effectively dissuade Russia, China and other countries from attempting to compete with the United States, then Option 1 or one of the other options that would maintain relatively large nuclear forces might be appropriate. Conversely, if one believes that deterrence remains the core mission of nuclear offensive strategic forces and that—given the enormous destructive capacity of nuclear weapons—even an adversary that is itself armed with large numbers of nuclear weapons can be effectively deterred with a relatively small nuclear arsenal, then Option 4 or 5 might appear appropriate.

On the other hand, fiscal constraints, the development of effective strategic defenses, or significant progress in the development and fielding of conventional offensive strategic forces could also lead one to choose an option that included smaller nuclear forces. At the extreme, even Options 4 or 5 might be consistent with the view that the United States must retain overwhelming superiority in strategic offensive capabilities (for dissuasion, deterrence and, if necessary, warfighting, purposes), if in addition to the nuclear-capable forces included in that option it is assumed that United States would acquire

[70] As in Option 4, under this option it is assumed that when SSBNs begin the overhaul process they would automatically have their warheads transferred to operationally deployable SSBNs. Otherwise, the operationally deployed warhead level would fall below 1,000.

and sustain large numbers of conventionally-armed long-range bombers (e.g., a replacement for the B-1B), as well as perhaps conventionally-armed ICBMs, SLIRBMs or similar systems, and acquire effective strategic defenses.

V. Cost of Options

This chapter provides rough estimates of the costs to DoD of each of the options for US nuclear offensive strategic forces described in the preceding chapter. These estimates include the cost of acquiring new weapon systems and other equipment, as well as operations and support (O&S) costs. As defined in this analysis, this former category consists of programs funded through DoD's research, development, test, and evaluation (RDT&E) and procurement accounts, while the latter category consists of activities funded through its military personnel, operations and maintenance (O&M), military construction and family housing accounts.

These estimates *do not* include costs associated with the acquisition and maintenance of nuclear warheads, which are funded through the DoE budget—although a brief discussion of these costs is included in this chapter. This chapter also includes a short discussion of costs associated with a number of other programs and activities related to, but distinct from, nuclear offensive strategic forces, such as nuclear C3I and ballistic missile defense programs.

This report estimates the costs of the various options described in this study on an annualized basis. In other words, the cost estimates reflect the amount of funding that would, on average, need to be provided annually to fully implement each option. Among other things, presenting costs on an annualized basis makes it easier to compare the costs of each option with the overall defense budget, which is generally discussed in terms of annual levels of funding. These annualized estimates are further broken down into two 15-year time periods, the first covering 2006-2020 and the second, 2021-35.

Table 6: DoD Funding for US Nuclear Offensive Strategic Forces, 2006-35

(average annual funding in billions of FY 2006 dollars)

Option	2006-20	2021-35	2006-35
Option 1	21.0	40.3	30.7
Option 2	15.8	29.6	22.7
Option 3	13.2	23.3	18.2
Option 4	10.3	16.7	13.5
Option 5	6.5	12.9	9.7

Source: CSBA.

Table 6 compares the estimated annualized cost of each option. All funding and cost estimates included in this chapter are expressed in FY 2006 dollars, and all changes in funding and costs are expressed in real (i.e., inflation-adjusted) terms. The section below briefly discusses the cost estimates for DoD of each of the options considered in this report. A noteworthy feature of each of the options is that costs increase, in some cases sharply, during the second 15-year period covered in this analysis. This is primarily due to the fact that, in all of the options, major new strategic weapons program are begun during this second period while, conversely, any (cost saving) force structure cuts are assumed to be completed during the first period (i.e., by 2020).

Option 1 (2,200/4,600 active strategic nuclear warheads): "Current Plan"

Implementing this option would cost an average of about $30.7 billion a year over the next three decades. This estimate breaks down into annualized costs of $21.0 billion over the 2006-20 period and $40.3 billion between 2021 and 2035. Under this option, annual funding for strategic offensive nuclear forces would be $15.1 billion, or nearly 100 percent, higher, on average, over the 2006-35 period, than in 2006. By 2021-35, annual funding for these forces would, on average, be $24.7 billion, or some 159 percent, higher than it is today.

For two reasons, this is the most costly option considered in this report. First, it would maintain the largest strategic offensive nuclear force structure—one that, in the case of bomber leg of the triad, would actually be substantially larger than today's. Second, it would pursue

two of the most costly new weapons programs, including both a new subsonic, near-term penetrating bomber, and a new, large-payload, long-range, supersonic penetrating bomber.[71]

Option 2 (2,200/4,200 active strategic nuclear warheads): "Current Plan"-Minus

This option is estimated to cost an average of $22.7 billion a year through 2035. This includes average annual costs of $15.8 billion between 2006 and 2020, and $29.6 billion over the following 15 years. This option would cost an average of $8 billion a year less to implement than Option 1 (see Table 7). The cost savings are the result of three differences. First, in contrast to Option 1, the size of the bomber force would not be expanded beginning in 2018, resulting in lower O&S costs in 2018 and later years. Second, no near-term bomber would be acquired. Third, under this option, rather than buying a new supersonic bomber beginning in 2030, the Air Force would acquire a less costly subsonic bomber.

Under this option, annual funding for nuclear offensive strategic forces would be $7.2 billion, or 46 percent, higher, on average, over the next 15 years than it is today. Over the 2021-35 period, average annual costs would be $14.1 billion, or 91 percent higher.

Table 7: DoD Savings Compared to Option 1, 2006-35

(average annual savings in billions of FY 2006 dollars)

Option	2006-20	2021-35	2006-35
Option 1	0.0	0.0	0.0
Option 2	5.2	10.7	8.0
Option 3	7.9	17.0	12.4
Option 4	10.7	23.6	17.2
Option 5	14.6	27.4	21.0

Source: CSBA.

[71] The decision to convert 24 Trident SLBMs to conventional missiles would contribute only relatively modestly to the high cost of this option. According to DoD, the conventional Trident modification program will cost about $503 million.

Option 3 (1,700/2,950 active strategic nuclear warheads): Cut Force Structure

This option would require annual funding of about $18.2 billion over the next 30 years, including an average of $13.2 billion a year through 2020 and $23.3 billion a year between 2021 and 2035. Compared to Option 1, this option would yield average savings of $12.4 billion annually. These savings are the result of differences noted in the case of Option 2, plus several other differences. Most importantly, this option includes cuts in all three legs of the US strategic nuclear force structure. These force structure cuts lead to both lower O&S costs and, reflecting the need to modernize a smaller force structure, lower procurement funding requirements. The fact that the new SSBN acquired under this option would be smaller than new submarine purchased in Option 1 results in further cost savings.

The annualized cost of US nuclear offensive strategic forces would be $2.3 billion, or 15 percent, less, on average, over the 2006-20 period than they are today. By 2021-35, however, annual funding for these forces would, on average, be $7.8 billion, or 50 percent, higher than it is today.

Option 4 (1,000/1,050 active strategic nuclear warheads): Cut Force Structure Deeply, Buy Smaller Replacement Systems

Implementing this option would cost an average of $13.5 billion a year through 2035, with annualized costs of $10.3 billion over the next 15 years and $16.7 over the following 15 years. This option would cost an average of $17.2 billion a year less to implement than Option 1. Because of the large force structure cuts included in this option, it would yield substantially larger O&S savings than Options 2 or 3. These force structure cuts also mean that fewer replacement weapon systems would need to be procured, resulting in substantial procurement savings. Additional savings result from the fact that under this option DoD would invest in less ambitious weapon programs. As in Option 3, DoD would procure a smaller SSBN. But, in addition, under this option the new ICBM acquired starting in 2015 would be the single-warhead SICBM, and the new bomber acquired beginning in 2030 would be the smaller, subsonic B-XM.

As a result of the relatively deep force structure cuts and scaled back modernization plans included in this option, annual funding for strategic offensive nuclear forces would be $2 billion, or 13 percent, lower over the 2006-35 period that it is today.[72]

Option 5 (1,000/1,050 active strategic nuclear warheads): Cut Force Structure Deeply, Replace only SSBNs

This option would cost an estimated $9.7 billion a year through 2035. This includes average annual costs of $6.5 billion between 2006 and 2020, and $12.9 billion during the subsequent 15 years. Implementing this option would require an average of $21 billion a year less than Option 1. The cost savings are the result of the deep reductions in force structure contained in this option, including a substantial cut in the size of the SSBN force and, much more importantly, the elimination of the ICBM and bomber legs of the strategic nuclear triad. These cuts result in a dramatic reduction in both O&S and acquisition costs.

Due to the deep cuts in both force structure and weapons programs included in this option annual funding for strategic offensive nuclear forces would be $5.9 billion, or 38 percent, lower, on average, over the next 30 years than it is today.

Possible Adjustments to Cost Estimates: Dual-Capable Bombers

The above estimates may overstate the cost to DoD of sustaining US nuclear offensive strategic forces to some extent because they implicitly attribute the full cost of developing, procuring operating and supporting dual-capable bombers entirely to nuclear offensive strategic forces. Equating the cost of dual-capable bomber forces with the cost of nuclear

[72] This option could be made even less costly if a decision were made to forego the acquisition of a new penetrating bomber beginning in 2030 and instead replace the B-2A with a new (cruise missile-equipped) standoff bomber. In this case, costs might be another $700 million a year lower over the 2006-35 period. This estimate is based on the assumption that development costs for such an aircraft would be one-third as much as for the B-XM, while unit procurement costs would be half as much. However, a standoff bomber might be less effective for some nuclear missions, as well as for conventional combat.

bomber forces has always been problematic and misleading. However, during the Cold War this oversimplification was, to some degree, understandable and perhaps justified.

Although long-range bombers were used to conduct conventional missions on many occasions during the Cold War, for most of that period the nuclear mission—including both deterrence and, if necessary, nuclear strike—was widely considered to be the preeminent mission for those bombers. Moreover, the new bombers developed and procured during the Cold War—including the B-52H, B-1B, and B-2A—were designed first and foremost with the nuclear mission in mind, and justified in budget documents and deliberations primarily on the basis of their nuclear mission.[73]

But if, in the future, what drives the United States to acquire and maintain a substantial long-range, dual-capable bomber force is primarily its conventional strike capabilities, allocating the *total* cost of developing, procuring, operating and supporting these aircraft to the *strategic* nuclear strike mission could be very misleading. In that case, arguably what should be allocated to that mission would be only the marginal cost to DoD of equipping and training these bombers so that, in addition to carrying out conventional missions, they can also carry out nuclear strikes. And, these costs are likely to be relatively modest.

A rough idea of what—at the extreme—making such an adjustment could do to the cost of the various options for nuclear offensive strategic forces described in this report can be gained by considering those cost estimates, exclusive of long-range bomber costs (see Table 8).

[73] Toward the end of the Cold War, the Air Force began to stress the B-2As conventional capabilities, but its development and initial procurement were justified, like previous bombers, primarily with reference to its nuclear role. Moreover, the argument that the B-2A should be procured for its conventional capabilities did not prove persuasive enough to prevent the program from being truncated to the purchase of only 21 aircraft—providing additional evidence of how closely linked to the nuclear mission long-range bombers were in the eyes of Congress and many others, including much of DoD's and the military's leadership.

Table 8: DoD Funding for US Nuclear Offensive Strategic Forces, Excluding Bombers, 2006-35

(in billions of FY 2006)

Option	2006-20	2021-35	2006-35
Option 1	12.4	25.7	19.0
Option 2	11.7	17.7	14.7
Option 3	9.7	15.7	12.7
Option 4	7.3	10.6	9.0
Option 5	6.5	12.9	9.7

Source: CSBA.

Possible Adjustments to Cost Estimates: Conventional SLBMs

The Bush Administration's decision to equip some Trident II SLBMs with conventional warheads suggests that attributing the full cost of fielding the US SLBM/SSBN force to nuclear offensive strategic capabilities could be just as misleading as attributing the full cost of dual-capable bomber forces to nuclear offensive strategic capabilities. However, the small number of missiles the administration has proposed to arm with conventional warheads means that to the extent there is any overstating of the costs attributable to US SLBM/SSBN forces in Options 1, 2 and 3 (Option 3 and 4 do not incorporate the proposal to deploy conventionally-armed SLBMs), the impact is very modest.

In the three options in this report that include conventionally-armed SLBMs, those missiles would account for only 7-14 percent of the SLBMs deployed. Moreover, since those missiles could be uploaded with nuclear warheads by drawing upon the responsive reserve included in each of those options, attributing even 7-14 percent of the procurement costs associated with those missiles to the conventional, rather than nuclear, strategic strike mission would be misleading. Likewise, while it is possible that the cost of developing a new SLBM to replace the Trident II missile (assumed in all options) might be somewhat higher if the new missile is to be dual-capable rather than nuclear-capable only, most of those cost would presumably have to be paid even if the goal was only to develop a new nuclear-armed SLBM.

The impact on funding requirements for SSBNs would likely be even less than for SLBMs. Even if it were assumed that absent the conventional strike mission future SSBNs could be made smaller than they otherwise would be, because of the need to carry fewer missiles, the savings would likely be relatively modest. Put another way, the marginal costs of designing and building an SSBN so that in addition to 10-14 nuclear-armed SLBMs it can carry two conventionally-armed missiles would probably be quite small.

On the other hand, if a decision were made to equip a much larger number of the SLBMs in the US SSBN fleet with conventional warheads than current plans envision, the costs fairly attributable to the conventional strike mission would grow, and could become substantial. If the US military were eventually to field dedicated conventionally-armed ICBMs or SLIRBMs—as recommended by the DSB Task Force on Future Strategic Forces (and discussed in Chapter 1)—the costs associated with those systems would, of course, be largely separate and distinct from the cost associated with fielding and supporting nuclear-armed versions of those systems.

Possible Adjustments to Cost Estimates: Operationally Deployed Versus Responsive Reserve Forces

Options 1, 2 and 3 in this report assume that the United States would split its arsenal of strategic nuclear warheads between an operationally deployed force and a responsive reserve that could be drawn upon during times of crises or conflict. Conversely, the remaining three options assume that the United States would maintain essentially all of its strategic nuclear weapons in its operationally deployed forces, and retain no responsive reserve. Since, under the first three options, tapping the responsive reserve would involve uploading warheads onto existing platforms and delivery vehicles, but no change in the number, types or operational status of the platforms and delivery vehicles themselves, the cost implications of keeping a portion of the strategic nuclear stockpile in reserve, rather than operationally deployed, would likely be very modest or essentially non-existent.

However, some advocates of making deeper cuts in nuclear offensive strategic nuclear forces have proposed including not only nuclear

warheads, but also some weapons platforms and delivery vehicles, in a responsive reserve. In this case, the cost savings could be more significant, if it is assumed that the weapon systems in the reserve force would be kept at lower states of readiness. However, even in this case, the savings would likely be quite modest. This is because only a small fraction of the costs associated with acquiring and supporting major weapon systems are typically variable. This is especially true of systems such as ICBMs and SLBMs, since, even when operationally deployed, they are kept essentially in storage (in silos and missile tubes). But even in the case of bombers and SSBNs, costs attributable to flying hours and steaming days make up only a relatively small fraction of total acquisition and O&S costs.

As a result, expanding the concept of a reserve force to include not only some portion of the nuclear warhead inventory, but also some portion of the force of weapons platforms and nuclear delivery vehicles would be unlikely to yield substantial additional savings. The level of savings would vary somewhat depending on just how low a state of readiness the responsive reserve would be kept. However, assuming that the United States would want to be able to activate these forces within a matter of days or weeks, rather than months or years, it seems unlikely that under any of the options described in this report the savings resulting from a decision to shift even half of the nuclear offensive force structure into a responsive reserve would yield even $1 billion a year in savings—with the savings being proportionately less in those options proposing smaller forces.[74]

[74] One prominent example of a proposal to keep a portion of the US nuclear offensive force structure—including both nuclear warheads and weapon systems—in reserve status has been offered by Sydney Drell and James Goodby. Under this proposal, about 500 strategic nuclear warheads would be operationally deployed and another 500 kept in a responsive reserve. This proposal would probably have long-term costs very close to those estimated in this report for Option 4. In terms of the total number of warheads (1,000) and the force structure (150-200 ICBMs, 8-9 SSBNs and 40-50 nuclear-capable bombers) included, this proposal is very similar to that option. Option 4 assumes that all the warheads would be operationally deployed, while the Drell/Goodby proposal calls for keeping half of the warheads operationally deployed and half in a responsive reserve. However, the overall readiness levels assumed for the various force structure elements would be essentially the same with the exception of the ICBM force. While Option 4 assumes that all ICBMs would be operationally deployed, the Drell and Goodby proposal assumes that 50-100 of the ICBMs would be kept off alert. But, as suggested above, such a change would be likely to yield only very modest savings.

Department of Energy and Nuclear Warhead Costs

As noted earlier, the cost estimates provided for the various options described in this report do not include the costs associated with developing, producing, maintaining, and (eventually) dismantling and disposing the nuclear warheads used to equip those forces. Those costs are borne primarily by DoE. The Department of Energy's nuclear weapons programs and infrastructure are multifaceted and complex, and providing precise estimates of the DoE costs associated with each of the above options would require substantial additional analysis falling well beyond the scope of this report. However, those costs are too high to simply ignore in any projection of the future costs of US nuclear offensive strategic forces. Fortunately, it is possible to provide a rough—order of magnitude—idea of the costs and savings that might accrue to DoE under various assumptions about the future direction of the US nuclear stockpile and DoE's weapons activities program.

The 2006 DoE budget includes $18.1 billion for defense-related activities. Some of this funding is allocated to programs and activities largely unrelated to acquiring and supporting nuclear warheads. About $782 million is provided for naval nuclear reactors. Since the Navy's SSBNs (as well as attack submarines and aircraft carriers) operate nuclear reactors, this funding—while not for nuclear weapons—is clearly related to supporting US nuclear offensive strategic forces. In addition, DoE's 2006 budget includes some $1.1 billion for the development of non-proliferation detection technologies and international efforts to stem proliferation.

However, the vast majority of the funding provided for DoE defense activities is allocated to programs and activities closely related to acquiring and supporting nuclear warheads, or covering cleanup costs associated with past nuclear warhead production. A reasonable estimate of the amount in the 2006 budget for DoE defense activities that is related to nuclear warhead acquisition, support and cleanup is $16.2 billion, or roughly 90 percent of the total.[75] Under the Bush Administra-

[75] Among other things, the FY 2007 request includes $27 million for the Reliable Replacement Warhead (RRW) program. The Bush Administration did not request funding for the development of the Robust Nuclear Earth Penetrator (RNEP) in FY 2007. Congress rejected funding for this proposed new nuclear "bunker buster" in the FY 2005 and FY 2006 requests. The RRW program is intended to explore the development of simpler and safer warhead designs. However, some observers are concerned that the program could evolve into a

tion's plan released in February 2006, funding for DoE defense activities is projected to average roughly $15.4 billion a year over the 2007-11 period, with nuclear warhead related activities continuing to absorb an average of 90 percent of that funding.

The options in this report that assume smaller warhead totals would have lower warhead-related DoE costs than would those that assume relatively high warhead totals. However, it is difficult to estimate how substantial an impact varying warhead totals would have on DoE defense-related costs. One substantial category of DoE costs that would be largely or entirely unaffected is that portion of DoE's budget allocated to environmental restoration and waste management—since those costs are driven primarily by past DoE nuclear weapons acquisition and support activities. But it is difficult even to estimate the impact of cuts in the size of the nuclear weapons stockpile on funding for DoE's nuclear weapons activities.

One approach to estimating the potential for savings from a smaller stockpile would be to assume that funding for the portion of DoE's weapons activities program that is most closely linked to warhead levels—its "directed stockpile work"—could be reduced proportionate to the level of cuts made. Under the current plan, funding in this category is projected to remain at about $1.3 billion a year over the next five years. Assuming this level of funding would be adequate to support a stockpile consisting of approximately 6,000 (strategic and non-strategic) warheads (consistent with the administration's apparent target for 2012) over the long term, reducing the stockpile to, for example, 1,000 warheads, might be expected to yield average annual savings of some $1 billion.

On the other hand, the savings might be substantially less. In a 2001 study, David Mosher concluded that:

> Further cuts in the [nuclear] stockpile are unlikely to reduce costs much further. One reason for this is that only about one tenth of the . . . annual budget for [nuclear warhead] production is directly related to the size of the stockpile. The lion's share of the production

costly effort to build new nuclear weapons and could require renewing nuclear testing. See for example, Union of Concerned Scientists, "Bush Administration FY07 Budget—Highlights and Low Lights," February 13, 2006, www.ucsusa.org/news/positions/president-bushs-fy-2007-budget.html.

> budget funds activities such as security and infrastructure that are quite insensitive to production rates. Savings will also be difficult to achieve because production rates are so low today that overhead costs—the cost of just maintaining the physical infrastructure and skilled employees to produce all the different types of components needed for the weapons in the stockpile—are a huge fraction of production costs.[76]

Mosher's analysis would suggest that savings from cutting the US nuclear stockpile to only 1,000 nuclear warheads would yield annual savings of under $200 million a year.[77]

Greater savings could be achieved if DoE were to consolidate its weapons laboratories and make various changes to improve the efficiency of its nuclear weapons complex. But again, it is difficult to estimate the precise level of savings that might be possible. In his 2001 study, Mosher indicated that partially consolidating two of DoE's nuclear weapons laboratories (Lawrence Livermore and Los Alamos) could result in savings of $300-400 million a year. Efficiency improvements might be expected to yield additional savings of several hundred million dollars annually.

Some critics argue that substantially greater savings could be achieved if DoE were to alter its overall philosophy for stockpile stewardship. DoE describes its current approach as "science-based." Under this approach, DoE plans to build a number of new test facilities, and develop new computers and computer models that can better simulate the interactions of an exploding nuclear weapon. The goal of these efforts, among other things, is to improve DoE's understanding of how nuclear weapons work and how age might affect their performance.

The United States conducted its last underground nuclear weapons test in 1992. Advocates of DoE's current approach to stockpile stewardship argue that the planned new facilities and other capabilities are needed, in particular, to compensate for this lack of explosive

---

[76] David Mosher, "The Hunt for Small Potatoes," in Cindy Williams, ed., *Holding the Line: US Defense Alternatives for the Early 21st Century* (Cambridge, MA: MIT Press, 2001), p. 132.

[77] Ibid.

testing. DoE also expects these new facilities to help it attract new talent to its laboratories.[78]

Another goal of the current approach to stockpile stewardship is to retain and modernize DoE's nuclear weapons design and manufacturing capabilities—to ensure that the United States has the capability to both maintain the current stockpile and, if necessary, begin manufacturing new nuclear warheads in the future. As noted earlier, the Bush Administration's concept of a New Triad includes a highly responsive design and manufacturing infrastructure as one of its legs. And it sees the nuclear weapons complex as one of the key sectors of that infrastructure. The National Nuclear Security Administration (NNSA)—the agency within DoE responsible for nuclear weapons programs, asserts that to be ready and responsive:

> This infrastructure must include a manufacturing capability with state-of-the art equipment combined with cutting edge applications of technology, and an ability to quickly provide modified or enhanced capabilities and products to meet emerging threats.[79]

Supporters of this approach to stockpile stewardship argue that it represents a prudent hedge for an uncertain future. Conversely, critics claim that it is a largely unnecessary and far more costly approach than is either necessary or prudent. Christopher E. Paine of the NRDC, for example, argues that:

> Apart from its evident self-serving qualities, there are some logical flaws and artificial categorical imperatives lurking in NNSA's new deterrent construct. To be credible, nuclear weapons need not be produced with "state-of-the-art" or "cutting edge" technology. Indeed, President Bush professes to have invaded Iraq to forestall development of what clearly would have been a crudely produced nuclear explosive device, the threat of which he nonetheless found credible.[80]

---

[78] David Mosher, *Preserving the Nuclear Weapons Stockpile Under A Comprehensive Test Ban* (Washington, DC: CBO, May 1997), pp. 72.

[79] DoE/NNSA FY 2005 CBR, "Weapons Activities/Readiness Campaign," p. 158.

[80] Christopher E. Paine, *Weaponeers of Waste: A Critical Look at the Bush Administration Energy Department's Nuclear Weapons Complex and the*

Paine also argues that the single largest component of DoE's nuclear weapons stewardship program is comprised of essentially nuclear weapons R&D activities.[81] While the FY 2006 budget included $1.3 billion for directed stockpile work (which, among other things, funds efforts to extend the lives of existing nuclear warheads), it included some $2.1 billion for various efforts related to new design, development and production activities.[82] In addition to concerns about costs, many critics also worry that the current approach to stockpile stewardship—with its emphasis on being ready to relatively rapidly expand US nuclear weapons design and production capabilities—will undermine international support for non-proliferation.[83]

As an alternative to the current approach to stockpile stewardship, some critics have advocated a "minimal" stewardship approach. Advocates of this approach argue that existing experimental facilities and a smaller stewardship effort would be sufficient to preserve the US nuclear stockpile indefinitely. As is the case with reducing the size of the US nuclear weapons stockpile, or making the current, science-based, approach more efficient, it is difficult to estimate what the impact would be on DoE's budgetary requirements of adopting a minimal stewardship philosophy.

It is possible that doing so could yield large savings. Over the past decade, DoE annual funding for nuclear weapons activities has grown by some 40 percent. And despite the fact that the US nuclear stockpile has shrunk significantly from its Cold War levels, the 2006 DoE budget contained $2 billion more for these activities that was spent on average during the Cold War.[84] Adopting a minimal approach to stockpile stewardship, especially if combined with reductions in the size of the nuclear stockpile and various efficiency initiatives, might

---

First Decade of Science-Based Stockpile Stewardship (Washington, DC: Natural Resources Defense Council, April 2004), p. 6.

[81] Ibid., p. 44.

[82] For a brief discussion of the various DoE "campaigns" that make up its nuclear weapons R&D effort, see, Ibid.

[83] For a discussion of a minimal stewardship see Mosher, *Preserving the Nuclear Weapons Stockpile Under A Comprehensive Test Ban*, pp. 69-73 .

[84] The estimate of Cold War spending on nuclear weapons activities is from Christopher Paine, "Bush Administration Wasting Billions on Nuclear Weapons Stockpile Research and Production," Natural Resources Defense Council Press Release, April 13, 2004, p. 2. See also, Mosher, *Preserving the Nuclear Weapons Stockpile Under a Comprehensive Test Ban*, Figure 4, p. 26.

allow DoE to bring the cost of its weapons activities back down to average Cold War levels, or perhaps even lower.

On the other hand, savings from adopting a minimal approach to stockpile stewardship might be less substantial. This could be for a variety of reasons. Among other things, for example, if under this approach less money were spent developing the capability to understand the impact of aging on nuclear weapons, more money might have to be spent replacing weapons components to ensure their reliability. In his 2001 study, Mosher concluded that "It is unclear at this time how much a production-based [minimal] stewardship program would cost or save."[85]

It is also worth noting that decisions about stockpile size and the best approach to stockpile stewardship are to some extent independent. One could, for example, decide to reduce the nuclear stockpile to only 1,000 warheads—consistent with Options 4 or 5—and still maintain the current science-based approach. Conversely, one could maintain a much larger nuclear stockpile—consistent with Options 1 or 2, for example—but adopt a less robust approach to nuclear weapons R&D and related activities.

The Cost of Other Nuclear-Related Programs and Activities

Nuclear offensive strategic forces, and the DoE nuclear weapons complex that supports those forces, represent the largest and most costly components of US nuclear forces, but they do not constitute the only US nuclear or nuclear-related forces. Other such programs and activities include nuclear offensive theater forces, nuclear C3I, ballistic missile defenses, strategic air defenses, and non-proliferation programs.

Rough estimates of the cost of these various nuclear-related areas are provided in Table 9. Combing these estimates with those provided earlier for US nuclear offensive strategic forces and the DoE nuclear weapons complex suggests that, today, the United States spends a total of about $54 billion a year on all nuclear-related programs and activities.

[85] Mosher, "The Hunt for Small Potatoes," p. 134.

This estimate may overstate those costs. For example, because it includes all costs associated with acquiring ballistic missile defenses, even though those systems could—if they can be made effective—be used to protect the United States and US forces deployed abroad from attacks by ballistic missiles armed not only with nuclear warheads, but conventional, biological or chemical warheads. Likewise, some of the non-proliferation programs included in this estimate are aimed at countering the spread not only of nuclear capabilities, but also technologies and knowledge related to other weapons of mass destruction. However, as a rough approximation of total US nuclear-related spending, this estimate appears reasonable.

Table 9: US Funding for Nuclear-Related Programs, 2006

(average annual funding in billions of FY 2006 dollars)

	1990	2006
Nuclear Offensive Strategic Forces	36.5	15.5
Nuclear Warheads (DoE)*	14.7	17.0
Nuclear C3I	14.2	9.5
Nuclear Offensive Theater Forces	2.5	0.4
Ballistic Missile Defenses	5.5	8.7
Air Defenses	2.8	1.5
Subtotal	**76.3**	**52.6**
International and other Non-Proliferation Initiatives (DoE and Other)	0.0	1.6
Total	**76.3**	**54.2**

* The FY 2006 estimate excludes about $1.1 billion in DoE funding for international and other non-proliferation initiatives.

Source: CSBA, 2006

The figures provided in Table 9 are offered to provide a better sense of the relative priority presently given to various types of nuclear-related programs and activities, the context in which nuclear offensive strategic forces must compete for funding, as well as some of the budgetary tradeoffs involving these various forces, programs and activities that could be made in coming years. At least four observations can usefully be made based on the figures provided in this table.

- First, although nuclear-related spending is considerably lower today than it was at the end of the Cold War, such spending remains substantial. With a budget of $54 billion for nuclear-related programs and activities, the United States presently appears to spend more each year on nuclear-related capabilities than all but perhaps one or two other countries spend on their entire military.

- Second, while US nuclear-related spending remains high in absolute terms and relative to foreign defense spending, it currently accounts for a relatively small share of overall US defense spending, and a significantly smaller share than it did at the end of the Cold War. The totals included in Table 9 for 1990 and 2006 equate, respectively, to 17 percent and 12 percent of total US defense funding in those years (exclusive of the cost of military operations). The decline has been much greater in the case of US nuclear offensive strategic forces in particular. Funding for these programs and activities has fallen from about 8 percent to 4 percent of DoD's total budget.

- Third, US spending on nuclear-related programs and activities is currently heavily weighted toward nuclear strategic offensive capabilities. However, spending on defensive capabilities has grown substantially, both in absolute terms and as a share of total nuclear-related spending, since the end of the Cold War.

- Fourth, the United States currently spends far more on nuclear-related offensive and defensive military capabilities than it does on measures aimed at protecting the country through non-military preventive measures. The ratio of spending on US nuclear-related military capabilities versus non-proliferation programs is now roughly 33-to-1. The ratio of DoD spending on nuclear offensive strategic forces versus non-proliferation programs is about 10-to-1.

Determining what will happen to funding for these other nuclear-related programs and activities in the future is no easier than projecting future funding levels for nuclear offensive strategic forces. And attempting to describe or assess DoD's long-term plans in any of these areas, or to suggest possible alternative approaches—let alone to estimate the costs of these plans, or alternative options—would require going far beyond

the scope and goals of this report. However, pressures to increase funding are likely to be felt in some, if not most, of these areas.

- **Defenses:** As discussed in Chapter 1, US plans for developing ballistic missile defense systems are relatively unsettled. However, based on what is known about those plans, it appears that funding for BMD programs will have to be increased substantially in coming year. According to an estimate by the Congressional Budget Office (CBO), executing the administration's plans for BMD programs would require increasing funding from about $8.7 billion in 2006 to an average of some $11-14 billion a year over the 2006-24 period.[86] Moreover, this estimate includes only acquisition costs, not costs associated with operating and supporting BMD systems once they are deployed.

- **Nuclear C3I:** It is, if anything, even more difficult to project future funding requirements for nuclear C3I activities, among other things because of the highly classified nature of many C3I programs. However, trends in overall (nuclear-related and other) C3I spending, at least, would seem to suggest that there will be significant pressure to increase spending in this area as well. DoD spending on C3I has grown more than any other part of the defense budget over the past five years. Between 2000 and 2006, DoD's overall C3I budget grew by some 58 percent, and it is projected to continue to grow by another 7 percent over the next five years.

- **Other:** Pressures may also build to increase spending on nuclear-related programs and activities related to preventing nuclear proliferation.

It is impossible to predict what effect pressures for funding growth in these other nuclear-related programs would have on DoD's ability to execute the various options for nuclear offensive strategic forces described in this report. It is possible that these pressures would have little or no impact on these options. In theory, the United States could

[86] These estimates were derived from Figure 11, in Adam Tabaler, *The Long-Term Implications of Current Defense Plans and Alternatives: Summary Update for Fiscal Year 2006* (Washington, DC: CBO, October 2005), p. 43. The lower estimate assumes that DoD can successfully meet its cost goals for BMD programs, while the higher figure is more consistent with historical rates of cost growth in weapons acquisition.

fully fund even the most costly option for nuclear offensive strategic forces (Option 1) included in this report and fully fund current plans for BMD and C3I capabilities.

On the other hand, doing so might not prove feasible. Due to deficit concerns or other pressures, it might prove necessary to choose among these different programs and activities—to, for example, pay for an expansion of BMD capabilities, in part, through offsetting cuts in plans for nuclear offensive strategic forces. Discussing the range of tradeoffs that could be made, or describing what the most appropriate tradeoffs might be, is far beyond the scope of this report. However, the substantial and growing costs associated with executing the range of nuclear-related programs listed in Table 9 and briefly discussed above, suggests that such tradeoffs may indeed have to be made.

VI. Conclusions

US spending on nuclear offensive strategic forces remains substantial. As noted in this report, the United States will spend about $15.5 billion on these forces in 2006. That said, the United States spends far less on nuclear offensive strategic forces today than it did during the Cold War. The drop in spending on these forces reflects primarily two factors. First, the decision to reduce the size of the nuclear offensive strategic force structure. And second, the much reduced pace of modernization for these forces.

Over the past decade, the United States has spent relatively little on the development and procurement of nuclear offensive strategic forces. The United States provided funding for both the last (Trident) SSBN the last (Peacekeeper) ICBM in 1991, and the last (B-2A) nuclear-capable bomber in 1993. As a result, the share of the US defense budget absorbed by these forces has declined sharply from Cold War levels.

However, much could change over the next several decades. Under current plans, DoD is projected to begin procuring a new ICBM and bomber around 2015 and a new SSBN in 2022. Those plans also envision procuring new advanced bomber or other long-range strike system beginning in the 2035 timeframe. Given the lead time required to develop such systems, critical decisions concerning the types of new systems to acquire will need to be made much earlier, in some cases within the next 5-10 years. As this report has made clear, these decisions will have enormous implications for future funding requirements.

If the United States were to decide to pursue a largely "business-as-usual" approach to modernizing its nuclear offensive strategic forces, consistent with the first option described in this report, it would require a massive increase in spending. In that case, DoD funding for these forces could grow to an average of as much as $30.7 billion a year over

the next 30 years—reaching an average of $40.3 billion annually over the 2021-35 period.

At the other extreme, if the United States were to decide to take a very different approach to modernizing its nuclear offensive strategic forces, those costs could actually decline from today's levels. Both Options 4 and 5, for example, would result in modest savings compared to today's spending on nuclear offensive strategic forces.

Notwithstanding the reductions that have been made since the end of the Cold War, the size and shape of the US nuclear offensive strategic force structure that exists today in many ways represents a relic of the Cold War. The three legs of the existing strategic nuclear triad were each developed during the Cold War, as was the idea of maintaining such a triad. Likewise, each of the specific weapon systems that now make up those legs of the triad were initially developed and procured during the Cold War. The United States has the opportunity to substantially, even dramatically, change the size and shape of its nuclear offensive strategic forces over the coming three decades.

It would be premature, at this point, to make decisions concerning each and every aspect of the United States' future nuclear offensive strategic forces. In some cases, it is too early to know how technological progress (or the lack thereof) might restrict or expand the kind of options available to policymakers and planners. In other cases, it may simply be earlier than necessary to commit to a particular path. However, it may be appropriate or even urgent that other decisions concerning US nuclear offensive strategic forces be made relatively soon. In any event, now is clearly the time to begin to think seriously about the future of US nuclear offensive strategic forces.

Given the long lead times involved in the acquisition of modern weapons systems, decisions made over the next 5-10 years may well—for better or for worse—largely determine how we will modernize much of this arsenal through 2035. There is also a real danger that if we do not begin to think through our options for these forces today, future opportunities will, by default, be narrowed or even foreclosed, as a result of commitments made to other kinds of forces and weapons programs. Decisions are being made today, for example, to move ahead with a range of tactical conventional weapons programs (e.g., Army's Future Combat System and the tri-service F-35 fighter) that will generate enormous

funding requirements—in some cases, for decades to come—that could crowd out future investments in nuclear offensive strategic forces.

Conversely, there is a danger that, absent a discussion now, substantial resources will—as a result of traditional bureaucratic interests and inertia, rather than analysis—be devoted to modernizing a nuclear triad that is of a size and shape that may be neither affordable, nor necessary, to meet US national security requirements. Once weapons programs enter the acquisitions process, they begin to gain a momentum that makes them increasingly difficult to stop, or even modify. Thus, waiting until plans for modernizing US nuclear offensive strategic forces are further along to begin to debate the merits of different options is likely to result in a much more constrained, limited and, to some extent, empty debate.

Appendix: Methodology for Estimating DoD Funding Requirements and Program Costs

The cost estimates provided in Chapter Three of this report (for the various options described in Chapter Two) were derived by combining three different broad categories of programs and costs. This section describes each of those categories, and briefly discusses how these estimates were derived.

Operations and Support (O&S)

These programs and activities include essentially all of those areas of the defense budget associated with manning, operating and sustaining US military forces on a day-to-day basis. As defined in this analysis, it includes funding provided through the military personnel and operations and maintenance accounts, as well as the military construction and family housing accounts. In other words, it includes all DoD funding exclusive of procurement and R&D. The readiness of US forces to fight effectively on short notice is largely a function of the level of O&S funding they receive. O&S funding pays the salaries and benefits of both military personnel and civilian DoD employees. It also covers the cost of fuel, some spare parts, and other maintenance and repair activities required to keep equipment in working condition.

It was assumed in this analysis that the level of O&S funding provided to support US offensive strategic nuclear forces in 2006 accurately reflected the annual costs of keeping forces of that size and type at relatively high readiness levels. It was further assumed that 2006 funding

levels for O&S activities therefore represents a reasonable baseline from which to project future O&S funding requirements.

The 2006 baseline estimate of O&S costs for offensive strategic nuclear forces was derived through a three-step process.

- First, using a variety of DoD, Congressional Budget Office (CBO) and other sources, the direct O&S costs associated with the major elements (i.e., ICBMs, SSBNs and bombers) of the US offensive strategic nuclear force structure were estimated.

- Second, a proportional share of indirect and overhead O&S costs were allocated to each of these major force structure elements.

- Third, the estimates of direct and indirect/overhead costs for each major force structure element were added together to generate an estimate of total O&S funding requirements.

This baseline, adjusted for changes in the number and types of major force structure elements, was then used to estimate the future O&S requirements of US offensive strategic forces under each option.

Procurement

This category covers the cost of producing (but not developing) all of the major and minor weapon systems and other equipment associated with US strategic offensive nuclear forces. These costs were estimated using a four-step process (see Table A1).

- First, an estimate was made of the unit procurement cost (that is, the average cost per copy) of each new major weapon system (ICBMs, SSBNs, and bombers) to be procured under each option. A range of different sources and methodologies were used to generate these estimates. In most cases, the starting point in the process was the cost of existing systems of the same or similar types. These cost figures were then adjusted to take into account differences in size, speed, payload and other characteristics, as well as the consistent and persistent historical trend towards higher unit procurement costs. Where available,

DoD, CBO and other estimates for similar systems were used to further refine the estimates used in this report.

- Second, the total cost of procuring the major weapon systems specified in each option was derived by multiplying the number of systems projected to be procured over the period covered in this report by the estimated unit procurement cost of the system.

- Third, an estimate was made of the cost of procuring "minor" procurement items under each option. Minor procurement items include everything from forklifts and trucks to munitions, training aircraft, and support ships, as well as the cost of modifications and upgrades of deployed systems. In this analysis, the amount of funding required for minor procurement was assumed to be positively correlated with both the size of the force structure and the cost of the major weapon systems being procured. Specifically, it was assumed that half of all DoD funding for minor procurement is associated with force structure size (measured in terms of O&S costs), and half of this funding varies directly with the amount provided for major procurement. In the former case, the estimate was calculated by multiplying the share of DoD's overall O&S budget accounted for by offensive strategic nuclear forces by an estimate of one-half of DoD's overall budget for minor procurement. In the latter case, the estimate was calculated by multiplying the funding projected for major weapons procurement by the historical ratio of major-to-minor procurement for offensive strategic nuclear forces. Adding these two figures together yielded the estimated to total funding requirement for minor procurement under each option.

- Fourth, the estimates of major and minor procurement costs were added together to derive the total procurement funding requirements of each option.

Table A1: Estimated Acquisition Costs of New Weapons Systems

(in millions of FY 2006 dollars)

Weapon System*	Procurement Cost	R&D Cost
Minuteman IV	50	15,000
SICBM	25	10,000
SLBM-X	100	20,000
SSBN-XM	6,000	6,000
SSBN-XS	5,000	5,000
B-XLS	1,400	70,000
B-XL	700	35,000
B-XM	450	25,000

* For a description of these weapons systems, see text.

Source: CSBA.

Research and Development

This category includes costs associated with researching, developing, testing, and evaluating new offensive strategic weapon systems and other equipment used to support those systems. Estimates of R&D funding for each option represent the sum of three different elements (see Table A1).

- First, the cost of developing the new ICBMs, SSBNs, bombers and other major weapon systems projected to be purchased in each option. These estimates were generated using essentially the same approach employed in estimating unit procurement costs. The starting point was the cost of developing similar systems in the past. These figures were then adjusted to take into account differences in weapon system specifications, and historical cost-growth trends. The figures were further refined by using, where available, estimates by DoD, CBO and others.

- Second, the cost of developing modifications and upgrades for deployed offensive strategic weapon systems. In the case of major US weapon systems, substantial funding is often provided not only to initially develop the system, but to develop improvements once it has been deployed. In this report, it is

assumed that DoD would, in the future, continue to fund these efforts at roughly the same level it has in recent years.

- Third, basic research related to the development of offensive strategic weapon systems. In addition to funding the development of specific new weapon systems and enhancements to deployed systems, each year DoD provides funding for R&D efforts focused on improving capabilities in broad technological and mission areas. This basic R&D can lead to major technological breakthroughs, though often such advances do not come to fruition for many years. For all of the options described in this report, it is assumed that basic R&D related to the offensive strategic forces mission area would, through 2035, be provided an average of about $1.5 billion a year.