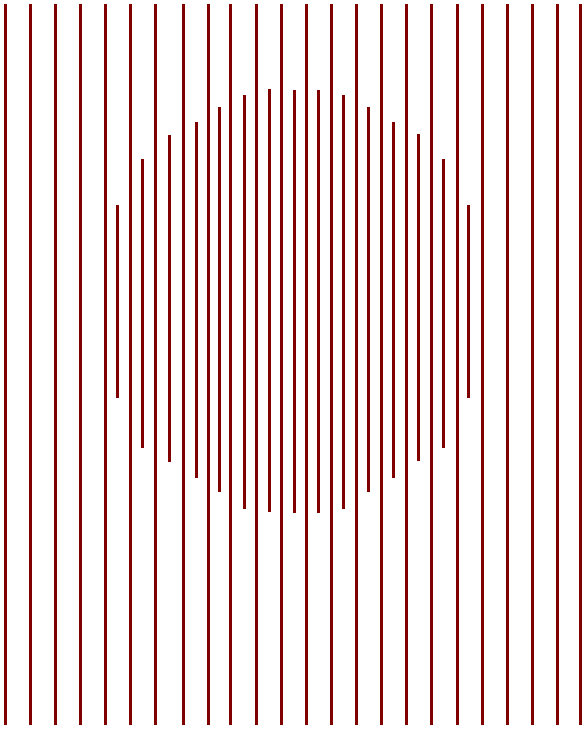
CBO PAPERS

IMPLEMENTING START II

March 1993



CONGRESSIONAL BUDGET OFFICE

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March 1993

CONGRESSIONAL BUDGET OFFICE
SECOND AND D STREETS, S.W.
WASHINGTON, D.C. 20515

NOTES

All costs and savings are expressed in 1993 dollars of budget authority.

Numbers in tables may not add to the totals indicated because of rounding.

The Bush Administration's plan used in this paper is drawn from the official January 1992 budget request, modified to reflect announced policy changes that followed from the START II Treaty. It does not, however, incorporate the January 1993 unofficial budget proposal offered by then Secretary of Defense Richard Cheney.

PREFACE

On January 3, 1993, during the final weeks of his presidency, George Bush and his Russian counterpart, Boris Yeltsin, signed the START II Treaty. Building on the Strategic Arms Reduction Talks (START) Treaty that Presidents Bush and Gorbachev had signed 18 months before, START II would cut strategic nuclear forces to only one-third of their current levels and permit spending on nuclear weapons programs to be reduced by billions of dollars a year.

Even though much nuclear arms control has just been completed, a number of questions remain. First, will Ukraine ratify START, and will both Russia and the United States ratify START II?

If the answer to these questions is yes, a host of others will arise. How should the United States then structure its nuclear forces to minimize budgetary costs while providing adequate deterrence and safety? What additional arms control initiatives might impede nuclear proliferation, enhance controls over excess Russian nuclear weapons, and improve security in other ways?

This paper, prepared at the request of the Chairman of the Senate Committee on the Budget, addresses these questions. It summarizes the Bush Administration's plan for nuclear forces; in addition, it develops and analyzes two options for implementing the START II treaty that would emphasize nuclear nonproliferation policy and reduce budgetary costs further. In keeping with the Congressional Budget Office's (CBO's) mandate, the paper makes no recommendations.

Michael O'Hanlon, Eugene Bryton, and Raymond Hall prepared this paper under the supervision of Robert F. Hale, R. William Thomas, and Michael Miller. Michael O'Hanlon developed most elements of the options and wrote the paper; Eugene Bryton and Raymond Hall assisted in devising the options and conducted the cost analysis. All three wish to thank Dunbar Lockwood of the Arms Control Association; a number of individuals employed by the Department of Energy; and Jim Werner, Tom Cochran, Stan Norris, and Chris Paine of the Natural Resources Defense Council. (Of course, the assistance of these individuals and organizations implies no responsibility for the final product, which rests exclusively with CBO.) The

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Paul L. Houts edited the paper, Christian Spoor provided editorial assistance, and Cynthia Cleveland prepared it for publication.

Robert D. Reischauer
Director

March 1993

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SUMMARY

If ratified and fully carried out, the START II Treaty and the 1991 START (Strategic Arms Reduction Talks) Treaty that preceded it could have profound effects. Multiple-warhead land-based missiles would be eliminated, and deployed forces would decline by about two-thirds--to 3,500 strategic (long-range) warheads and perhaps 8,000 total warheads each for the United States and Russia.

START II would, however, only establish ceilings on the number and capacity of the land-based missiles, bombers, and submarines that deliver long-range, or strategic, nuclear weapons. The treaty does not prescribe any cuts in shorter-range, or theater, nuclear forces or in actual inventories of nuclear warheads. Nor does the treaty directly affect other aspects of nuclear forces that significantly influence costs, including missile defenses, Department of Energy activities that produce and maintain nuclear warheads, and intelligence activities. As the proposed START II treaty is debated, therefore, the Congress may consider alternative approaches to the nature of U.S. nuclear forces that will be maintained under its various limits.

This Congressional Budget Office paper analyzes the Bush Administration's plan for nuclear forces submitted in January 1992, and amended to reflect the START II treaty signed in January 1993. It also develops and scrutinizes two illustrative options for implementing START II in ways that would reduce the defense budget below levels anticipated in the Bush plan and that might also help curb the proliferation of nuclear weapons.

The options are designed to preserve the most modern and capable elements of U.S. nuclear forces. Still, they would provide less insurance against the possibility of a surprise nuclear attack on the United States and the possibility of major technological breakthroughs that made existing U.S. nuclear systems more vulnerable. The remaining level of insurance may, however, be adequate for the post-Cold War era. The options are not exhaustive, but they do show two possible ways in which less expensive--yet still capable and flexible--nuclear forces might be preserved.

THE BUSH ADMINISTRATION'S PLAN

Under the Bush Administration's plan for nuclear forces submitted in January 1992, modified to reflect START II, the Congressional Budget Office estimates that the United States would retain at least 8,000 nuclear warheads in all. The cost for all U.S. nuclear forces and nuclear-related activities would average nearly $42 billion a year between fiscal years 1994 and 2010. (All costs and savings are expressed in constant 1993 dollars of budget authority.)

Compared with earlier plans, the current Bush plan envisions important economies in bomber and missile programs--such as ending the production of B-2 bombers; canceling the small intercontinental ballistic missile (ICBM) program; and reducing deployed submarine, bomber, and missile forces. Under the plan, budgetary savings would average some $16 billion a year compared with spending plans as they existed in 1990.

Despite these reductions, the Bush Administration's plan would retain several vigorous programs--as its hefty price tag might suggest. It would maintain three different types of long-range or strategic systems that can deliver nuclear warheads; it also would develop and deploy multilayered defenses against ballistic missile attacks. In addition, it would continue substantial efforts to research and develop new nuclear warheads and would maintain an extensive intelligence network responsible for tracking the nuclear weapons programs and forces of other countries.

OPTION I: MAKE FURTHER REDUCTIONS IN U.S. FORCES

Option I in this paper assumes further changes in U.S. forces that would reduce costs while possibly reinforcing nuclear nonproliferation efforts. Reductions occur in all three main "legs" of the strategic nuclear triad--bombers, intercontinental ballistic missiles, and submarine-launched ballistic missiles deployed on nuclear-powered ballistic-missile submarines. Reductions also occur in the Strategic Defense Initiative (SDI) program to develop protection against missile attack, Department of Energy (DOE) activities to build nuclear warheads, and Department of Defense activities that provide certain types of intelligence information on other countries' nuclear forces.

The specific reductions in forces in this option include retiring some 48 B-52H bombers--half of the force of 95 that the Bush Administration planned to keep. Such a cut, like the others outlined in this paper, would not prevent the United States from deploying the full complement of 3,500 strategic warheads that it would be allowed under the START II treaty. But it would

reduce the capacity of U.S. forces to increase their deployments of nuclear warheads should that ever be desired. Option I would also retire 200 Minuteman III ICBMs, halve the operations tempo for ballistic missile submarines, eliminate certain parts of the currently planned program for missile defenses and reduce the number of ground-based interceptors from 750 to 300, cut production of the Trident II (or D5) missile, reduce research on new types of nuclear weapons and stop nuclear testing after fiscal year 1996, and trim back spending on certain intelligence activities.

Compared with the Bush Administration's plan, these actions would lower budget authority for nuclear forces by an average of about $4.4 billion a year between 1994 and 2010 (see Summary Table). Near-term savings would be about $3.2 billion in 1994 and $4.4 billion in 1995.

Ending nuclear testing and negotiating an international comprehensive test ban treaty could buttress nonproliferation efforts. With such policy initiatives, the United States might improve the prospects for toughening up the Nuclear Non-Proliferation Treaty when it comes due for renewal in 1995.

Option I would, however, make no fundamental changes in U.S. nuclear force structure, such as eliminating an entire leg of the nuclear triad. It would also continue the practice followed by all recent arms agreements--that is, to limit the number and capacity of strategic delivery platforms but not the inventory of nuclear warheads possessed by either country. Thus, under

SUMMARY TABLE COST SAVINGS UNDER CBO OPTIONS COMPARED WITH THE BUSH ADMINISTRATION'S PLAN
(In billions of 1993 dollars of budget authority)

Option	1994	1995	1996	1997	Annual Average Savings, 1994-2010
I. Further Reductions	3.2	4.4	5.3	6.1	4.4
II. Warhead Dismantlement	7.0	7.9	7.8	9.1	7.2

SOURCE: Congressional Budget Office.

NOTE: The Bush Administration's plan is based on January 1992 budget submissions and other official documents, updated by the Congressional Budget Office to reflect changes expected in light of the signing of the START II treaty.

Option I, since the United States and Russia could store substantial numbers of excess nuclear warheads, they would still have the capability to return to very large deployed strategic forces. More seriously, Option I would fail to address the problem of "loose nukes" in a politically unstable Russia.

OPTION II: DISMANTLE WARHEADS AND KEEP LESS INSURANCE

Option II presumes dismantling all nuclear warheads in excess of an agreed limit--4,000 warheads per country, about half the number likely to be retained under Option I and the Bush Administration's plan. Under this approach, the non-nuclear components of excess warheads would be destroyed. This policy would permit additional cuts in DOE activities that develop, build, test, and maintain U.S. warheads. Perhaps more important, it would reduce the number of warheads in Russia and help consolidate those that remained in the most secure depots and bases.

In addition, Option II would make further cuts in other U.S. forces that would reduce budgetary costs. Perhaps most notably, it would retire all U.S. land-based missiles. It also would reduce the test program for the D5 missile more than does Option I.

Even without land-based missiles, the United States would not be placing all its nuclear eggs in a single basket; it would still have two delivery platforms for strategic nuclear weapons (bombers and submarines). Nevertheless, it would clearly have less insurance against the possibility--albeit remote--that one or both of these systems could be left more vulnerable to attack by an advance in weapons technology.

Option II envisions quick implementation of all these reductions. They are assumed to be carried out by 1998, earlier than assumed for the reductions under the Bush Administration's plan or Option I (reductions that probably would not be completed until the year 2000). Compared with the Bush Administration's plan, budgetary savings under Option II would average $7.2 billion a year between 1994 and 2010. Savings would amount to $7.0 billion and $7.9 billion in 1994 and 1995, respectively. Near-term savings would be substantial even though this option, as well as Option I, assumes that up to $500 million a year in aid would be provided to Russia and other former Soviet republics to help them reduce their nuclear arsenals in a safe, secure, and verifiable manner.

FURTHER ARMS CONTROL MEASURES ARE NECESSARY

Notwithstanding the brisk pace of recent arms control negotiations, further measures would be required under all the approaches in this paper--including the Bush Administration's plan.

Each of the options would pose its own arms control challenges. The Bush Administration's plan, with its ambitious SDI program for missile defenses, would require major modification to the Anti-Ballistic Missile (ABM) Treaty. Option I also would require significant changes in the ABM treaty. In addition, to ensure that the ban on testing would be multilateral, it would require an international comprehensive test ban (CTB) treaty, which President Clinton advocated during his campaign.

Option II would mandate the greatest number of new types of arms control, though it probably would pose much less daunting challenges in the realm of renegotiating the ABM treaty. It, too, would require a CTB. In addition, it presupposes an agreement between the United States and Russia (and perhaps other republics of the former Soviet Union) to dismantle and destroy excess warheads, as well as measures to verify these actions. Such an agreement would necessitate a new type of arms control effort. But it would be consistent with the Biden Condition, which the U.S. Senate attached to the instrument of ratification of the START treaty to ensure oversight of denuclearization efforts in the former Soviet republics. Monitored dismantling of warheads might be an important step toward addressing the vexing problems of nuclear safety and security.

To speed the process, an agreement on warhead dismantlement might initially be put in place through a politically binding protocol to the START II treaty. That protocol could call for dismantling and destroying warheads in excess of the agreed limit over some time period--perhaps seven to 10 years. To aid each side in verifying the other's compliance, the protocol could also call for sharing information about dismantling warheads and for cooperatively observing the dismantlement process with some type of nonintrusive on-site inspections. In the long run, the protocol probably would be replaced by a treaty stipulating a given pace of monitored dismantlement--perhaps employing new and rigorous approaches toward on-site verification such as those used in the recently signed multilateral Chemical Weapons Convention.

CONCLUSIONS

Compared with the Bush Administration's plan, this paper's options for U.S. forces under the START II treaty would maintain fewer delivery systems for strategic warheads and make other economies in force structure. Option II would cut the U.S. and Russian nuclear warhead arsenals, dismantling or destroying those warheads that were in excess of prescribed limits. The options would also maintain smaller systems of defenses against missile attacks.

These reduced capabilities may be acceptable in the post-Cold War era, especially since the United States would retain its most modern and capable nuclear systems. Indeed, to the extent that they would buttress nonproliferation efforts, they may even be desirable in a time when the spread of nuclear weapons to radical countries ranks high on the list of threats to U.S. national security. Moreover, the options would reduce the defense budget by an average of between $4 billion and $7 billion a year over the next 15 years or so. Savings of about $3 billion to $8 billion a year could be realized in 1994 and 1995.

CHAPTER I
INTRODUCTION

During much of the Cold War, the United States and the Soviet Union each possessed more than 25,000 nuclear warheads and spent tens of billions of dollars a year to purchase, maintain, operate, and support their offensive and defensive nuclear forces. But substantial change is now under way. Inventories of warheads are declining significantly as a result of recent arms control agreements, including the Intermediate Nuclear Forces Treaty, the 1991 unilateral decisions by Presidents Bush and Gorbachev to cut their arsenals of shorter-range warheads, and the Strategic Arms Reduction Talks (START) Treaty--that is, if START is ratified by Ukraine and then carried out.

Together these accords are likely to reduce each superpower's arsenal to perhaps 15,000 warheads by the end of the decade. In the process, U.S. spending on nuclear-related activities could be significantly lowered, by an average of some $14 billion a year, relative to the annual level of more than $57 billion that was anticipated under the 1990 Department of Defense plan.

In addition, on January 3, 1993, Presidents Bush and Yeltsin signed the START II treaty between the United States and Russia.[1] If ratified--and assuming that START is ratified by Ukraine--START II might further reduce total nuclear arsenals to some 8,000 warheads apiece and bring about additional savings in the defense budget that could average $2 billion a year.

Although START II would limit the number of strategic offensive warheads that can be deployed, it would not place any limits on many elements of nuclear forces--such as the inventories of warheads that can be maintained as well as Department of Energy (DOE) activities to design and test new types of nuclear warheads. It also places no direct limits on missile defenses. It does, however, note the ongoing obligations placed on both countries by the Anti-Ballistic Missile (ABM) Treaty. Moreover, it builds on a START treaty that contains a Russian statement explicitly linking reductions in offensive arms to continued observance of the ABM treaty. But ambiguity continues to shroud the legal status of missile defenses and the exact nature of the links between offensive and defensive forces.

1. Formally, the START II treaty is the "Treaty between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms."

Decisions regarding missile defenses, DOE, and other activities and programs related to nuclear forces will influence budgetary costs significantly. They may also affect efforts to curb nuclear proliferation, improve nuclear safety, and deal with the possibility of missile attack. As ratification of START II is debated and future budgets and military forces are shaped, therefore, the Congress may consider various approaches to overall U.S. nuclear policy and forces.

The Bush Administration's plan has many positive features. It would make significant cuts in the number of forces--about two-thirds of the existing numbers of deployed strategic warheads. These reductions would be achieved in part by eliminating certain categories of nuclear weapons in their entirety and would realize budgetary savings in the process.

But the Bush plan retains more systems and programs than many analysts prefer. Under any of the approaches discussed in this paper, the United States would deploy 3,500 strategic nuclear warheads--as many strategic weapons as were in the first U.S. single integrated operational plans (SIOPs) for nuclear war in the early 1960s. With such a robust strategic deterrent likely to remain, cuts in other types of U.S. nuclear forces and in some nuclear modernization programs may be possible--and even desirable. They could aid in mitigating the danger of "loose nukes" in the former Soviet republics, and in reinforcing the international stigma against developing or using nuclear weapons. These potential risks of nuclear proliferation are among the greatest threats to future U.S. security; yet, START II does not directly address them.

Moreover, under START II the United States and Russia could keep any number of excess warheads they chose. They could also continue to design, test, and produce new types of warheads without any restrictions. Although testing has its advantages--including the ability to check the reliability of weapons and perhaps improve the safety of warheads in the arsenal--coupling START II with policies that would forgo testing and seek an international comprehensive test ban (CTB) treaty could offer advantages.

How much a CTB would affect efforts to stem the spread of nuclear technologies and weapons is currently a matter of debate. But proponents believe that a CTB would hinder the efforts of smaller countries to develop high-performance nuclear warheads usable on ballistic missiles as well as thermonuclear or "fusion" warheads. It could also add momentum to international efforts to strengthen the Nuclear Non-Proliferation Treaty (NPT)--due for renewal in 1995--and thereby reduce the chances that a future renegade country, such as Iraq under Saddam Hussein, would be able to build

a sophisticated nuclear weapons technology base while appearing to be an NPT signatory in good standing.

Some U.S. nuclear forces and policies consistent with START II could also yield budgetary savings. Certain additional cuts might be made unilaterally, as the United States makes decisions on how to structure its nuclear forces to comply with the recently signed treaty. Certain other policy changes might require further bilateral arms control measures, perhaps framed as a protocol to the START II treaty. The options in this paper, which include both unilateral and negotiated elements, could save the United States an average of $4 billion to $7 billion a year.[2]

2. For a discussion of more far-reaching possible changes in U.S. nuclear policy, see Congressional Budget Office, *The START Treaty and Beyond* (October 1991).

CHAPTER II

THE BUSH ADMINISTRATION'S PLAN AND ALTERNATIVES

The starting point for this paper is the Bush Administration's detailed plan for nuclear forces submitted in January 1992, but with modifications. The plan has been updated to reflect changes announced by the Bush Administration to accommodate START II and by Congressional Budget Office estimates of changes that might take place in the Department of Energy in the wake of START II.

The Clinton Administration has submitted a revised budget plan for defense spending. But it has not yet announced a detailed, long-range plan for nuclear forces and probably will not do so publicly until later this year or early next year. The Bush plan, therefore, must be the starting point.

The guiding principles behind the options presented in this paper are fairly simple: budgetary frugality and nuclear nonproliferation. In both options, a force structure containing 3,500 strategic nuclear weapons--quite substantial by historical standards and in comparison with other countries' forces--would be maintained. In addition, Trident submarine fleets, B-1 and B-2 bomber inventories, and command, communications, and control technologies are to be preserved at the same levels as in the Bush plan. Basic research and development work, as well as nuclear-related intelligence activities, would be scaled back--but fairly modestly.

Significant reductions are considered, however, in most other types of nuclear and nuclear-related systems. Option I incorporates reductions of forces and economies in operations; Option II includes deeper cuts that would eliminate some additional insurance, flexibility, or added capability from U.S. nuclear forces. The options are illustrative and by no means exhaustive.

OFFENSIVE NUCLEAR WEAPONS

In the category of strategic offensive systems, the United States retains three major types of systems: long-range or "heavy" bombers; intercontinental ballistic missiles (ICBMs) based in concrete silos in the interior of the United States; and submarine-launched ballistic missiles (SLBMs) based on nuclear-powered submarines that spend most of their time hidden in the globe's oceans.

Both options in this paper would retain most of the submarine and bomber systems that the United States currently intends to keep under the Bush Administration's plan; Option I would also keep a sizable number of ICBMs. But other types of systems are reduced or eliminated in the options laid out below.

The Bush Administration's Plan

Under the Bush Administration's plan, the United States might maintain a total inventory of at least 8,000 nuclear warheads (see Table 1). The strategic portion of the U.S. inventory of nuclear warheads is assumed to be governed by the START II treaty, recently signed but not yet ratified by either Russia or the United States. START II would limit U.S. and Russian forces, placing a ceiling of 3,500 on each country's deployed strategic warheads. START II would also eliminate all land-based missiles with multiple warheads; these types of missiles have been of particular concern to analysts because of their potential to destroy large elements of an enemy's forces preemptively. (See Box 1 for more details on the START II treaty.)

In addition to the overall limit of 3,500 warheads, the START II treaty specifies a limit on the number of warheads that could be deployed on the sea-based portion of the strategic triad. In all, 1,750 warheads could be deployed on submarines.

Under the Bush Administration's plan as it stood when the START II treaty was signed, the United States eventually would deploy 18 of the new Trident submarines. Each submarine eventually would carry 24 of the new D5 (Trident II) submarine-launched ballistic missiles, though initially 8 of the submarines would have the older C4 (Trident I) missile. The C4 and D5 missiles would carry 4 warheads apiece--half the maximum number they are capable of carrying. Another 500 warheads would be deployed on Minuteman III missiles, each carrying 1 warhead rather than the 3 with which they are now equipped.

The remaining 1,250 or so warheads would be on those bombers dedicated to the nuclear role. This paper assumes that these remaining warheads would be carried by 94 B-52H bombers with an average of about 10 warheads, plus 20 B-2 bombers each with a capacity for 16 munitions. But plans are not yet clear on this point since the START II treaty leaves the United States a good deal of flexibility in deciding how to configure its strategic bomber forces.

TABLE 1. BROAD CHARACTERISTICS OF THE APPROACHES

	Bush Administration's Plan	Option I: Make Further Reductions	Option II: Dismantle Warheads
Warheads			
Deployed strategic warheads	3,500	3,500	3,500
Theater warheads	1,600	0	0
Surplus warheads[a]	3,000	4,500	500
Total[a]	8,000	8,000	4,000
Offensive Forces			
All heavy bombers[b]	211	163	163
Submarines	18	18	18
ICBMs	500	300	0
Defensive Forces	6 sites, 125 interceptors per site, space-based sensors and interceptors	6 sites, 50 interceptors per site, space-based sensors	Same as Option I, but no space-based assets
DOE Activities	Maintain large inventory, capability to rebuild, test	Maintain large inventory, capability to rebuild, no testing after 1996	Same as Option I, but keep smaller inventory
Intelligence Activities	Substantial	Reduced by 20 percent	Same as Option I
Most Changes in Place No Later Than:	2000	2000	1998

SOURCE: Congressional Budget Office; Department of Defense.

NOTE: ICBM = intercontinental ballistic missile; DOE = Department of Energy.

a. These estimates are approximate; official numbers are classified.

b. Includes all bombers in service, not just primary authorized aircraft.

BOX 1.
The START II Treaty

The treaty signed on January 3, 1993, by President George Bush of the United States and President Boris Yeltsin of the Russian Federation builds on the blueprint of the 1991 Strategic Arms Reduction Talks (START) Treaty signed by President Bush and President Mikhail Gorbachev of the then Soviet Union. Its verification procedures, definitions and categories of weapon systems, weapons databases, and formal procedures for implementation provide the framework for the treaty known as START II (for more detail on the START treaty, see the Congressional Budget Office study *The START Treaty and Beyond*, October 1991, p. 44).

START II makes deeper cuts in the number of warheads allowed to be deployed and changes some of the counting rules and other provisions associated with START. Its most notable provisions include the following:

- Implementation of the treaty must be completed by January 1, 2003, at the latest, but can be completed by December 31, 2000, if the United States provides Russia sufficient financial assistance.

- No country may deploy more than 3,500 nuclear warheads on its strategic delivery vehicles.

- Of the 3,500 total, no more than 1,750 warheads may be on submarine-launched ballistic missiles.

- No country may deploy more than a single warhead on any land-based intercontinental ballistic missile (ICBM).

- No country may deploy "heavy" ICBMs--that is, missiles of a size exceeding that of the Russian SS-19. In effect, this provision requires Russia to retire all of its SS-18 ICBMs.

- Bombers are counted as carrying their full capacity of warheads. In the case of the United States, B-1s and B-2s are counted as carrying 16 warheads, B-52Gs are counted as carrying 12, and B-52Hs are counted as carrying 20 (though they could be counted as carrying fewer if reconfigured).

(continued)

Under the START II treaty, U.S. B-1 bombers could be designated for non-nuclear or "conventional" missions; in that case, they would not count against the treaty limits. Such conventional bombers would not be allowed to train for nuclear missions. Nor could they be located at bases where nuclear weapons for bombers were stored. (Nevertheless, no fundamental physical barrier would prevent the bombers being converted back to their strategic mission and equipped with some of the surplus warheads that the United States would be permitted to retain under the START II treaty.)

BOX 1.
Continued

- Ballistic missiles can be downloaded more than the START treaty allows. For example, the United States plans to deploy submarine-launched ballistic missiles (the C4 and D5) with 4 warheads each, rather than the maximum loading of 8. Russia probably will deploy 105 of its SS-19 missiles with a single warhead each and may deploy the SS-N-20 with some 6 warheads rather than the maximum number of 10.

- Russia may keep 90 of its SS-18 missile silos, after suitably modifying them to make them unusable for a large missile. Doing so requires filling the silos with 5 meters of concrete each, and fixing a restrictive steel ring at the top of each silo. All other SS-18 silos must be destroyed.

- Each country is allowed to reorient up to 100 heavy bombers for purely conventional missions and no longer count these systems as carrying nuclear weapons. These aircraft must never have been equipped to carry nuclear-armed cruise missiles, however, and must not be based near bomber nuclear weapons or used to conduct nuclear training flights. But they do not need to be physically modified.

- Should it so choose, either party may reorient a bomber to a conventional mode once and may later reorient it back to a nuclear mode (the United States apparently plans to reorient its B-1 bombers to a conventional role).

Under the START II treaty, all required reductions in strategic nuclear forces must be accomplished no later than the beginning of the year 2003. The treaty also states that, if the United States provides Russia with financial assistance in reducing its forces, the changes can be in place by the end of the year 2000. In this paper, for purposes of costing it is assumed that all reductions in U.S. offensive forces would be completed by the year 2000 for the Bush plan.

Although it places a limit on deployed strategic warheads, the START II treaty would not limit the number of warheads that Russia or the United States could retain in its overall arsenal. Each country could maintain as many theater and surplus warheads as it wished. In this regard, the treaty is similar to past arms control treaties, which have focused on limiting the number and capacity of delivery platforms rather than on warheads. In total, under the Bush Administration's plan, the United States might maintain an inventory of more than 8,000 nuclear warheads. That inventory could, for example, consist of 3,500 warheads on dedicated long-range nuclear delivery systems, about 1,600 short-range weapons, and 3,000 or more excess warheads in storage.

Option I: Make Further Reductions in U.S. Forces

In contrast to the Bush Administration's plan, Option I would achieve additional cost savings through further economies in forces and operations. Option I would, however, preserve the core of modern U.S. nuclear systems. It would also avoid fundamental changes in U.S. nuclear forces, such as the elimination of an entire class of nuclear delivery vehicles.

In the realm of strategic bombers, Option I would retire an additional 48 B-52H bombers--those that, according to the Air Force's June 1992 Bomber Roadmap, will not be equipped with the capability to carry precision-guided munitions. Option I would keep 47 B-52H, 20 B-2, and 96 B-1 aircraft--all for both nuclear and conventional roles. (Actually, by official START and START II counting rules, this number of aircraft in active inventory might translate to about 45, 20, and 94 "countable" bombers in each respective category.) By retiring some bombers, Option I would reduce the basic capability of the United States to increase quickly its number of deployed strategic warheads. But since Option I would not incorporate verified dismantlement of excess warheads, it is assumed to include a total nuclear arsenal of more than 8,000 warheads just as in the Bush plan.

Option I would retain all 18 Trident submarines. To further reduce costs and to reflect the lower tensions of the post-Cold War world, however, it would make changes in the deployments of U.S. nuclear forces as well. It would reduce the at-sea rate of ballistic missile submarines by half and thus retain only a single crew for each submarine instead of two. This change would be akin to steps taken by the Bush Administration in 1991 to shift strategic bombers off continuous runway alert. In this case, though, it would still keep six submarines at sea at a time.

The option would also greatly curtail the purchase of D5 ("Trident II") SLBMs for Trident submarines through three separate measures. The first measure would consist of deploying fewer missiles on the country's 18 Trident ballistic missile submarines, placing 12 SLBMs on each vessel rather than the maximum loading of 24. (Doing so might require the United States to seek a special dispensation from Russia through the Bilateral Implementation Commission, since the START II treaty makes no explicit allowance for cutting missile tubes out of submarines or otherwise rendering them inoperable.)

In addition, the D5 program would be scaled back with two other steps: the United States would retain the older C4 missile on 8 Trident vessels, and would curb the missile test program for the new D5 by about 80 missiles (to a level more typical of historical averages for strategic missile test programs). These actions would reduce the planned purchase of D5 missiles from some 800 under the Bush Administration's January 1992 plan to less than 400 under this option. (Since 295 missiles already have been purchased, this option would terminate D-5 procurement after 1995.)

Finally, Option I would reduce the Minuteman III ICBM force from 500 missiles to 300. These various changes would all be in place by the year 2000, as assumed for the Bush Administration's plan.

Under this approach, two-thirds of the U.S. arsenal of deployed strategic warheads would be found on the bomber force--meaning that U.S. nuclear forces would, in percentage terms, be more vulnerable to surprise attack under this approach than under the Bush Administration's plan. About 1,500 warheads would be deployed on B-1 aircraft, 320 on B-2 bombers, and some 530 on the remaining B-52H, for a total of more than 2,300. There would be 300 warheads on ICBMs and some 850 on submarines; the total U.S. strategic nuclear force, under this scheme, thus would also reach 3,500. The remaining 4,500 warheads would consist of perhaps 500 theater or tactical warheads and some 4,000 excess warheads in storage.

Option II: Dismantle Warheads and Keep Less Insurance

In contrast with both the Bush Administration's plan and Option I, Option II includes a binding limit on the number of warheads that either Russia or the United States could retain. The limit would be set at 4,000 nuclear warheads, perhaps half the number that either country is likely to retain under current plans and the START II treaty. It would thus permit Russia and the United States each to maintain no more than 3,500 strategic warheads plus a backup of no more than 500 warheads. Backup warheads, which would have to be stored domestically, could be used to replace those strategic warheads undergoing maintenance or could be kept for shorter-range platforms such as tactical aircraft. They also would serve as a hedge against the possibility that a problem might surface systematically in a particular type of warhead, rendering that entire category unusable for a time.

Any warheads in excess of the total limit of 4,000 eventually would have to be dismantled. The non-nuclear components of the warheads would have to be destroyed.

In addition to requiring warhead dismantlement, Option II would impose other changes aimed at saving money by maintaining less insurance against political and technological events that appear highly unlikely at this point in history. In regard to strategic warheads, Option II assumes retirement of all U.S. land-based missiles and thus a nuclear force structure composed of only two legs of the traditional strategic triad. It would, however, retain all 18 Trident submarines and all the bombers remaining in the force posture of Option I.

To make up for the retirement of land-based missiles and maintain the total strategic warhead count of about 3,500, the number of warheads carried by each submarine-launched ballistic missile would be increased from four to six. (Despite recent concerns about the safety of the D5 missile and its warheads, placing six warheads on each missile--still less than the maximum loading of eight--is, according to several experts, no less safe than putting four on each.)[1]

Option II would also impose additional cuts on the test program for the D5 missile. Option I would reduce annual tests from about 13 to about nine, on average; this option would further reduce the test program to the equivalent of roughly 10 firings every other year. In this way, procurement of

1. For an example of the safety concerns recently voiced in regard to the D5 missile system, see Ray E. Kidder, "How Much More Nuclear Testing Do We Need?" *Arms Control Today* (September 1992), p. 13.

the D5 could be reduced by another 70 missiles or so below the level under Option I; no further budget authority would be required after 1993. Option II also would reduce the number of tanker aircraft that support strategic bombers by providing aerial refueling (see Box 2 for more detail on tankers). Changes under Option II would be fully in place by 1998, earlier than assumed here under the Bush plan or Option I.

Box 2.
Tankers

Option II would retire those tanker aircraft not being reequipped with new engines. In other words, it would keep the 400 KC-135R (as well as the 60 KC-10A that are primarily used for tactical conventional missions), but would retire the other 150 or so KC-135s that the United States apparently plans to keep. In so doing, it would retain nearly 800 "KC-135A equivalents" and give up about 15 percent of today's refueling capacity.

Would such a reduction be prudent? The answer to this question centers on issues relating to conventional forces--most notably, how many regional wars the United States should envision fighting at once. Operation Desert Storm required some 300 tankers, representing perhaps 400 to 500 KC-135A equivalents; adding the need to respond to a simultaneous crisis, or establish a defensive deployment, a total of 800 KC-135A equivalents in the force structure would appear quite adequate. Were two large regional wars to break out simultaneously, however, the Pentagon's planned 950 equivalents might be necessary.

Many analysts doubt the need to prepare for two such wars at once, however--something the United States was not able to handle even during Cold War days when it was feared that Moscow might orchestrate a coordinated global assault against U.S. interests.[1]

1. William Kaufman and John D. Steinbruner, *Decisions for Defense* (Washington, D.C.: The Brookings Institution, 1991), pp. 42-50; Leon V. Sigal, "The Last Cold War Election," *Foreign Affairs* (Winter 1992/1993), p. 11; Michael O'Hanlon, *The Art of War in the Age of Peace* (Westport, Conn.: Praeger, 1992), pp. 9-24.

DOE ACTIVITIES TO DESIGN AND DEVELOP NEW NUCLEAR WARHEADS

Department of Energy activities related to work on nuclear weapons can be divided into four broad categories: researching and testing nuclear weapons, either to develop new technologies and designs for warheads or to check the reliability and properties of existing weapons; producing and maintaining nuclear materials; building and maintaining nuclear warheads; and cleaning up the radioactive waste from decades of past DOE weapons efforts--efforts that generally emphasized haste and production over environmental safety.

The START II treaty does not restrict those DOE activities in any way. In shaping U.S. nuclear policy in the context of START II, however, the Congress could consider a range of policy changes that would have important budgetary effects and that--in the eyes of many--could buttress efforts to curb nuclear proliferation.

The options illustrate a range of choice in all DOE weapons activities except those related to the cleaning up of nuclear waste, which are assumed to remain as proposed in the Bush Administration's plan. For those sites that might be closed down under the options but not under the Bush plan, some pressures might arise to increase funding for cleanup. But the urgency of dealing with radioactive waste at a site would not be greatly affected by whether or not weapons activities continued there. Thus, it is reasonable to assume that the pace of cleanup depends only on existing levels of contamination and not on the future characteristics of the U.S. nuclear arsenal.

The Bush Administration's Plan

In the President's January 1992 budget request, the total annual budget for the Department of Energy's work on nuclear weapons was expected to rise by 1997 to more than $15 billion. For the rest of the decade and beyond, some $6 billion of this amount would be devoted to cleaning up radioactive waste produced by DOE and the agencies preceding it during the last five decades.

Under the version of the Bush Administration's plan set forth in this paper, which reflects CBO's assumptions about how DOE would scale back operations under START II, expenditures are assumed to be less than in last year's budget request. DOE funding for nuclear cleanup would be unaltered relative to current plans at $6 billion a year, and funding for naval nuclear reactors would remain at about $800 million annually. But other funding would decrease gradually from its current level of about $7 billion to less than

$5.5 billion. It then would remain constant in real terms (see Table A-2 and Appendix B for a discussion of the changes).

Notwithstanding those reductions, the Bush Administration's plan would retain an arsenal of perhaps 8,000 warheads, the ability to modernize that arsenal with new types of warheads, and the capacity to rebuild an even larger arsenal fairly quickly should world conditions deteriorate. The plan is also assumed to envision continued testing of nuclear warheads into the indefinite future.

Option I: Make Further Reductions in U.S. Forces

Option I illustrates an approach to curtailing DOE activities that reflects a strengthening of efforts aimed at curbing nuclear proliferation, coupled with efforts to reduce the federal budget.

The option assumes that testing of U.S. warheads would cease by the end of fiscal year 1996--as current law requires, provided that no other countries engage in tests. To ensure that no other countries would test, a comprehensive test ban treaty--supported by President Clinton during his campaign--would probably be required. Option I also assumes that research aimed at modernizing the U.S. nuclear arsenal would be scaled back. An end to testing would make it difficult to carry out thorough research and development on new warheads anyway.

Several specific changes in DOE activities follow from these assumptions. Activities at the Nevada Test Site would be scaled back after 1996, focusing only on activities such as "hydronuclear" testing. Research, development, and non-nuclear testing of nuclear warheads would also be reduced. Instead of three national laboratories engaging in this work, it might suffice that only two remain involved--perhaps Sandia National Laboratories, which is the only laboratory currently responsible for designing the non-nuclear components of warheads, plus either the Lawrence Livermore or Los Alamos facilities.[2] (See Table A-2 for more detail about the DOE changes, and Appendix B for a discussion of these changes in greater depth.)

2. Statement of Victor S. Rezendes, Director, Energy and Science Issues, Community and Economic Development Division, General Accounting Office, before the House Committee on Science, Space, and Technology, September 24, 1992, p. 5.

Option II: Dismantle Warheads and Keep Less Insurance

In addition to the changes under Option I, Option II would make further economies by cutting the inventory of warheads that would be maintained. Arsenals would be reduced about 50 percent from levels anticipated in the Bush plan, dropping to about 4,000 warheads per country.

The Savannah River Site's K-reactor would be shut down permanently. That reactor produces tritium gas, a key element in warheads that decays fairly quickly with time. With the reduction in warheads, however, the need for more tritium could be delayed until 2025 or so. Construction of a new nuclear reactor or particle accelerator to replace the K-reactor could thus be delayed until well after 2010, improving the chances that new technologies to produce tritium will be available when construction begins.

Under Option II, additional reductions and consolidations could also take place in activities related to the production of warheads, beyond those assumed under the Bush Administration's plan. Appendix B discusses some of the details.

COMMAND, CONTROL, COMMUNICATIONS, AND INTELLIGENCE ACTIVITIES

Although most information on the subject is classified, the Bush Administration reportedly requested some $50 billion, at least, for command, control, communications, and intelligence (C^3I) activities for fiscal year 1993. A significant amount of this funding--perhaps as much as one-quarter or so--goes to support nuclear forces and nuclear-related activities. The START II treaty does not restrict C^3I activities. But it may be appropriate to reassess C^3I in light of the cuts in nuclear forces and other changes in nuclear policy that are now taking place.

The Bush Administration's Plan

The total budget for C^3I includes nearly $20 billion for command, control, and communications (C^3)--the web of systems and activities that interlinks U.S. military forces and enables them to carry out missions properly. Of that amount, some $5 billion, or 25 percent, is devoted to strategic nuclear C^3. In addition, some $30 billion a year is reportedly devoted to two main branches of the intelligence community: one that monitors other countries under the National Foreign Intelligence Program (NFIP), and another that supports U.S.

forces by observing the operations of other countries' military forces under Tactical Intelligence and Related Activities (TIARA).[3] The question is what part of total intelligence spending primarily supports U.S. nuclear forces. Unfortunately, the answer is classified. However, if nuclear intelligence receives about the same share of total funding for intelligence as strategic C^3 does of total C^3--some 25 percent--its funding apparently would amount to roughly $7.5 billion a year.

Options I and II

Any cuts in intelligence must be made very carefully. Most of the information describing these activities is highly classified, making public scrutiny of plans and budgets difficult. Some activities supported by these funds enjoy near-universal approbation among security analysts and policymakers because they contribute directly to stability; they provide assurances that attacks are not under way and that forces are secure. Nevertheless, many intelligence activities are related in magnitude to the size and activity level of the military forces of other countries. With the end of the Cold War and corresponding sharp cuts in the force levels and military operations of the former Soviet Union and its Cold War allies, carefully chosen economies in U.S. intelligence spending may be reasonable. If so, significant budgetary savings may be possible.

In this spirit, the National Defense Authorization Act for Fiscal Year 1991 mandated that all types of intelligence personnel be reduced by 25 percent by the end of 1996. Although such cuts may have begun, only modest reductions in intelligence funding--and thus, presumably, in personnel--reportedly have occurred since the bill was passed. Therefore, to be consistent with the 1991 law, large cuts may still be appropriate.

To illustrate in a reasonable way the potential for savings under both Option I and Option II, funding for that portion of intelligence related to nuclear forces is assumed to be reduced by 20 percent. This reduction applies to personnel, operating, and investment spending. Reductions in investment might be achieved by, for example, reducing the number of imaging satellites and the number of platforms designed to monitor Russian air defense radars. Thus, of an annual budget of $7.5 billion for nuclear-related intelligence activities, cuts of $1.5 billion are assumed.

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3. See testimony of Duane P. Andrews, Assistant Secretary of Defense, Command, Control, Communications, and Intelligence, before the Subcommittee on Defense, House Committee on Appropriations, April 2, 1992, p. 392; George Lardner, Jr. and Walter Pincus, "Congress May Seek Review of All Intelligence Spending," *The Washington Post*, January 10, 1993, p. A4.

Savings in certain categories of intelligence would be partially offset by added costs in others. In particular, about $500 million a year would cover monitoring and complying with the additional force reductions--and helping Russia as well as the other former Soviet republics to do so, in the interest of bringing excess warheads under secure control as soon as possible. Therefore, net savings in intelligence would be about $1 billion a year for each option.

Savings might be larger if reductions could also be achieved in budgets for command, control, and communications. Because many of the details of the C^3 budget are classified, and because of the importance of reliable communications, no explicit cuts in funding are assumed under the options in this paper. Nevertheless, some cuts may be possible--for example, in satellite programs such as the MILSTAR system, and for communications devices directly related to delivery vehicles being retired under the options.

MISSILE DEFENSES

The United States remains a party to the 1972 Anti-Ballistic Missile Treaty, which places strict limits on developing and deploying missile defenses. The intent of that treaty was to prevent a possibly dangerous, and almost certainly expensive, action/reaction process in which U.S. and Soviet planners would overcompensate for each other's missile defenses by building ever larger offensive nuclear forces. With the major improvements in technology and in superpower political relations that have occurred since 1972, however, it is not clear if the ABM treaty in its current form still makes sense.

The Bush Administration's Plan

The core of the Bush Administration's current program under the Strategic Defense Initiative (SDI) is named GPALS, for Global Protection Against Limited Strikes. It would encompass space-based and ground-based sensors and interceptors. The ground-based elements would involve perhaps six defensive sites; each of these sites might be equipped with 125 ground-based interceptors to destroy incoming warheads, as well as radars to track the warheads and guide interceptors to them.

Eventually, the Bush Administration's plan would add space-based sensors (called "Brilliant Eyes") to support the work of these ground sites, and space-based interceptors (called "Brilliant Pebbles") to attack missiles and warheads early in their trajectories when they were outside the Earth's

atmosphere. Between 40 and 60 Brilliant Eyes sensor satellites and about 1,000 Brilliant Pebbles interceptors would be deployed.

In addition, a substantial program of defenses against shorter-range or theater missiles--such as the SCUD missiles of Desert Storm fame--would be developed and deployed as part of the overall SDI program. The Patriot missile has some capacity in this regard and will be upgraded and retained in the future. New capabilities in the form of the theater high-altitude air defense (THAAD) system and perhaps other missiles would also be added.

Options I and II

Framing alternatives for SDI is difficult because the range of possible policies is so wide. On one extreme is no deployment of any missile defenses (save, perhaps, those against short-range missiles of the Iraqi SCUD variety); on the other extreme might be a large missile-defense system such as those envisioned at various times under the SDI programs of the Reagan and Bush Administrations. This paper's options avoid those two extremes.

Both options retain the Bush Administration's plan for defenses against theater missiles. The options would also deploy defenses against long-range missiles at six sites--assuming that the United States was able to modify the ABM treaty with Russia in such a way as to permit this type of deployment, or that it chose to withdraw from that treaty entirely (accepting the attendant risks to other types of arms control).

Both options could handle only smaller missile attacks. But a smaller attack--be it from accident, an unauthorized launch by a small group of military commanders, or a small nuclear power--may be the most likely threat. Moreover, a defense might stand a good chance against a small attack--whereas the pursuit of a nationwide defense system designed to counter a large attack strikes many analysts as sisyphean. Perhaps most important, defenses able to handle only smaller attacks would run less risk of interfering with negotiated controls on offensive arms.

Specifically, both Option I and Option II would have about 50 ground-based interceptors at each of six sites. Under both options, defenses would use ground-based radars--the six that would be located at the missile defense bases, as well as early warning radars already operated by the United States. All of these radar systems might be interconnected under both options, should that be allowable under a revised form of the ABM treaty. They would then

detect and track incoming warheads and guide interceptors to their targets (see Table A-3 in Appendix A for details).

In addition, major changes in space-based programs would occur. Neither option would deploy space-based interceptors. Option I would deploy Brilliant Eyes sensor satellites, but Option II would not.

FURTHER ARMS CONTROL MEASURES

Despite the brisk pace of arms agreements in recent years, none of the approaches discussed in this paper could be carried out fully without some additional efforts. The Bush Administration's plan as well as the two options would require significant arms control efforts--though none would require further negotiations on strategic force levels.

In all three approaches, ratification of existing agreements would be necessary. Under the Bush Administration's plan and both options, strategic offensive forces are assumed to be consistent with the START II treaty, which must be ratified by both the United States and Russia. All three approaches also depend on the necessary precursor to START II--the original START treaty, which has not yet been ratified by Ukraine.

In addition, some new arms control measures would be required. The Bush Administration's plan and both options would eventually require some modifications of the ABM treaty in order to permit deploying a nationwide system of missile defenses. But changes would have to be more fundamental under the Bush plan than under the other two approaches.

Options I and II also assume that a comprehensive test ban treaty will eventually be negotiated and ratified. The ABM modifications and the CTB treaty--both of which have been under active consideration in defense and arms control circles--would not need to be put in final form for several years. But Option II would require new and relatively near-term arms control measures to provide confidence that existing warheads were dismantled and their non-nuclear components destroyed.

ABM Treaty Modifications

The existing ABM treaty permits the United States and Russia to deploy no more than 100 interceptors at one site. Space-based sensors and interceptors are generally prohibited.

To varying degrees, the Bush Administration's plan for missile defenses as well as the plans envisioned under both the options would require modifying the existing treaty. All three approaches would require changes to permit deployment of defenses at more than one site. The Bush Administration's plan and Option I would require additional modifications to permit deployment of space-based sensors. Finally, the Bush Administration's GPALS system would need still more treaty changes to allow some 750 ground-based interceptors and 1,000 space-based interceptors to be deployed.

Increasing the number of sites where missiles could be deployed, as under Option II, might not be particularly difficult to negotiate. Indeed, the original form of the ABM treaty itself allowed for two sites and 200 interceptors. But challenges probably would mount as negotiators attempted to find room under treaty limits for more and more elements of the Bush Administration's GPALS system. If it could not persuade Russia to rewrite the ABM treaty to allow a multilayer defense, the United States could face a stark choice: abandon the GPALS program or risk provoking the Russian Republic to withdraw from the START process. Both the preamble of the START II treaty and a unilateral statement by the Soviet Union attached to the START treaty underscore the relevance of the ABM treaty to offensive arms control in Moscow's eyes.

CTB Treaty

Options I and II in this paper assume an end to testing new nuclear warheads. Ceasing testing could induce other countries not to test either--and might provide momentum to concluding an international comprehensive test ban treaty. A number of countries have advocated a CTB for years, and momentum is currently mounting because of testing moratoriums in Russia, France, and the United States.

Conceivably, a CTB could allow a small number of reliability tests every few years, though generally a CTB is understood to permit no testing whatsoever. Under such circumstances, the United States could still maintain confidence in its warheads through hydronuclear testing, computer modeling, and other approaches, which already are the principal means by which the United States monitors and safeguards its stockpile.[4]

4. See, for example, J. Carson Mark, "Do We Need Nuclear Testing?" *Arms Control Today* (November 1990), p. 13.

The CTB might begin in 1995 or 1996--the former date coinciding with the extension of the Nuclear Non-Proliferation Treaty, the latter consistent with legislation attached to the Energy and Water Development Appropriations Act for fiscal year 1993 and known as the Hatfield Amendment. The grace period of two to three years would allow certain improvements in safety to be made in the existing U.S. arsenal.[5]

The CTB would not, of course, physically prevent tests by other countries. But U.S. seismic listening stations and other intelligence methods could, under a CTB and the monitoring provisions that probably would be part of it, detect explosions of weapons only one-tenth the size of the Hiroshima and Nagasaki bombs--that is, those with a yield exceeding that of a detonation of one kiloton of a conventional explosive.[6] Were violations to occur, the United States could seek, probably through the United Nations, to cut off international trade in high-technology goods to the offending country. It could also consider advocating much more serious sanctions, should that be necessary.

Warhead Dismantlement and Destruction

Under Option II, Russia and the United States (and perhaps other republics of the former Soviet Union) would have to agree that warheads in excess of the limit of 4,000 would eventually be dismantled and their non-nuclear components destroyed. The agreement itself, while probably relatively straightforward, would raise some thorny verification issues that require discussion. On-site and intrusive inspections might be necessary to verify this dismantlement and destruction. Negotiating the scope and nature of these inspections would almost certainly be difficult and time-consuming: such inspections are unprecedented, and neither country would be comfortable permitting inspections that, if done improperly, could divulge the details of its warhead designs.

Negotiating these important new verification procedures could be all the more challenging because of the problems that are being encountered in ratifying the original START treaty. START was signed by the United States and the Soviet Union in July of 1991. When the Soviet Union dissolved, four former Soviet republics became responsible for START under the terms of the May 1992 Lisbon Protocol. As agreed in Lisbon, Ukraine, Kazakhstan,

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5. See, for example, Kidder, "How Much More Nuclear Testing Do We Need?" pp. 11-14.

6. See Gregory E. Van der Vink, "Verifying a Comprehensive Test Ban," *Arms Control Today* (November 1990), p. 21.

and Belarus would eliminate all their strategic nuclear delivery vehicles over the seven-year START implementation period. In the process, they would dismantle their warheads or give them to Russia and would become non-nuclear parties to the Nuclear Non-Proliferation Treaty.

Ukraine has not yet agreed to surrender all of its nuclear weapons, however--and, in the opinion of many officials and analysts, may decide never to do so.[7] To induce ratification by Ukraine, the West might give it more attention and increased economic aid, as well as engage its leaders in an ongoing diplomatic process to find ways of mitigating their fears of Russia. If their fears of Russia and concerns about being marginalized in international politics persist, Ukrainian ratification simply may not occur. In this case, the entire START process would be in serious jeopardy. If these republics do not become nuclear-free states, negotiations over dismantling and destroying warheads would have to take place between parties other than the United States and Russia, which would surely complicate the bargaining.

Politically Binding Measures as an Interim Step. Under Option II, neither country would actually attain the limits on warheads before the turn of the century. As an interim step, therefore, it might be acceptable to reach a politically binding agreement to dismantle or destroy warheads. The START treaty took this approach with regard to those sea-launched cruise missiles that carry nuclear warheads.

Such a politically binding accord, which would facilitate long-term planning, would not be a formal part of a START II treaty. But it might be appended to it as a protocol--a technique used with the ABM treaty.

In particular, to put Option II in place, a politically binding protocol might pledge the United States and Russia each to reduce its total nuclear inventory to some 4,000 warheads and never to exceed that level in the future. Such a step could be accompanied by an agreement to exchange detailed databases listing warhead types, locations, and numbers; they could be updated semiannually or annually to track the progress in consolidating excess warheads and dismantling them. The agreement might stipulate ceilings for given years--perhaps requiring reductions of 2,000 warheads per country per year, down to a target of 4,000 warheads or so by the early years of the next century.

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7. See R. Jeffrey Smith, "Officials See Shift in Ukraine's Nuclear Position," *The Washington Post*, December 19, 1992, p. A10.

Additional steps could be included as well--such as the suggestion of Senators Nunn and Lugar to remove quickly from deployment those warheads that will not be permitted by treaty (such as those on SS-18 missiles). The agreement could also require rapid consolidation of all excess warheads at secure sites in the United States and Russia. In addition, it could give priority to dismantling those excess warheads deemed most threatening (mostly ballistic missile warheads). It could also provide for monitoring reactors to ensure that they were not being used to produce fissile materials for weapons.

A politically binding agreement could entail experimenting with various cooperative monitoring techniques for dismantling warheads, storing fissile materials, and banning production of fissile materials.[8] Such steps might be achievable quickly. (Recent statements by some Russian officials suggest that they may be willing to negotiate controls on fissile materials.) They would also be consistent with the letter and spirit of the so-called Biden Condition to the START treaty, which endeavors to place firmer controls on nuclear materials and weapons in Russia.

This approach would follow the successful pattern the then-Soviet Union and the United States established under their bilateral chemical weapons agreement. With the accord, they worked out acceptable and effective monitoring arrangements in the years before their agreement on the multilateral Chemical Weapons Convention (recently concluded under United Nations auspices). In the START II context, such efforts might serve as test cases for negotiations to expand inspection rights in a renewed Nuclear Non-Proliferation Treaty--due for reconsideration by its many signatories in 1995.

More Binding Verification Might Follow. A politically binding agreement on dismantling warheads and destroying their non-nuclear components might eventually be supplanted by more formally binding provisions that include rigorous on-site monitoring. There are reasons for optimism about finding acceptable procedures for on-site monitoring of warhead inventories and dismantlement. The above-noted Chemical Weapons Convention (CWC), for example, constitutes an important breakthrough that should contain valuable precedents for other types of arms control verification as well. The CWC divides relevant sites into three categories and has separate monitoring

8. For ideas on this subject, see *Report on the Fourth International Workshop on Nuclear Warhead Elimination and Nonproliferation* (Washington, D.C.: Federation of American Scientists and Natural Resources Defense Council, 1992); Theodore B. Taylor, "Warhead Dismantlement and Fissile-Material Disposal," in Frank von Hippel and Roald Z. Sagdeev, eds., *Reversing the Arms Race* (New York: Gordon and Breach, 1990), pp. 91-115.

provisions for each.[9] So-called challenge inspections--short-notice visits to any site at which the inspecting party suspects illicit activity--will be permitted as one category of monitoring. But the inspected country will have an opportunity to control access in ways that balance its legitimate national security and commercial concerns with the needs of inspectors.

Such Approaches Could Mitigate Concerns Raised in START II Negotiations. Verified limits on warheads--assuming they can be achieved--might resolve some of the concerns that arose during negotiations over the START II treaty. Those negotiations were paralyzed for a number of weeks by Russia's desire to maintain its SS-19s as single-warhead missiles, as well as U.S. desires to minimize constraints on the operational status of its heavy bombers. In each case, one country's concerns centered largely around the possibility that the other could, with its excess inventory of nuclear warheads, expand its nuclear forces quickly.

Option II, by limiting U.S. and Russian warheads, would do much to mitigate these concerns. By placing limits--even if only "politically binding" at first--on numbers of warheads, it would close loopholes that permit the United States to keep a large but "uncounted" nuclear-capable bomber force and that permit Russia to retain excess warheads for its strategic missile forces.

Economic Assistance Might Facilitate Warhead Dismantlement. The United States might improve the prospects for establishing ceilings on warheads by offering to pay part of the costs Russia, Ukraine, Belarus, and Kazakhstan would incur in dismantling and destroying their warheads. Washington might continue the current policy of committing several hundred million dollars each year to these countries' disarmament efforts--and speed up spending money already appropriated. In this way, a small part of the savings yielded by further arms cuts would be used to address a pressing threat to U.S. security--the problem of excess nuclear warheads and other weapons of mass destruction in politically unstable former Soviet republics.

Indeed, because economic assistance to improve the security of former Soviet warheads may be so important to global security, it is included in both Options I and II--even though the former approach would not include verifiable dismantlement of excess warheads.

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9. See, for example, Michael Krepon, "Verifying the Chemical Weapons Convention," *Arms Control Today* (October 1992), pp. 19-24.

CHAPTER III

BUDGETARY SAVINGS

The two options analyzed in this paper could result in substantial budgetary savings. Potential savings are estimated here for an average year between 1994 and 2010, a period long enough to reflect the full effects of changes under the options. Savings in budget authority are also estimated for each year between 1994 and 1997.

AVERAGE ANNUAL SAVINGS OF $4 BILLION TO $7 BILLION WOULD OCCUR IN 1994-2010

Relative to the Bush Administration's assumed plan--based on its budget that was submitted in January 1992, with the modifications described previously--Option I would save an average of more than $4 billion a year in the 1994-2010 time period. Option II would save more than $7 billion annually. (All costs in this paper are expressed in terms of constant 1993 dollars of budget authority.) These numbers are shown in Table 2; additional detail is found in Table A-4 in Appendix A.

The savings occur because of reductions in four main categories of costs. Under Option I, savings are realized through reductions in the Department of Defense's offensive forces (nearly $2 billion a year); DoD's Strategic Defense Initiative program (about $900 million annually); the Department of Energy's activities to develop, produce, and maintain offensive nuclear warheads (about $600 million a year); and the intelligence community's nuclear-related activities, net of increases in costs for monitoring, compliance, and safeguarding (about $1 billion a year). Under Option II, DoD's offensive force programs would yield additional annual savings, relative to Option I, of $1.4 billion a year; DoD's SDI program would yield another $700 million a year; and DOE's activities would be cut by another $700 million a year.

SAVINGS WOULD ADD TO SUBSTANTIAL REDUCTIONS ALREADY REALIZED

These annual savings would come on top of savings that are already expected as a result of recent arms agreements and changes in U.S. nuclear policy prompted by the end of the Cold War. The Congressional Budget Office

TABLE 2. U.S. AVERAGE ANNUAL COSTS AND SAVINGS UNDER CBO OPTIONS, 1994-2010
(In billions of 1993 dollars of budget authority)

	Cost of Bush Administration's Plan	Savings Under Proposed START II Options	
		Option I: Further Reductions	Option II: Warhead Dismantlement
All Nuclear-Related Activities Except Missile Defenses			
Offensive forces[a]	9.8	1.9	3.3
Nuclear warheads	12.3	0.6	1.3
Nuclear C^3I	12.7	1.0	1.0
Air defenses[b]	2.0	0	0
Subtotal	36.8	3.5	5.6
Strategic Defense Initiative			
Theater defenses	0.9	0	0
Strategic missile defenses[c]	4.0	0.9	1.6
Subtotal	4.9	0.9	1.6
Total	41.7	4.4	7.2

SOURCE: Congressional Budget Office.

NOTES: The Bush Administration's plan is based on January 1992 budget documents, but updated by CBO to reflect the START II treaty.

C^3I = command, control, communications, and intelligence.

a. Includes funding for strategic tankers and basic research and development, but excludes some funding in the DoD budget for unspecified functions.

b. The Pentagon's recently concluded roles and missions study would eliminate or sharply reduce dedicated air defense squadrons, but such changes are not yet official policy and thus are not incorporated.

c. Average annual costs reflect long-term funding requirements.

estimates that, compared with plans for nuclear forces submitted in 1990, the Bush Administration's current plan--which is assumed to reflect the START II treaty--would save an average of about $16 billion a year over the next decade and a half.[1]

Of that $16 billion, about $7 billion resulted from revisions included in the first post-Cold War defense plan, submitted in February 1991. That budget--based partly on the belief that the first START treaty would soon be concluded--reduced intended purchases of B-2 bombers, Trident submarines, MX test missiles, and other systems. It also changed the SDI program. Another $7 billion or so in savings was codified in the plan submitted in January 1992. That plan made further and drastic reductions in purchases of B-2 bombers and canceled the small ICBM as well as short-range attack missile (the SRAM II and SRAM-T) programs.

Assuming it is ratified, START II could result in additional savings of $2 billion a year. About $100 million a year would be saved in DoD operations costs for the MX missile; another $300 million or so would come from the Air Force decision, apparently tied to the START II treaty, to retire 33 B-52G aircraft currently devoted to conventional missions and use B-52H aircraft for both nuclear and conventional roles in the future.[2] The rest of the savings--some $1.5 billion a year--would result from assumed restructuring in Department of Energy facilities and operations.

MUCH OF THE SAVINGS COULD BE REALIZED QUICKLY

The options considered in this paper could begin producing savings quickly. Under Option I, savings of about $3.2 billion could be realized in fiscal year 1994, $4.4 billion in 1995, $5.3 billion the next fiscal year, and $6.1 billion by 1997 (see Table 3). Under Option II, annual savings would reach $7.0 billion in 1994, $7.9 billion in 1995, $7.8 billion in 1996, and $9.1 billion by 1997.

Substantial savings are realized quickly largely because of changes in missile defense programs (see Table 3). Under the options, programs to develop and deploy space-based sensors and interceptors are assumed to be curtailed or canceled starting in 1994. New budget authority for D5 missile procurement would cease after fiscal year 1995 for Option I, and immediately for Option II. Reductions in intelligence activities, and in DOE activities

1. Congressional Budget Office, *The START Treaty and Beyond* (October 1991), pp. 57-75.

2. Congressional Budget Office, "Memorandum for the Record on the Budgetary Impact of the Bush/Yeltsin Accord" (June 29, 1992).

associated with warheads, contribute less to immediate savings because these changes are assumed to be made in even increments over the next few years. They would reach their maximum values at the end of the decade.

The above estimates of possible savings are measured against the Bush Administration's plan submitted in January 1992, as modified to reflect changes following directly from START II. Savings would be somewhat different if calculated against other benchmarks.

Comparing Options I and II with the Bush Administration's last official budget of January 1992--which did not account for the START II treaty--savings in fiscal years 1994 and 1995 associated with the options would be

TABLE 3. ANNUAL SAVINGS UNDER CBO OPTIONS COMPARED WITH THE BUSH ADMINISTRATION'S PLAN, 1994-1997
(In billions of 1993 dollars of budget authority)

Cost Category	1994	1995	1996	1997
Option I: Further Reductions				
Offensive Forces	1.5	2.3	3.0	3.0
Nuclear Warheads	0.2	0.3	0.5	0.6
Nuclear C^3I	0.2	0.4	0.6	0.8
Missile Defenses	1.2	1.3	1.3	1.7
Total	3.2	4.4	5.3	6.1
Option II: Warhead Dismantlement				
Offensive Forces	4.1	4.5	4.4	4.8
Nuclear Warheads	0.2	0.5	0.7	0.8
Nuclear C^3I	0.2	0.4	0.6	0.8
Missile Defenses	2.5	2.5	2.1	2.8
Total	7.0	7.9	7.8	9.1

SOURCE: Congressional Budget Office.

NOTE: The Bush Administration's plan is based on January 1992 budget documents, but updated by CBO to reflect the START II treaty.

C^3I = command, control, communications, and intelligence.

several hundred million dollars a year greater than shown in Table 3. Over the 1994-2010 period, average savings would be almost $2 billion a year greater--totaling more than $6 billion for Option I and more than $9 billion for Option II. This difference is primarily the result of CBO's estimate of the difference in DOE costs before and after START II.

Comparing these options to the January 1993 plan submitted by then Secretary of Defense Dick Cheney, savings could be slightly smaller. In that plan, former Secretary Cheney anticipated terminating production of the D5 missile after fiscal year 1997. Under such a change in plans, savings over the 1994-1997 period would be essentially unaffected, but average annual savings over the entire time frame of the study could decline by up to half a billion dollars a year.

UNCERTAINTIES EXIST IN THE ESTIMATES

In each case, estimates of savings assume that the Departments of Defense and Energy could buy weapons at the prices they now anticipate. In other words, they presume no unanticipated cost growth. This assumption may be optimistic--particularly for Strategic Defense Initiative programs for defenses against ballistic missiles, where many technologies are new and most are still in research and development stages. Consequently, the annual costs of all three force postures--but especially the Bush Administration's plan, which includes several revolutionary technologies in its GPALS missile-defense program--ultimately could prove to be more expensive than estimated here, perhaps by as much as a couple billion dollars a year.[3] Under these circumstances, the relative savings that would be realized by Option I or II--as compared with the Bush Administration's plan--would be greater than estimated here.

The cost categories used here, though generally straightforward and clearly related to nuclear forces, are in several cases somewhat arbitrary. Costs for B-1 and B-2 bombers, refueling tankers, and continental air defenses are included in the nuclear category even though these systems have other uses as well. Conversely, most systems used to track Russian submarines, such as U.S. attack submarines, P-3 surveillance and antisubmarine warfare aircraft, SOSUS underwater listening arrays, and certain types of surface ships, are not included even though they often track Russian submarines whose principal mission is nuclear. Also, some "unspecified" costs in the DoD budget--often referred to as overhead costs--are not captured in their entirety under the

3. CBO, *The START Treaty and Beyond*, p. 75.

Bush plan or the options. Although one could make different assumptions, the framework used here is reasonable and has the advantage of simplicity.

CHAPTER IV

THE ALTERNATIVES AND U.S. NATIONAL SECURITY: DETERRENCE, DEFENSE, SAFETY, AND NONPROLIFERATION

Traditionally, nuclear weapons programs and policies were assessed primarily in the context of an ongoing U.S.-Soviet rivalry. In that multifaceted competition, nuclear weapons had a great deal of political and symbolic value in addition to their strictly military characteristics. At a time when the chief U.S. adversary possessed an extremist and imperialistic ideology, huge armies in Europe, and an ambitious policy of fomenting revolution in the developing countries, Washington was unsure of its ability to use conventional forces for deterrence and therefore tended to go the extra mile with its nuclear forces.

With the end of the Cold War, other criteria have received more attention. They include the role of nuclear deterrence vis-a-vis countries other than Russia; possible links between U.S. nuclear forces and the proliferation of nuclear weapons to other countries; and the peacetime safety and security of nuclear weapons. The adequacy of defenses against ballistic missile attacks also has become an important and contentious criterion.

OPTIONS PROVIDE STRONG DETERRENT

Are 10 nuclear warheads enough to deter attack if a country's truly vital interests are at stake? If not, are 100 needed, or 1,000, or even 10,000? How much do requirements increase if a country hopes to deter attack against not only its own territory, but also that of its allies and perhaps even that of neutral countries as well? Are nuclear weapons even relevant to the latter types of situations?

Clearly, no one can answer these questions definitively. The answer probably varies considerably from adversary to adversary and from one situation to another. Ultimately, however, the requirements of deterrence must somehow be assessed. In this regard, it may be helpful to consider measures such as the numerical balance of nuclear forces between the United States and other countries, the ability to survive another country's attack and retaliate, and perhaps even the ability to conduct a successful disarming preemptive strike against some other country's nuclear forces.

Numerical Balances Still Favor United States Under Options

Simple comparisons of strategic warhead inventories represent one way--albeit a crude one--of evaluating a country's deterrent. Under the Bush Administration's plan and both of the options, the U.S. inventory of strategic warheads is assumed to be limited by the provisions of the START II treaty. That treaty would guarantee the United States parity with Russia. Under the Bush plan and Option I, the total U.S. arsenal, including theater and surplus weapons, could amount to more than 8,000 warheads--more than 10 times the size of the arsenal of the United Kingdom, France, or China (see Table 4). Under Option II, U.S. superiority over smaller powers would be less overwhelming, yet still considerable. The United States would have a nuclear arsenal more than five times the size of those of the medium nuclear powers. Under both options, Washington would be assured of parity of strategic warheads with Russia.

Further reductions in U.S. nuclear capabilities may be acceptable in the post-Cold War era. During the Cold War, nuclear weapons programs were viewed through the prism of an intense bilateral competition and valued as much for their symbolic as their potential military effects. With that conflict over--and others of the same intense geopolitical and ideological nature unlikely to develop over the next few decades--nuclear force requirements are receiving a fundamental reexamination. The smaller force levels chosen by nuclear powers like France, the United Kingdom, China, and Israel--whose arsenals number in the hundreds of warheads--might correspond better to the real needs of deterrence.

That point is made forcefully by former officials such as McGeorge Bundy and Robert McNamara, who dealt with key Cold War crises in the Kennedy Administration and found the details of the superpower nuclear balance irrelevant to their thinking. In those and other cases, deterrence during the Cold War tended to succeed or fail as a function of more usable instruments of foreign policy--such as U.S. conventional force capabilities--as well as the clarity and credibility with which U.S. commitments and intentions were conveyed. The size and detailed characteristics of nuclear arsenals were rarely, if ever, relevant to such crises.[1]

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1. See, for example, Robert S. McNamara, *The Changing Nature of Global Security and Its Impact on South Asia* (Washington, D.C.: Washington Council on Non-Proliferation, 1992), pp. 14-16; McGeorge Bundy, *Danger and Survival* (New York: Vintage Books, 1988), pp. 584-591; Richard K. Betts, *Nuclear Blackmail and Nuclear Balance* (Washington, D.C.: The Brookings Institution, 1987); James A. Nathan, ed., *The Cuban Missile Crisis Revisited* (New York: St. Martin's Press, 1992); Robert Jervis, *The Illogic of American Nuclear Strategy* (Ithaca: Cornell University Press, 1984); Thomas C. Schelling, *Arms and Influence* (New Haven: Yale University Press, 1966).

TABLE 4. ESTIMATED NUCLEAR FORCES OF THE UNITED STATES AND OTHER COUNTRIES, 1992 AND 2000

Country	Year of Calculation	Submarine-Launched Ballistic Missile Warheads	Intercontinental Ballistic Missile Warheads	Bomber Warheads	Total Warheads
United Kingdom	1992	144	0	100	500
France	1992	384	18	100	500
China	1992	12	8	200	500
Russia (START II Treaty)[a]	2000	1,750	700	700	8,000
Russia--Option I	2000	1,750	700	700	8,000
Russia--Option II	2000	1,750	700	700	4,000
United States (Bush Administration's Plan)	2000	1,728	500	1,272	8,000
United States--Option I	2000	850	300	2,350	8,000
United States--Option II	2000	1,300	0	2,200	4,000

SOURCES: International Institute for Strategic Studies, *The Military Balance 1992-1993* (1992), pp. 231-236; Theodore B. Taylor, "Warhead Dismantlement and Fissile-Material Disposal," in Frank N. von Hippel and Roald Z. Sagdeev, *Reversing the Arms Race* (New York: Gordon and Breach, 1990), p. 93; Congressional Budget Office.

NOTES: Other countries may also have nuclear weapons, though none is a declared nuclear-weapon state. Israel has been reported to have as many as 200 warheads; India detonated a nuclear device in 1974; Pakistan was cut off from U.S. security assistance because it was, in the U.S. government's view, attempting to develop nuclear weapons; and South Africa may have been involved in a nuclear weapons program as well. Recent examples of countries that have attempted to develop nuclear weapons programs include Iraq and North Korea. Ukraine and other former Soviet republics besides Russia retain at least some nuclear weapons, though they are not expected to do so indefinitely. Iran has been reported of late to be pursuing nuclear technologies or nuclear devices as well.

a. Russia's forces might include some 25 submarines (6 Typhoon, 7 Delta IV, and 12 Delta III), 60 Bear aircraft, and 700 ICBMs, of which 600 could be SS-25s or SS-25 follow-ons. See Dunbar Lockwood, "Strategic Nuclear Forces Under START II," *Arms Control Today* (December 1992), p. 13.

Options Provide Less Capability for Preemptive Attack

The expression nuclear deterrence is sometimes used euphemistically as a surrogate for warfighting strategy--including those elements of strategy that could involve a preemptive attack by the United States on some other country. U.S. nuclear strategy included such ideas during the Cold War and may well continue to do so today.

The Bush Administration's plan would retain a number of programs that could be useful in a preemptive strike. The programs would enhance U.S. capability to attack "counterforce" targets--that is, nuclear-related military facilities such as silos that have been hardened to withstand nuclear attacks. Important programs in this regard are the large D5 missile test program (which contributes to missile accuracy), an expanded imaging satellite fleet, and DOE's ongoing capacity to develop new warheads such as "earth-penetrating" weapons that could attack super-hardened underground depots, silos, and command bunkers.

Through these efforts, the Bush Administration's plan would continue to improve U.S. capabilities for an attack against the nuclear forces--or against the network providing command, control, and communications--of Russia or some other country. When coupled with the planned GPALS missile defense system, these weapons might provide a potentially "war-winning" capability, at least against some smaller nuclear powers and in certain types of scenarios.

The two options analyzed in this paper would make several cuts in programs such as the D5 missile, imaging satellites, and efforts to develop nuclear warheads that could contribute to a successful preemptive strike--thereby reducing this capability somewhat. The reductions may be acceptable, however, because the chances that Washington actually would use nuclear weapons in a preemptive strike seem extraordinarily small, and certainly smaller than when huge Soviet armies threatened Western Europe. Indeed, these reductions might have desirable implications, if they reduce other countries' fears of a U.S. nuclear preemptive strike and thereby calm nerves in crises.

If Washington ever decided to attack the nuclear forces of a small nuclear power preemptively, moreover, it would probably use conventional weapons. As demonstrated forcefully during the 1991 Gulf War, precision-guided conventional munitions are increasingly accurate and effective--as well as being much less escalatory and far less destructive than nuclear weapons. If history and logic are good guides, U.S. decisionmakers probably would choose to rely on conventional forces, the deterrent effect of their offensive

retaliatory capability, and perhaps on some limited defense system. If not, they would have to accept the enormous political onus and moral quandaries associated with initiating a nuclear war and violating the taboo against nuclear weapons that has reigned for nearly 50 years.

Options Could Permit Retaliation Against Broad Target Set, but Possibly with Fewer Warheads than in Bush Plan

Central to virtually all theories of deterrence is the need to be able to withstand an opponent's attack and have enough warheads to retaliate against some set of targets in the adversary's country. Clearly, the premise on which such theories rest is that the threat of repraisal should deter the initial attack.

Estimates of the number of warheads that would survive an enemy attack depend on the size and characteristics of one's own arsenal and on those of the potential adversary. Survivability also depends on the amount of warning assumed to precede an enemy attack. The more warning, the more of one's own forces that could be dispersed and, hence, the greater the fraction of one's nuclear arsenal that could survive and be available for counterattack.

CBO estimated the number of warheads likely to survive an enemy attack under highly pessimistic assumptions: a well-coordinated, massive surprise attack by a remilitarized Russia. Under these worst-case assumptions, about 1,200 U.S. strategic warheads would survive under the Bush Administration's plan compared with about 300 warheads under Option I and 400 warheads under Option II (see Table A-5). By contrast, with the forces the United States might have deployed under the START treaty, at least 2,400 warheads would be capable of surviving a surprise attack.[2]

Under all three force postures, most of the survivable warheads would be those located on submarines that would be deployed at sea at the time of attack. Currently, two-thirds of the force is normally at sea, and it is assumed to remain so under the Bush Administration's plan, in contrast to one-third under Options I and II. Indeed, submarine-based warheads would be the only type that would survive a surprise attack under Option II. All land-based missiles would have been retired and--just as with Option I and the Bush Administration's plan--no bombers would be on alert.

The number of surviving warheads would be substantially higher under Options I and II--by as much as a factor of three or more--if U.S. forces were

2. Congressional Budget Office, *The START Treaty and Beyond* (October 1991), p. 86.

assumed to have significant warning of an attack. Under these circumstances, more submarines could be put to sea and a significant fraction of the bomber fleet--perhaps one-third at a time, a rate that could be maintained over a long period--could be put on runway alert with weapons aboard.[3] The percentage of U.S. forces available for retaliation after such an attack would not be significantly diminished, relative to the situation today. Surviving warheads also would be much larger in number if the enemy force were smaller--which would surely be the case if the United States were some day attacked by a regional power that had attained the ability to launch ballistic missiles or deliver weapons over intercontinental distances in some other way.

In the event of a technological breakthrough that made the U.S. ballistic-missile submarine fleet at least partially vulnerable even when deployed at sea, the number of surviving warheads could be smaller under Option II than under Option I. Were the United States to become apprised of this rather unlikely event, it could of course return some of its bombers to a constant alert status--assuming that a technological breakthrough had not made them vulnerable as well.

If the United States were, however, somehow unaware of a technological breakthrough and failed to make such an adjustment in its nuclear forces, the situation could be more serious. This development would be of greatest concern, of course, should breakthroughs in antisubmarine warfare (ASW) technology virtually make the oceans "transparent"--a possibility that is much less likely than a more modest improvement in ASW, but one that cannot be entirely ignored nevertheless.

What do these estimates of surviving warheads suggest about the capability to retaliate under the various approaches analyzed in this paper? The roughly 1,200 warheads that might survive under the Bush Administration's plan would provide the ability to attack a wide variety of enemy targets. Against Russia, for example, the United States could attack many remaining nuclear forces, military installations, and military industries, though on balance it could not attack nearly as many secondary facilities as it could today (see Table A-6 in Appendix A for more information on possible targets).

The power and accuracy of new systems such as the D5 missile system, coupled with substantial investment in intelligence assets under the Bush plan, would increase U.S. capability to conduct counterforce attacks. These

3. For a more complete analysis of nuclear exchanges, see CBO, *The START Treaty and Beyond*, pp. 77-99, 143-165.

capabilities would be particularly useful if the United States wanted to perform nuclear warfighting, which under some theories of deterrence could involve successive attacks and counterattacks of various types. To the extent that American policymakers still find such theories consistent with the tremendous risks associated with nuclear attack, they may continue to place a high premium on retaining war plans similar to those of the past. Even if all these programs were completely funded, however, the United States would find its prospects for a successful disarming strike against a country with a large nuclear arsenal and dispersed forces to be quite poor.[4]

Because they would contain fewer warheads capable of surviving a surprise enemy attack, the two options would provide less capability to carry out a variety of warfighting scenarios. Against Russia, for example, certain smaller airfields, military industries, and missile sites that could remain on U.S. nuclear war plans under the Bush Administration's plan would have to be removed from the target list. Because of reductions in intelligence funding, warhead development, and the D5 program, the options would also provide less capability to carry out counterforce attacks.

Fewer targets could be attacked under the two options than under the Bush Administration's plan, but the options would still provide the ability to survive an enemy attack and retaliate against a wide variety of valued facilities. Indeed, against Russia, key categories of military and industrial facilities--like major tactical airfields, Army divisional headquarters, depots and marshaling yards, key rail lines and bridges, and metals and petroleum production facilities--could still be attacked systematically and in a fairly comprehensive manner (see the small and medium target sets in Table A-6).

The two options would provide large nuclear arsenals, as measured by the total destructive power they contain and the numbers of casualties they could inflict. In fact, in one sense the options are not fundamentally different in retaliatory capability from the Bush plan. All three force postures--the Administration's plan and the options--could cause the deaths of hundreds of millions of people. All provide enough survivable nuclear warheads to be capable of destroying a wide range of military and industrial targets.

In addition, all would be highly capable as retaliatory forces even in the unlikely event of large-scale Russian cheating. As long as U.S. submarines remain invulnerable at sea, and bombers remain capable of returning to

4. CBO, *The START Treaty and Beyond*, pp. 77-99.

runway alert, even the addition of several thousand warheads to Russia's arsenal would not measurably change the survivability of U.S. forces.[5]

Still, one caveat deserves reiteration: under normal day-to-day conditions, no more than 10 percent of the warheads deployed in Options I and II would be able to survive a large surprise attack and retaliate. For the case of Option II in particular, which contains no ICBMs, the surprise attack against U.S. forces probably could be carried out with as few as several tens of warheads (U.S. bombers and submarines not on alert would be deployed at a small number of unprotected bases where they would be highly vulnerable to nuclear attack). According to some theories of deterrence, a potential aggressor might feel tempted to attack if 90 percent of U.S. nuclear forces were vulnerable. This concern must be put in perspective; it seems far-fetched to think that the remaining 5 percent to 10 percent of the U.S. arsenal--representing well over 1,000 times the destructive power contained in the Hiroshima and Nagasaki bombs--would not deter even the most extreme of leaders from attempting a cold-blooded nuclear bolt from the blue. But some people might argue that 90 percent vulnerability in U.S. nuclear forces is worrisomely high in percentage terms.

OPTIONS MAY CONTRIBUTE TO NUCLEAR NONPROLIFERATION

Many analysts now believe that deploying nuclear forces large and capable enough for effective deterrence has become much less pressing an issue than preventing radical countries from getting nuclear weapons. That countries with declared nuclear weapons are not currently showing radical foreign policy agendas buttresses this view. Generally, today's nuclear powers seem much more interested in achieving sustainable economic growth and in avoiding catastrophes like major war than in gaining new territory or power--perhaps because they already have shed their share of blood in the 20th century.

Ideological fervor has not, unfortunately, been equally dispelled in much of the Middle East, the Indian subcontinent, and localized parts of Europe and Asia. In most of these areas, colonial powers imposed political structures and borders, thereby leaving the potential for hot dispute after their departure. Under such circumstances, extreme behavior--even including the use of nuclear weapons if available--cannot be ruled out.

Few analysts would disagree with the importance of stemming the proliferation of nuclear weapons. But devising specific policies to serve that

5. CBO, *The START Treaty and Beyond*, pp. 111-115.

goal is difficult. Strict multilateral controls on the export of technologies needed to build nuclear weapons clearly are crucial--though it is challenging to forge consensus about such controls because of countries' competing economic incentives to export.

U.S. trade policy and general macroeconomic policy, as well as foreign aid programs aimed at promoting economic growth and democratic institutions around the world, are probably important in reducing the chances of all types of war, including nuclear war. But these programs have effect only over time.

Would further cuts in the size and modernization of U.S. nuclear forces, such as those envisioned in the options in this paper, also aid the nonproliferation cause? Some analysts would say no. Several officials of the Bush Administration have argued that countries tend to base their decisions about acquiring nuclear weapons much more on their specific security environments than on the nature of superpower nuclear programs. Whatever they say for diplomatic effect in international forums, these countries ultimately may care far more about their neighbors' foreign and military policies than about whether the United States is maintaining many thousands of warheads and testing new types in the distant deserts of the American Southwest.

Some analysts also argue that overwhelmingly large and highly modern forces, such as those that would be maintained under the Bush Administration's plan, may reinforce the nonproliferation cause. According to this logic, large forces can reassure U.S. allies who otherwise might be tempted to acquire their own nuclear weapons. They may also deter potential adversaries from acquiring nuclear weapons and becoming more aggressive in military affairs by reminding them that the United States remains active in the defense of its global interests and willing to play the role of global leader in security affairs.

Other analysts contend, however, that smaller forces and further arms control measures, such as those embodied in the options in this paper, would contribute more effectively to the nonproliferation cause. For Option II, the enormous destructive power contained in even 4,000 warheads may be just as capable of reassuring U.S. allies as that in the 8,000 or more warheads retained under the Bush Administration's plan--especially since nuclear weapons are probably less important in this regard than conventional military forces and diplomatic engagement. Smaller U.S. nuclear forces may also be seen by the international community as more consistent with the Nuclear Non-Proliferation Treaty (NPT). Then Acting Secretary of State Lawrence Eagleburger made this argument when he requested the U.S. Senate to ratify the START treaty in the fall of 1992.

Under both options, the impression that Washington was seeking to delegitimize nuclear weapons could be furthered if cuts in forces were combined with a U.S. pledge never to be the first to use nuclear weapons in a conflict. Such a pledge would be similar to the one just exchanged between Russia and China in the context of their bilateral relations.[6] It would amount to a generalization of a pledge made by the United States in 1978 never to direct a nuclear attack against any non-nuclear country unless that country undertook hostile actions in alliance with some nuclear power.

The two options analyzed in this paper also presume that the United States would cease nuclear testing after 1996 and become party to a comprehensive test ban (CTB) treaty, steps that could benefit nonproliferation efforts. They would move the United States toward fuller compliance with Article VI the Nuclear Non-Proliferation Treaty, as it is interpreted by many countries that are critical of U.S. nuclear policy. That multilateral treaty, in effect since 1970 but requiring extension in 1995, commits the world's nuclear weapons states--as their part of the bargain--to move toward a complete ban on nuclear testing and to work toward nuclear disarmament.

With the nuclear weapons states in what was viewed as better compliance, it might become easier to beef up inspection rights under the NPT to allow challenge inspections. Such inspections could, it is hoped, deter would-be Iraqs from believing they could develop nuclear weapons clandestinely, while being signatories to the NPT. Just as important, a CTB--if signed and respected by the fledgling nuclear powers--would also impede their efforts to develop sophisticated warheads such as fusion weapons and warheads that might be capable of intercontinental delivery by ballistic missile.

In addition, for those future occasions when the NPT or CTB might be ignored or violated, the success of the United States in mobilizing international pressure, trade sanctions, and possibly other measures against potential proliferators may well depend on its ability to retain a moral high ground on nuclear weapons policy. For example, to the extent that the U.N. Special Commission was able to destroy the bulk of the Iraqi nuclear weapons program after the conclusion of the Gulf War, it may have been because the U.N. Security Council--and the international community at large--saw a fundamental distinction between nuclear weapons in the hands of countries that treat them responsibly and nuclear weapons in the hands of a ruthless regime that recently had launched wars of aggression and employed weapons of mass destruction.

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6. See Sheryl WuDunn, "Russia and China in Military Deal," *The New York Times*, December 19, 1992, p. 6.

OPTION II IN PARTICULAR COULD ENHANCE WARHEAD SECURITY AND SAFETY

The physical security of existing nuclear weaponry might be improved considerably under Option II. The Bush Administration's plan for nuclear forces and the two options already incorporate an important step toward improved physical security: eliminating most theater nuclear weapons from overseas deployment, and consolidating them at central depots or destroying them. These measures were key elements of the fall 1991 unilateral pledges made first by President Bush and, subsequently, by then Soviet President Gorbachev. Already largely carried out, they represent significant accomplishments.

But problems remain. Most acutely, Russia continues to need help storing and safeguarding its excess warheads as they await destruction.

Option II would attempt to address this problem by mandating the dismantlement of surplus warheads, and by improving the ease with which warhead stocks could be monitored through database exchanges and cooperative inspections. Additional funding--financed with a part of the savings achieved by reducing the U.S. nuclear arsenal--would be made available to help Russia and other former republics destroy excess warheads, build secure facilities to store remaining warheads, and expand the scope of consultation with U.S. weapon scientists and security personnel.

OPTIONS WOULD FORGO CERTAIN POSSIBLE IMPROVEMENTS IN WARHEAD SAFETY

Nuclear warheads require respect even during daily operations. Accidental detonation of their high explosives or extended exposure to fire, though unlikely to produce a nuclear explosion, could result in dispersing particles of highly toxic plutonium. Thousands of casualties could result from such an accident if it occurred near a populated area.

Under the Bush Administration's plans for the Department of Energy, ongoing research, development, and testing work could be used to develop and test new warheads less prone to accident. By assuming that a comprehensive test ban treaty is completed in 1996 or so, the two options would effectively preclude developing and producing these new warheads.

Although significant, this concern needs to be put in perspective. Today's nuclear arsenal is already safer on a warhead-by-warhead basis than those of

past decades. It is becoming smaller, more modern, and even safer as the Bush-Yeltsin framework leads to retirement of many older warheads. It would be smaller still under the options in this paper. In addition, some testing would be allowed from 1993 to 1996, permitting certain safety improvements to be incorporated.

Moreover, the chances of nuclear accidents have already been reduced through improved operational procedures and may be reduced further in this way in the future. A careful calculation of costs and benefits, which could be made only with access to classified information, might well show that spending billions of dollars of public funds to mitigate this particular risk would be less effective a means of enhancing public health than using the same funds in some other endeavor unrelated to defense.

OPTIONS WOULD PROVIDE NATIONWIDE MISSILE DEFENSES

The Bush Administration's planned system of missile defenses, dubbed the Global Protection Against Limited Strikes, is reportedly designed to protect the entire nation against attacks by up to some 200 incoming warheads--the number that might be carried, for example, by a fully loaded Russian Typhoon submarine and that might be launched by several rogue officers working together. Against smaller attacks, the multilayered GPALS system would have the benefit of redundancy: it would be able to attack a single incoming weapon at two different parts of the weapon's trajectory. In this way, it would increase the chances of successful interception in an operation in which a single defensive failure would allow far too much damage to be considered acceptable.

Advocates of GPALS also argue that it is not large enough to call into doubt the viability of Russia's deterrent force: Russian offensive forces still could have a reasonable chance of surviving a U.S. attack and penetrating U.S. defenses. Russian fears, one might contend, eventually could be dispelled by forceful and persistent negotiation tactics, together with a U.S.-Russian relationship that continued to evolve in positive directions.

Nonetheless, missile defenses under the two options in this paper would be more modest than GPALS. Like the Bush Administration's plan, both the options would move gradually toward deployment of six defensive sites, sufficient to provide nationwide coverage. Under both options, however, each defensive site would have only 50 ground-based interceptors, compared with 125 interceptors under the Bush Administration's plan, and no deployed interceptors in space. Such a smaller number of interceptors might only be

sufficient to defend against an attack of some 50 to 75 incoming warheads. This system would also forgo some of the redundancy associated with GPALS. Under Option II in particular, which forgoes all research on space-based sensors and interceptors, there would be no attempt to develop any of the added insurance that might come with space-based systems.

Although more limited in capability than GPALS, the system of defenses deployed under the options may be more consistent with the sorts of attack that could be expected from a regional power that someday acquired ballistic missiles and nuclear warheads that could be deployed on them. Given the types of offensive arms control posited under START II, these smaller ground-based defenses might also be sufficiently capable against an attack launched by rogue Russian officers on a ballistic missile submarine or in an ICBM missile field.[7] The system would also rely on the more mature and reliable technologies associated with ground-based systems, reducing technical and budgetary risk.

Because of its smaller capacity, the defensive system under the options would also be less likely to jeopardize negotiations on offensive forces. The system would still be at odds with existing U.S. treaty commitments under the 1972 Anti-Ballistic Missile Treaty, which limits U.S. and Russian defensive systems each to a single site containing no more than 100 interceptors. But it would be considerably less apt to look like the beginnings of a robust nationwide defense than would GPALS. Relatively unsophisticated Soviet defenses caused the United States great concern during the latter years of the Cold War. In this light, the U.S. program to develop missile defenses not surprisingly continues to cause great angst among many Russians. In the process, it complicates the prospects for arms control on offensive nuclear weapon systems.[8]

Indeed, the Bush Administration's proposed GPALS could cause the Russians to shy away from substantial additional reductions in their offensive warheads. One potential source of friction: the alleged maximum capability of GPALS to intercept 200 incoming warheads is based on certain assumptions about the nature of a Russian attack. In reality, GPALS might be capable of intercepting several times as many warheads in the event of an uncoordinated Russian attack that might follow a U.S. first strike. Under such assumptions, Option II--which presupposes a bilateral treaty limiting inventories of warheads--might begin to look imprudently small to Russian

7. See CBO, *The START Treaty and Beyond*, pp. 167-171.

8. See, for example, Matthew Bunn, "The ABM Talks: The More Things Change...," *Arms Control Today* (September 1992), pp. 15-23.

planners. Thus, such critics might argue, the United States should deploy missile defense systems no more extensive than those of the type proposed under the two options in this paper, lest U.S.-Russian efforts to control offensive nuclear arms be put at risk.

CONCLUSIONS

The Bush Administration's outgoing plan for U.S. nuclear forces, including the arms control dimension of its plan featuring the recently signed START II treaty, is markedly different from the plan that existed at the beginning of that Administration. But it still proposes to maintain a substantial arsenal of nuclear warheads and a substantial system of defenses to deter or--if, heaven forbid, deterrence fails--to engage in a future nuclear war.

The two options presented in this paper would maintain fewer offensive systems--in one case dismantling or destroying those that are in excess of prescribed limits--and would maintain smaller systems of defenses. But these reduced capabilities may be acceptable in the post-Cold War era. Indeed, they may be desirable at a time when nuclear weapons proliferation may have become the single greatest threat to U.S. national security. If so, the U.S. defense budget could be reduced by an average of $4 billion to $7 billion a year over the next 15 years. Savings over the next two fiscal years could total $7.6 billion for Option I and $14.9 billion for Option II.

APPENDIXES

APPENDIX A

ADDITIONAL TABLES

TABLE A-1. STRATEGIC NUCLEAR DELIVERY VEHICLES AND ASSOCIATED PLATFORMS UNDER START II

	START	Bush Administration's Plan	Option I: Further Reductions	Option II: Warhead Dismantlement
Trident Submarines[a]	18	18	18	18
Deployable SLBMs	432	432	216	216
Deployable D5	432	432	120	120
ICBMs				
MX	50	0	0	0
Minuteman 3	500	500	300	0
Bombers				
B-2	20	20	20	20
B-1	96	96	96	96
B-52H	95	95	47	47
B-52G	33	0	0	0
Other				
ACM	450	450	450	450
SLCM	400[b]	400[b]	0	0
B-1, B-2 upgrades	yes	yes	yes	yes
Other, Related				
KC-135R	400	400	400	400
KC-135, other	150	150	150	0
Imaging satellites	8[c]	8[c]	4	4

SOURCE: Congressional Budget Office.

NOTES: SLBMs = submarine-launched ballistic missiles; ICBMs = intercontinental ballistic missiles; ACM = advanced cruise missile; SLCM = sea-launched cruise missile.

a. Operational tempo would be reduced from the current 67 percent alert rate to about 33 percent for Options I and II.

b. Some estimates are as high as 600.

c. Unofficial, unclassified estimate.

TABLE A-2. DEPARTMENT OF ENERGY WEAPONS PROGRAMS

	START (Fiscal year 1993 plan)	Bush Administration's Plan	Option I: Further Reductions	Option II: Warhead Dismantlement
Annual Tests	6	6	6 (3 years only)	6 (3 years only)
New Plutonium Processing and Pit Manufacturing Facility	yes	yes	yes	yes
Research, Development, and Testing	yes	yes	40 percent cut	40 percent cut
Accelerated Dismantlement	no	no	no	no
Potential for Rapid Increase in Arsenal	yes	yes	no	no
Production of Tritium	yes	yes	no	no
Annual Warhead Production Rate	500	250	250	125
Cleanup Cost	about $6 billion per year	about $6 billion per year	about $6 billion per year	about $6 billion per year

SOURCE: Congressional Budget Office.

TABLE A-3. NUMBERS OF STRATEGIC MISSILE DEFENSE SYSTEMS

	Bush Administration's Plan	Option I: Further Reductions	Option II: Warhead Dismantlement
Number of Ground-Based Sites	6	6	6
Radars	6	6	6
Interceptors	750	300	300
Space-Based Assets			
Sensors	40 to 60	40 to 60	0
Interceptors	1,000	0	0

SOURCES: Strategic Defense Initiative Organization; Congressional Budget Office.

TABLE A-4. REMAINING COSTS FOR SELECTED ACQUISITION AND MODIFICATION PROGRAMS (In billions of 1993 dollars)

Program	Bush Administration's Plan	Option I: Further Reductions	Option II: Warhead Dismantlement
B-2 Bomber	5.6	5.6	5.6
B-1 Bomber	2.1	2.1	2.1
D-5 Missile	12.8	2.2	0.0
C-4 Missile	2.2	7.9	8.1
Trident Backfit	3.0	0	0
Minuteman Modifications	8.2	4.9	0
ATARS Platforms	0.4	0.2	0.2
SDI			
Theater	15.7	15.7	15.7
Brilliant Pebbles	9.2	5.1	0
Brilliant Eyes	6.9	6.9	0
Limited defenses	23.7	22.1	22.1
Other follow-on systems	11.6	6.8	6.8
Research and support	11.3	6.5	6.5
Total, SDI	78.4	63.1	51.1

SOURCE: Congressional Budget Office.

NOTE: ATARS = Advanced Tactical Air Reconnaissance System; SDI = Strategic Defense Initiative.

TABLE A-5. SURVIVABLE U.S. NUCLEAR FORCES, ASSUMING RUSSIAN FIRST STRIKE AND NO U.S. ALERT

	Submarine-Launched Ballistic Missile Warheads	Intercontinental Ballistic Missile Warheads	Strategic Bomber Warheads	Total Warheads
U.S. Forces, START-Compliant, 2000	2,300	100	0	2,400
U.S. Forces, START II, 2000	1,200	a	0	1,200
U.S. Forces, Option I, 2000	300	a	0	300
U.S. Forces, Option II, 2000	400	0	0	400

SOURCE: Congressional Budget Office, *The START Treaty and Beyond* (October 1991).

NOTE: Numbers are rounded.

a. Less than 50.

TABLE A-6. ILLUSTRATIVE SETS OF TARGETS IN A LARGE MILITARY-INDUSTRIAL ECONOMY

Category	Targets in the 1991/1992 Single Integrated Operational Plan (SIOP)	Medium Set of Targets	Small Set of Targets
Nuclear Forces			
Silos, launch centers	1,500	0	0
Mobile missile launch points and garrisons	1,500	0	0
Bomber and submarine bases	30	0	0
Antiballistic missile radar systems and large phased-array radar systems	20	0	0
Surface-to-air missile system sites	500	0	0
Interceptor bases	150	0	0
Bomber dispersal bases	50	0	0
Interceptor dispersal bases	100	0	0
Theater nuclear weapons, depots	150	0	0
Command, Control, Communications, and Intelligence			
Major fixed sites	100	0	0
Major mobile sites	25	0	0
Alternative leadership sites	250	0	0
Other	1,625	0	0
Other Military Targets			
Major depots	200	150	75
Marshaling yards	50	40	25
Major tactical aircraft bases	150	150	25
Major bridges; rail and petroleum lines	100	100	25
Major headquarters	50	50	0
Small headquarters, depots, etc.	450	300	0
Industry			
Major military production centers	60	50	50
Other critical war industry	190	60	0
Major metals production centers	50	50	50
Major petroleum fields, refineries	50	50	50
Other	750	0	0
Total	8,000	1,000	300

SOURCES: U.S. Army memorandum provided to Congressional Budget Office; Congressional Budget Office, *The START Treaty and Beyond* (October 1991), pp. 14-15, 22-23; Frederick S. Nyland, "Exemplary Industrial Targets for Controlled Conflict," in Desmond Ball and Jeffrey Richelson, eds., *Strategic Nuclear Targeting* (Ithaca: Cornell University Press, 1986), p. 215.

NOTE: The figures for military forces are based on actual Russian assets; the figures for industry are inferred from data on U.S. assets.

APPENDIX B

DEPARTMENT OF ENERGY WEAPONS ACTIVITIES UNDER THE BUSH ADMINISTRATION'S PLAN AND THE OPTIONS

The Department of Energy has exclusive responsibility for designing, testing, building, and maintaining nuclear warheads. DOE's work includes research, development, and testing (RD&T), as well as production and maintenance, of nuclear materials and weapons.

The Bush Administration planned to continue a substantial program to clean up those existing DOE sites that have been contaminated over the decades with radioactivity.[1] This program would be unaffected under the two options in this paper; its cost would average $6 billion a year over the 1994-2010 period under all approaches.

DOE ACTIVITIES UNDER THE BUSH ADMINISTRATION'S PLAN

Although it decided to reduce operations at many Department of Energy facilities, the Bush Administration also formulated a plan for rebuilding part of the complex and keeping most of its sites involved in large-scale operations--including the development and production of new classes of warheads. It viewed these activities as necessary to maintain the high reliability of existing weapons, develop new warheads that might be safer than existing types, and possibly develop new warheads with characteristics suited to certain specialized missions. The Bush Administration also planned to retain the capability to rebuild the U.S. arsenal to Cold War levels relatively quickly should the international situation deteriorate.

Many DOE plans already appear to be based on the Bush-Yeltsin framework--now translated into the START II treaty--and an associated arsenal of some 8,000 nuclear warheads. But detailed budget plans that reflect these recent events are not yet available, and it is therefore possible that the Bush Administration's plan may not cut DOE funding as much as the Congressional Budget Office has estimated. In that case, the savings realized under either Option I or Option II--as measured relative to CBO's estimate of the Bush Administration plan--would of course be greater than shown in this paper.

1. More detail on DOE plans can be found in Department of Energy, *Nuclear Weapons Complex Reconfiguration Study* (January 1991).

Research, Development, and Testing

To the extent they can be culled from official documentation, the basic elements of the Bush Administration's plan for future research, development, and testing are as follows. The main nuclear laboratories--Los Alamos, Sandia, and Livermore--would continue to devote about 50 percent of their effort to DOE defense programs, with funding for these activities comparable with current levels. A merging of some functions of the labs would occur. But the general philosophy of having two independent nuclear weapons research and development centers--as well as an additional laboratory for non-nuclear functions associated with weapons--would remain a high priority.

The labs would be supported by the Nevada Test Site, a facility with an annual operating budget of some $400 million a year. Testing plans are complicated by the Energy and Water Development Appropriations Act for fiscal year 1993. This act calls for a nine-month moratorium on testing, followed by a three-year period in which up to five tests per year are allowable. The act apparently would allow an additional three reliability tests over that period, permitting a grand total of 18 tests by the end of fiscal year 1996. But these tests could be used only to improve the safety and reliability of existing warheads. Beyond 1996, no nuclear testing would be allowed, assuming that no other countries were to test.

The Bush Administration objected to the appropriations act, however, and voiced strong opposition to the moratorium. It probably would have pursued changes in this law in a second term of a Bush presidency. Thus, it is assumed that the Bush Administration's plan would maintain the test site's funding of $400 million a year--at a minimum, to keep the site on standby status ready to resume testing in case the appropriations act became inoperative. Under this approach, any warheads to be tested at Nevada would still be built chiefly at the labs, but some components would continue to come from the Y-12 facility in Oak Ridge, Tennessee, and the Savannah River Site near Aiken, South Carolina.

Production and Maintenance of Materials

Current DOE plans have not been completely captured in a single document because planning assumptions have been changing rapidly. Apparently, however, they anticipated only limited future work in producing nuclear materials. No diffusion plants or nuclear reactors would be run in order to produce the basic fissionable materials--uranium 235 and plutonium 239. Oak Ridge, Tennessee, would retain its responsibilities for the country's supply of

U-235 and nuclear materials containing lithium. Some other facility--probably at a remote location such as the Nevada Test Site, or perhaps Pantex in Texas--would become the home of a new plutonium storage, processing, and pit manufacturing center. Such a facility might entail capital costs of $1 billion and annual operating costs of $200 million.

The K-reactor at Savannah River would be kept on a standby status, at the cost of some $200 million a year, in case its capabilities to produce tritium and other special materials were deemed useful at some future date. (One of these other special materials is plutonium 238, used to power spacecraft on long voyages in deep space. Eventually, Pu-238 may be produced at Hanford's Fast Flux Test Facility in Washington State, but for the time being, it will be purchased from Russia.) The Savannah River site in South Carolina would also continue, for several more years, to extract plutonium from materials that contain a mixture of substances. Similar work might continue at the Rocky Flats Site in Colorado.

Eventually, the United States would have to resume production of tritium under this or any other nuclear force option. Because it decays with a half-life of 12.3 years, tritium--a key element in most types of warheads--must be periodically replenished. In practice, the tritium in a warhead is stored in a bulb-shaped removable reservoir that makes it possible to replenish a warhead's tritium supply without disassembling the entire warhead.

Today's tritium stocks are much larger than tomorrow's nuclear arsenal will require--meaning that a hiatus of over a decade in tritium production can be tolerated. The planned nuclear arsenal, of perhaps 8,000 warheads in all, could be maintained from existing tritium inventories until 2012, according to DOE. (In 2012, assuming that no tritium production had occurred at Savannah River's K-reactor in the ensuing years and that no tritium had been sold for commercial purposes, the country's inventory of tritium would be about one-third of what it is today.) A new type of nuclear reactor or particle accelerator might need to be operational and producing tritium by 2005--implying that construction of such a new production reactor might have to begin in the latter half of this decade.

Production and Maintenance of Warheads

In contrast to production and maintenance of materials, work on weapons production would continue at a healthy pace under the Bush Administration plan--though not right away. Weapons production and maintenance includes the production of plutonium "pits," lithium deuteride, and the non-nuclear

components of warheads such as high explosives, fuses, and electronic timing devices.

Plutonium pits are concentric shells that, when compressed by a precisely timed detonation of high explosives that surround them, reach critical mass. At that point, they undergo nuclear fission and produce a nuclear explosion. In a fission weapon, that is the extent of the explosion, with a yield typically equivalent to that produced by a few thousands of tons of TNT (also the yields of the Hiroshima and Nagasaki bombs). In the more common fusion weapon, the fission explosion then triggers a much more powerful thermonuclear explosion as hydrogen atoms--present in the form of lithium deuteride--fuse to form helium.

Under the Bush Administration's plan, Kansas City, Missouri, would probably become responsible for most non-nuclear components of warheads. (In the past, those activities have been conducted at the Kansas City, Rocky Flats, Mound, Pinellas, and Pantex sites.) But some specialized components, such as detonators, may be built at the national laboratories. In addition, high explosives may be produced at the Pantex site (located near Amarillo, Texas).

Pantex's main mission, however, would remain assembling nuclear warheads from their constituent parts and disassembling old warheads. During the 1990s, disassembly could constitute most or all of the work done at Pantex, as the United States reduces its total nuclear arsenal by more than 10,000 warheads. (It is not required to do this work by treaty, but rather by concerns about safety and efficiency.) Working at the rate of 1,500 to 2,000 warheads a year, Pantex could finish this task by the end of the decade--at which point Pantex would return to a more steady-state mode of assembling and disassembling an average of perhaps 250 warheads per year.

DOE ACTIVITIES UNDER OPTIONS I AND II

Both Options I and II would make large cuts in nuclear warhead research, development, and testing, consistent with the assumption that all nuclear testing would cease after 1996. Option II, under which the United States would maintain an inventory of 4,000 nuclear warheads compared with some 8,000 warheads under the Bush Administration's plan, would make additional changes in tritium production and the overall pace at which warheads would be maintained and built.

Research, Development, and Testing

Under the options in this paper, the United States would have a smaller nuclear arsenal and would reduce its testing. That could reasonably lead to a reduction in RD&T activities.

The reduction could be accomplished in many ways. One approach is to maintain roughly the current level of RD&T activity at either Los Alamos Laboratory or Livermore Laboratory, but not both. Whichever laboratory remained engaged in nuclear weapons work would run all weapons development and testing--though the testing would not involve large nuclear yields, since a comprehensive test ban would be in force.[2] The other laboratory could eliminate this part of its mission, entailing budget reductions of perhaps $400 million a year.

Such a decision would clearly eliminate the ability of the two labs to compete with each other in the traditional fashion. But, as a recent study by the General Accounting Office suggested, the change might be acceptable at a time when nuclear weapons technologies have become well understood, and when arms control treaties would be in place that would reduce the need for RD&T at the laboratories. Under this approach, the lab surrendering its nuclear functions might well remain at or near its current size. But if so, it would undertake work on civilian technologies that would be funded out of budgets other than those for DOE nuclear activities. With fewer types of warheads in the arsenal and a more leisurely approach to developing new warheads, Sandia Laboratories could scale back its warhead RD&T activities. The options assume that 20 percent of Sandia's nuclear-related work could be eliminated in this way, but that its other efforts--not duplicated elsewhere--would be retained.

As for testing, the options in this paper assume that U.S. nuclear testing ceases after 1996. That assumption is consistent with current law, which prohibits U.S. testing after 1996 unless other nations resume testing. A comprehensive test ban is assumed to be negotiated that would prevent the United States and other countries from testing.

A CTB would reduce costs at the Nevada Test Site only marginally, since hydronuclear testing probably would continue at Nevada (just as it might in other countries). Such testing consists of using a fully assembled weapon, identical in every respect to an actual warhead except that it would contain

2. Tom A. Zamora, "New Jobs for Old Labs?" *The Bulletin of the Atomic Scientists* (November 1992), pp. 18-19.

only a small concentration of fissile material within a larger mass of uranium 238 or some other nonfissile substance. Through careful measurement of events that follow the initiation of neutron generation in such a mock warhead, DOE can learn a great deal about the performance and reliability of an actual warhead in a manner that would generate only a very small nuclear yield--and thus be consistent with even the strictest type of comprehensive test ban. Savings arising from changes in RD&T, as well as other DOE activities, are shown in Table B-1.

Production and Maintenance of Materials

Under Option II, work intended to refit and test DOE's K-reactor at the Savannah River Site could be stopped and the reactor shut down. With only monitoring activities and security functions then required, funding for this reactor might decline from some $200 million a year to $25 million.

Work to refit the K-reactor could be halted. The reduced tritium requirement associated with scaling the arsenal down by several thousand more warheads would provide the United States a cushion of about 12 additional years.

In addition to halting work on the K-reactor, completing a new production reactor for tritium therefore could be deferred until the year 2025 or so. This delay would provide more time for new technologies to be developed before one has to be selected for the new reactor.

Production and Maintenance of Warheads

Under both of the options, the number of sites engaged in producing and maintaining warheads would probably be the same as under the Bush Administration's plan, which already envisions a good deal of consolidation. Under Option II, the activity at each site might be reduced by about 50 percent. But this would lead to only modest reductions in costs because of the large overhead expenses associated with safeguarding and securing a DOE facility. As under the Bush Administration's plan, a new facility would be built to process and store plutonium and to build plutonium pits for new warheads in the future.

Some special DOE activities might continue under Options I and II but are assumed to be funded elsewhere. Any production of special nuclear isotopes for medicine, for powering spacecraft, and so forth would be funded

under either nonweapons accounts within the Department of Energy or the budgets of the agencies in need of such materials.

TABLE B-1. DEPARTMENT OF ENERGY BUDGETS FOR DEFENSE ACTIVITIES (In billions of 1993 dollars)

	15-Year Averages		
	Bush Administration's Plan	Option I: Further Reductions	Option II: Warhead Dismantlement
Research, Development, and Testing	1.6	1.0	1.0
Weapons and Materials	2.8	2.8	2.6
Reconfiguration (Including tritium capability)	0.7	0.7	0.3
Other (Including verification and control technology)	0.4	0.4	0.4
Subtotal	5.5	4.9	4.3
Environmental Restoration and Waste Management	6.0	6.0	6.0
Naval Reactors	0.8	0.8	0.8
Total	12.3	11.7	11.1

SOURCE: Congressional Budget Office.