Progress in Nuclear Weapons Elimination

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Presented
at the

25th Pugwash Workshop on Nuclear Forces
"Problems in Achieving a Nuclear-Weapon-Free World"

25-27 October 1996

London

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SUMMARY

Since March 1970, the nuclear weapon parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) have been subject to the nuclear disarmament obligation contained in Article VI, which requires that "effective measures related to cessation of the arms race,"–such as the Comprehensive Test Ban Treaty (CTBT) and a "cutoff" of fissile material production for weapons–be pursued in good faith "at an early date." Good faith negotiations, not necessarily at an early date, are also required on "effective measures related to nuclear disarmament," which the NPT preamble further describes as "effective measures *in the direction of* nuclear disarmament," leading to "the elimination from national arsenals of nuclear weapons and their means of delivery *pursuant to* a treaty on general and complete disarmament under strict and effective international control."

Despite the failure of the nuclear weapon powers to achieve the cessation of the arms race at an early date, this race had indeed abated considerably by the time of the NPT's 25 year Review and Extension Conference in May 1995, with several arms reduction and arms race cessation measures already in place or pending. As a result the conference agreed to extend the NPT indefinitely, it also endorsed a "program of action" to achieve the "full realization and effective implementation of Article VI," including "the determined pursuit by the nuclear weapon-states of systematic and progressive efforts to reduce nuclear weapons globally, with the ultimate goals of eliminating those weapons, and by all States of general and complete disarmament under strict and effective international control."

While a recent advisory opinion of the World Court has ruled that "there exists an obligation to pursue in good faith and to bring to a conclusion negotiations leading to nuclear disarmament in all its aspects under strict and effective international control," the Court did *not* find that this obligation extends to eliminating nuclear weapons from national arsenals *before, or independently of,* a treaty on general and complete disarmament. In short, a legally binding obligation to eliminate nuclear weapons *per se*–without a host of crippling caveats and conditions–remains to be created.

The START I Treaty entered into force on 5 December 1994, and by the end of 2001, the treaty requires each side to have reduced its strategic nuclear forces to 1,600 deployed delivery vehicles having 6,000 "accountable warheads, of which 4,900 can be ballistic missile warheads. The START II Treaty, signed on 3 January 1993, requires that by 1 January 2003, each side shall have no more than 3,500 accountable warheads on its strategic nuclear delivery vehicles, of which 1,750 warheads may be deployed on multiple warhead submarine launched ballistic missiles (SLBMs), and the balance on single warhead ballistic missiles and/or bombers. "Heavy" intercontinental ballistic missiles (ICBMs) and MIRVed ICBMs are banned. "Reserve" stocks of strategic nuclear warheads, and nuclear weapons deliverable by shorter range systems, such as sea-launched cruise missiles and tactical aircraft, are not covered by the agreement.

While the United States Senate consented to ratification of START II on 26 January 1996, the Russian Duma has not, and a substantial body of opinion in Russia views the treaty as giving the United States a nuclear advantage with respect to deployed strategic warheads. The treaty is also regarded as too costly to implement on the agreed timetable because it requires the early retirement of Russian ICBMs before the end of their useful service life, and the production and deployment of an additional 500 single warhead ICBMs just to reach the 3,000 warhead level by 2003. To maintain parity with the U.S., additional resources will have to be dedicated for missile submarine and SLBM modernization, silo conversion, and improved C^3I systems.

This situation should provide incentives for the Russian security establishment to seek a nuclear deterrent relationship with the United Sates at a much lower, and more economically sustainable level of forces, and for the United States to relieve its own severe budgetary pressures by further reductions in the size and operating tempo of its nuclear forces. However, no serious discussions of further arms reductions have taken place under the Clinton-Yeltsin Administrations, despite the fact that a new framework agreement that addressed Russian concerns could pave the way for Russian ratification of START II, which the Clinton Administration regards as the irreducible condition for commencing START III negotiations.

Far from assuaging Russian concerns by agreeing in principle now to go beyond START II, the United States continues to modernize its strategic nuclear forces and to develop a "hedge option" for "reconstituting" them to back to their START I levels. By the end of 1996, Minuteman launch control centers will be upgraded with Rapid Execution and Combat Targeting (REACT) consoles, and missile guidance improvements will be implemented between 1998 and 2002. In fact, the number of operational U.S. strategic weapons has been increasing over the past two years with the addition of the sixteenth and seventeenth Trident ballistic missile submarines (SSBNs), and now stands at 8,100 warheads. This number could rise again in 1997 when the eighteenth and final SSBN joins the force, before dropping to fourteen if and when START II enters into force.

Retirement of four older SSBNs of the same class based on the Pacific coast has been delayed until close to the 2003 target date for full implementation of the START II reductions, costing taxpayers additional billions of dollars in operations and maintenance funding. The four SSBNs remaining in the Pacific fleet will be "backfit" with the Trident II missile between FY 2000 and 2005, and eventually two or three submarines will be shifted from the Atlantic fleet to balance the fourteen submarine fleet to be maintained under START II, and all missiles will be downloaded from eight to five warheads each. Two-thirds of U.S. SSBNs are still at sea at any given time–a patrol rate comparable to those at the height of the Cold War–and each submarine continues to have two crews. If the planned SLBM Strategic Retargeting System (SRS) achieves an operational capability, U.S. SSBNs will have the ability for rapid targeting and retargeting of Trident IIs to any spot on the globe.

In Russia, the first of six Typhoon class SSBNs entered Severodinsk shipyard for overhaul and missile conversion in 1991, and it is still there. The five other Typhoons likewise await modernization with the SS-N-26 SLBM, but the missile has not gone into production. In fact, no SSBNs or SLBMs are in production, but a second new SLBM for the Delta V SSBN, and a new class of SSBN to replace the Typhoon and Delta IV, are under development. The SS-25 single warhead ICBM is the only strategic weapon system still under production, and flight tests of a new variant (called Topol-M) planned for silo basing continued in 1995 and 1996.

While the public and media perception is that U.S. and Russian nuclear weapon stockpiles under START II will be reduced to no more than 3,500 warheads each by 2003, the truth is that both nation's are planning stockpiles that are three times this amount, on the order of 10,000-11,000 warheads.

Clinton Administration plans call for the retention of an additional 950 warheads for nonstrategic nuclear forces (SLCMs and gravity bombs), another 2,500 warheads as a "hedge stockpile" for "uploading" on existing strategic delivery systems, 700 spares for the active inventory, and another 2,500 intact warheads in an "inactive reserve" status (i.e. without tritium reservoirs and other limited life components) that could in theory be returned to service following a "surge" in the nuclear stockpile support base, but which will more likely be used as test items and spares. The balance of the roughly 22,000 warheads in the 1990 stockpile will be dismantled, but some 5,000 of the 12,000 plutonium intact pits recovered in the warhead disassembly process will be retained as a "strategic reserve." We estimate that this pit reserve amounts to about 15 tonnes (t) of plutonium, or roughly half the 32 t that will remain in intact weapons, for a total of 47 t to be retained for weapons use, out of a total stockpile of 85 t of weapon-grade plutonium. The U.S. government has declared that the balance of 38 tons of WGPu–almost half of it not in pit form–is surplus to military needs and may be permanently withdraw from the U.S. weapons stockpile.

While the CTBT was opened for signature in New York on 24 September 1996,– a major achievement–the Clinton Administration has purchased the assent of the U.S. nuclear weapons establishment to the treaty with a massive $4 billion per year "Stockpile Stewardship and Management Program." This program actually exceeds the $3.6 billion average annual expenditure for nuclear weapons research, development testing, production and stockpile surveillance during the Cold War. Whether this level of spending can be politically sustained for the entire decade promised by the President once the CTBT has entered into force is open to question. But so likewise is the ultimate entry-into-force of the treaty, which is impaled on a formula requiring ratification by India and other countries that may well withhold ratification for an extended period, if not indefinitely.

As best we can discern, by 2004, current Russian plans and programs call for the retention of a force comparable to the planned U.S. force. Of an estimated 21,700 Soviet nonstrategic and air defense nuclear weapons in 1991, under the Bush-Gorbachev and Bush-Yeltsin initiatives Russia has committed to eliminate 14,200. If one assumes the remaining balance of 7,500 nonstrategic warheads becomes obsolescent by 2003, and if one then adds to this number 3,000 INF missile warheads and 1,900 strategic warheads from Ukraine (required to be dismantled as a condition of their removal from Ukraine), then some 26,600 warheads were potentially available for disassembly beginning in 1991. Russian official statements suggest that on the order of 1,600 warheads were dismantled that year, leaving 25,000 warheads potentially available for dismantlement in 1992, out of a total stockpile estimated by Russian sources at 35,000 warheads in that year. Thus absent further agreements beyond START II, Russia has the *nominal potential* to retain as many as 10,000 intact strategic warheads (operational plus reserve) and another 10,500 former INF and nonstrategic warheads.

In reality, the bulk of the 7,500 remaining nonstrategic warheads will become obsolescent over the next seven years, and Russian sources indicate that most or all are likely to be dismantled. We assume that an active nonstrategic warhead inventory of 1,350 SLCM warheads and tactical bombs–comparable to the planned U.S. inventory–is retained, either partly or completely obtained from new production. Given Russia's defense budget crunch, even this estimate is probably on the high side. Likewise, some fraction or all of the 3,000 INF warheads could be retained in an inactive reserve status, but we will assume that Russia retains the same number of former INF warheads in an inactive reserve status as the United States, that is, one the order of 500 weapons. Even under an optimistic budget scenario, Russia is not likely to deploy more than about 2,800 operational strategic warheads under START II, leading to a larger inactive strategic reserve stockpile of some 5,000 weapons, and a smaller "hedge" stockpile of some 950 warheads for "uploading" on formerly MIRVed ICBMs. Assuming a spares allowance of 400 weapons (10 percent of the active inventory), then by our calculation Russia is likely to retain a total stockpile of around 11,000 weapons by the year 2004.

We estimate that Russian reactor production of WGPu since 1948 amounts to some 150-170 t, of which 115-130 t was actually fabricated into weapon components, with the balance in production scrap, solutions, residues, and losses to nuclear waste and the environment. An additional 30 tons of separated reactor grade plutonium is stored at Chelyabinsk-65. This estimate for Russian WGPu in pits is roughly double the 66 t of WGPu contained in U.S. weapon pits, and Russia's total separated plutonium inventory of close to 200 tons is roughly double that of the U.S. Given the agreement in principle between the two sides that U.S. and Russian plutonium disposition programs should proceed in parallel with the goal of reducing to equal levels of military plutonium, Russia will be required to dispose of its plutonium at a rate three times that of the United States to reach equal levels by a given date. For Russia to reduce its total separated plutonium inventory via the MOX option in VVER-1000 to 50 tons in ten years would require full-core loading of 15 VVER-1000 reactors–all seven VVER-1000 reactors in Russia and most of the 10 operating VVER-1000s in Ukraine.

As for the disposition of highly-enriched (>20% U-235) uranium from weapons, the U.S. DOE has announced that it produced 994 t for all purposes through 1992. In our estimates we assume that the U.S. had about 500 t of "oralloy" ("Oak Ridge Alloy" ~ 93.5% U-235), and about 230 t between 20% and 90%-enriched, in weapons or assigned for weapons use. Only about one-half of the 174 t of HEU that the United States has declared excess to its military requirements was ever in weapons or produced for weapons use. In other words, the U.S. is currently continuing to reserve on the order of 650 tons of HEU for potential military use, including an estimated 330 t in and for weapons and about 320 t of oralloy for the Navy, sufficient for a 100+ year reserve.

While the total production of Soviet/Russian HEU has never been officially disclosed, it is believed to be on the order of 1,200 t. Under a 1994 contract for U.S. purchases of HEU derived from Russian weapons, Russia agreed to sell the United States up to 500 t of HEU equivalent (in the form of LEU) at a rate of 10 t per year for the first five years, and 30 t per year for the next 15 years. Thus far, however, the U.S. Enrichment Corporation, executive agent for the U.S. side of the deal, has taken delivery of 6 t of HEU equivalent in 1995, and contracted for 12 t in 1996, and 18 t in 1997.

Finally, Russia and the United States have made almost no progress in negotiating formal agreements for nuclear stockpile data exchanges, reciprocal monitoring of warhead fissile material storage sites, and other cooperative measures to enhance confidence in reciprocal stockpile declarations. Russia has essentially cutoff bilateral talks on these issues, and it is unclear when they will be restored. The 10 May 1995 Joint Statement on Transparency and Irreversibility of the Process of Reducing Nuclear Weapons" remains essentially a dead letter.

Introduction: The Disarmament "Obligation" of the Nuclear Weapon Powers

Since entry into force of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) on 5 March 1970, the nuclear weapon powers nominally have been subject to the disarmament obligations imposed by Article VI of the treaty:

> Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures related to the cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.

However, as the preamble to the treaty makes clear, Article VI requires only that "effective measures relating to cessation," such as the Comprehensive Test Ban Treaty (CTBT) and fissile material "cutoff," be pursued "at an early date." Regarding the broader question of good faith negotiations on nuclear *disarmament*, the preamble speaks of the intention of the parties "to undertake effective measures *in the direction of* nuclear disarmament," and of their desire to –

> facilitate the cessation of the manufacture of nuclear weapons, the liquidation of all their existing stockpiles, and *the elimination from national arsenals of nuclear weapons and the means of their delivery pursuant to a treaty on general and complete disarmament under strict and effective international control.*

Thus as far as their legally binding NPT obligations are concerned, the nuclear weapon powers are obliged to negotiate in good faith on arms race cessation measures–such as the test ban and cutoff–at an early date. Subsequently nuclear disarmament, the elimination of nuclear weapons from national arsenals, may be postponed until there is a treaty on general and complete disarmament under strict and effective international control. In this respect, the NPT is a creature of its time, as it clearly conditions the complete elimination of nuclear weapons on the emergence of a comprehensive disarmament regime that would eliminate other weapons of mass destruction as well as significant offensive conventional capabilities. Thus the NPT appears tacitly to legitimize the notion that the nuclear weapon states are justified in retaining some level of nuclear armament as a general purpose deterrent to war until a treaty on "general and complete disarmament" can be achieved.

Despite the failure of the nuclear weapon powers to achieve the "cessation of the nuclear arms race at an early date," the nuclear arms race had indeed abated considerably by the treaty's 25 year Review and Extension Conference in May 1995. By that date, two nuclear arms reduction agreements (INF and START I) had entered into force, a third (START II) was awaiting ratification, and a CTBT was nearing completion in Geneva.

Under these hopeful circumstances, the Conference of the Parties adopted an indefinite and unconditional extension of the treaty.

But the Review and Extension Conference also recognized that the ultimate goals of the elimination of nuclear weapons and general and complete disarmament remained unfulfilled, and thus it adopted a set of "Principles and Objectives for Nuclear Nonproliferation and Disarmament" to guide "the full realization and effective implementation of the provisions of the Treaty." Under the heading "Nuclear disarmament," this document states:

> Nuclear disarmament is substantially facilitated by the easing of international tension and the strengthening of trust between States which have prevailed following the end of the cold war. The undertakings with regard to nuclear disarmament as set out in the Treaty on the Non-Proliferation of Nuclear Weapons should thus be fulfilled with determination. In this regard, *the nuclear-weapon States reaffirm their commitment, as stated in article VI, to pursue in good faith negotiations on effective measures relating to nuclear disarmament.*
>
> The achievement of the following measures is important in the full realization and effective implementation of Article VI, including the program of action as reflected below:
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> ....[c] The determined pursuit by the nuclear weapon-states of *systematic and progressive efforts to reduce nuclear weapons globally, with the ultimate goals of eliminating those weapons*, and by all States of general and complete disarmament under strict and effective international control.[1]

Finally, at the request of the UN General Assembly, the International Court of Justice in the Hague recently issued an Advisory Opinion on the legality of the Threat or Use of Nuclear Weapons that noted:

> ...in view of the current state of international law, and of the elements of fact at its disposal, the Court cannot conclude definitively whether the threat or use of nuclear weapons would be lawful or unlawful in an extreme circumstance of self-defence, in which the very survival of a state would be at stake.

But the Court did conclude, unanimously, that:

[1] Final Document, Part I, Organization and work of the Conference, 1995 Review and Extension Conference of the parties to the treaty on the Non-proliferation of Nuclear Weapons, NPT/CONF.1995/32 (Part I), New York, 1995.

> There exists an obligation to pursue in good faith and to bring to a conclusion negotiations leading to nuclear disarmament in all its aspects under strict and effective international control.[2]

In this paper we assess the progress made by the nuclear weapon states (NWS) toward the ultimate goal of a Nuclear Weapons Free World (NWFW) in the following areas:

- U.S. and Russian Strategic Arms Reductions
- Reduction in the Size of the Nuclear Weapon Stockpiles
- Comprehensive Test Ban Treaty
- Data Exchange, Transparency and Nuclear Stockpile Verification Measures
- Cut-Off in the Production of Nuclear Weapon Usable Nuclear Materials
- Disposition of Nuclear Weapon-Usable Fissile Materials
- Treaty on the Non-Proliferation of Nuclear Weapons

Strategic Arms Reductions

START I

Strategic Arms Reduction Talks (START) between the United States and the Soviet Union began on 29 June 1982 in Geneva. Nine years of negotiations culminated in Moscow on 31 July 1991, when Presidents George Bush and Mikhail Gorbachev signed the Treaty on the Reduction and Limitation of Strategic Arms (START I), with associated annexes, protocols and a Memorandum of Understanding. Following the breakup of the Soviet Union, the Lisbon Protocol of 23 May 1992 committed Belarus, Ukraine and Kazakhstan to eliminate the strategic nuclear weapons left on their territories. START I entered into force on 5 December 1994. Seven years after entry into force, the treaty requires each side to have reduced its strategic nuclear forces to 1,600 deployed delivery vehicles having 6,000 "accountable" warheads, of which 4,900 can be ballistic missile warheads.

In consenting to ratification of START, the Senate adopted eight conditions "which shall be binding on the President." Most concerned the transfer of arms control treaty obligations to the successor states of the USSR and their promised adherence to the NPT as non-weapons states. The eighth and last condition, however, is of particular interest for its relevance to the goal of systematically accounting for, and progressively eliminating, nuclear weapon stockpiles and stocks of weapon-usable fissile materials. Called the Biden Condition, after its principal sponsor, Delaware Senator Joseph Biden, the condition reads as follows:

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2 International Court of Justice, Communiqué, No.96/23, 8 July 1996, p. 2.

(8) NUCLEAR STOCKPILE WEAPONS ARRANGEMENT.—In as much as the prospect of a loss of control of nuclear weapons or fissile material in the former Soviet Union could pose a serious threat to the United States and to international peace and security, in connection with any further agreement reducing strategic offensive arms, the President shall seek an appropriate arrangement, including the use of reciprocal inspections, data exchanges, and other cooperative measures, to monitor–

(A) the numbers of nuclear stockpile weapons on the territory of the parties to this Treaty; and

(B) the location and [fissile material] inventory of facilities on the territory of the parties to this treaty capable of producing or processing significant quantities of fissile materials. [3]

In its report on the treaty, the Committee on Foreign Relations concluded its explanation of this condition as follows:

> All Administrations since the mid-1960's have appreciated and supported the importance of nuclear transparency and accountability as it applies to stocks of enriched uranium and plutonium held by non-weapon states, including other former adversaries-turned-allies such as Germany and Japan. Indeed, it is this basic principle of openness and accountability which underlies the entire international safeguards system, which virtually all observers agree needs to be supported and strengthened. The Condition seeks to begin the process of applying this universally supported general principle to the specific situations of Russia and the United States.
>
> Beyond the imperative of nonproliferation, there is the additional consideration of holding open the prospect of making verifiable deep nuclear weapon reductions that could be embraced by all nuclear weapon states in the future.[4]

START II

Presidents Bush and Yeltsin concluded a framework agreement for a START II treaty on 17 June 1992, negotiated a further seven months and signed START II on 3 January 1993. Beginning 1 January 2003, the treaty limits the warheads on each side's intercontinental strategic forces to 3,500 "accountable warheads, " of which 1,750 may be deployed on MIRVed Submarine Launched Ballistic Missiles (SLBMs), none may be deployed on heavy Intercontinental Ballistic Missiles (ICBMs), none may be deployed on

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[3] The START Treaty, Report of the Committee on Foreign Relations, United States Senate, Exec. Rept. 102-53, 102nd Cong., 2d Session, USGPO, Washington: 1992, p. 101.

[4] Ibid., p. 93. The Natural Resources Defense Council vigorously advocated the inclusion of this Condition in resolution of ratification adopted by the Committee.

MIRVed ICBMs, and the balance may be deployed on single warhead ballistic missiles and/or bombers.[5] Nuclear weapons deliverable by shorter range systems, such as sea-launched cruise missiles and combat aircraft, are not covered by the agreement.

On 26 January 1996 the U.S. Senate approved a resolution consenting to ratification of START II by a vote of 87 to 4. The resolution contained eight "conditions" which are binding upon the U.S. president, and 12 "declarations" which are non-binding expressions of the U.S. Senate's intent. None of the conditions or declarations amend the treaty or require any Russian action.[6]

However, four of the declarations, which express the "intent of the Senate" in providing its advice and consent to ratification of START II, are of considerable interest because they reflect some of the major political and military-strategic crosscurrents bearing on the prospects for achieving much deeper reductions and eventual elimination of nuclear arsenals.

Citing the Clinton-Yeltsin Joint Statement on the "Transparency and Irreversibility of the Process of Reducing Nuclear Weapons" agreed to in Moscow on 10 May 1995, the Senate reinforced the message of the Biden Condition by declaring that "both parties to the START II Treaty should attach high priority to –

(A) the exchange of detailed information on aggregate stockpiles of nuclear warheads, on stocks of fissile materials, and on their safety and security;

(B) the maintenance at distinct and secure storage facilities, on a reciprocal basis, of fissile materials removed from nuclear warheads and declared to be excess to national security requirements for the purpose of confirming the irreversibility of the process of nuclear weapons reductions; and

(C) the adoption of other cooperative measures to enhance confidence in the reciprocal declarations on fissile material stockpiles.[7]

Under the heading "Substantial Further Reductions," the Resolution cited the U.S. obligation under Article VI of the NPT and called upon the President, "in anticipation of the ratification and entry into force of the START II Treaty . . . to seek further strategic offensive arms reductions to the extent consistent with United States

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5 START II Treaty, Report together with Additional Views, Committee on Foreign Relations, United States Senate, Exec. Report 104-10, 104th Cong., 1st Session, December 15, 1995, p. 10-11.

6 *Arms Control Today*, February 1996, p. 30.

7 Ibid., p. 32.

national security interests," and urged "the other nuclear weapon states to give careful and early consideration to corresponding reductions of their own nuclear arsenals."[8]

However, under the heading "Nature of Deterrence," the Senate also urged further actions to implement the 17 June 1992 Bush-Yeltsin Joint Statement on a Global Protection System, which, the declaration asserts:

> ...endorsed the cooperative development of a defensive system against ballistic missile attack and demonstrated the belief by the governments of the United States and the Russian Federation that strategic offensive reductions and certain defenses against ballistic missiles are stabilizing, compatible, and reinforcing.[9]

The declaration went on to express the sense of the Senate that "an offense-only form of deterrence cannot address by itself the emerging strategic environment," in which proliferators "having a fundamentally different calculus not amenable to deterrence" succeed in acquiring "missiles and weapons of mass destruction...for the express purpose of blackmail or terrorism."

However, lest there be any misapprehension that the United States is prepared to dispense with nuclear deterrence altogether, the conservative Senate majority supporting deployment of ballistic missile defenses added a lengthy declaration regarding "United States Commitments Ensuring the Safety, Reliability, and Performance of its Nuclear Forces":

> (A) The United States is committed to proceeding with a robust stockpile stewardship program, and to maintaining nuclear weapons production capabilities and capacities, that will ensure the safety, reliability, and performance of the Untied States nuclear arsenal at the START II levels and meet requirements for hedging against possible international developments or technical problems in conformance with United States policies and to underpin deterrence.
> (B) The United States is committed to reestablishing and maintaining sufficient levels of production to support requirements for the safety, reliability, and performance of United States nuclear weapons and demonstrate and sustain production capabilities and capacities.
> (C) The United States is committed to maintaining United States nuclear weapons laboratories and protecting the core nuclear weapons competencies therein.
> (D) As tritium is essential to the performance of modern nuclear weapons, but decays radioactively at a relatively rapid rate, and the United States

8 Ibid.

9 Ibid., p. 33.

now has no meaningful tritium production capacity, the United States is committed to ensuring rapid access to a new production source of tritium within the next decade.

(E) As warhead design flaws or aging problems may occur that a robust stockpile stewardship program cannot solve, the United States reserves the right, consistent with United States law, to resume underground nuclear testing if that is necessary to maintain confidence in the nuclear weapons stockpile. The United States is committed to maintaining the Nevada Test Site at a level in which the United States will be able to resume testing within one year following a national decision to do so.

(F) The United States reserves the right to invoke the supreme national interest of the United States to withdraw from any future arms control agreement to limit underground nuclear testing.[10]

These declarations reflect the competing and sometimes conflicting approaches – cooperative denuclearization, a shift to ballistic missile defenses, and a continued emphasis on nuclear deterrence – that now characterize the low-level and largely incoherent debate in the U.S. over the future role of nuclear weapons in U.S. and global security strategy.

START II has not been ratified by the State Duma (the parliament) of the Russian Federation. Russian arms control experts view START II as giving the United States a nuclear advantage with respect to deployed strategic warheads, and as being too costly to implement. To meet the current START II schedule, existing Russian forces, such as MIRVed ICBMs, will have to be dismantled, at considerable expense, some five years ahead of the end of their planned service life. Closing the "gap" between U.S. and Russian deployed strategic warheads resulting from elimination of these MIRVed missiles would require deployment of an additional 500 new single warhead ICBMs. To reach even the 3,000 warhead level by 2003, Russia would have to increase its deployment rate for single warhead missiles from 10-20 to 80-90 per year, which does not appear feasible from a budgetary perspective. Additional resources would also have to be allocated to new ICBM tests, conversion of silos, development and testing of a new SLBM, missile submarine modernization, and improved C^3I systems.

Moreover, during the past two years the issue of expanding NATO eastward to include such nations as Poland, Hungary, and the Czech Republic has served as an argument by Russian hard-liners for not ratifying START II and for retaining large stocks of non-strategic nuclear weapons to offset a conventional imbalance, a logic reminiscent of NATO's during the Cold War. The Russian military leadership sees nuclear weapons as preeminent in deterring both conventional and nuclear war.

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10 Ibid.

It is an open question whether START II will be ratified by the State Duma. While the reelection of President Yeltsin probably has improved the prospect, the question of his health leaves a confused situation.

START III Negotiations

Neither the United States nor Russia governments have shown any serious interest to date in going beyond START II to eliminate more nuclear weapons in a START III treaty. No serious discussions of further arms reductions have taken place during the Clinton Administration. The United States has announced that it will not commence negotiations of new strategic arms limitation talks until Russia has ratified START II.

Implementation of START I. Implementation of START by the five parties to the Treaty--the United States, Russia., Ukraine, Kazakhstan, and Belarus--is moving forward. The Treaty has been implemented in an orderly fashion since entering into force in December 1994. In fact, the United States had already decreased its operational strategic forces to START I levels before the treaty entered into force, while continuing several modernization programs. Modernization of Russian strategic forces proceeds at a very modest pace.

The START I Treaty requires exchanges of data, at periodic intervals, about the status of strategic forces of the five parties. Since entry into force of the treaty on 5 December 1994 there have been three updated memorandums of understanding (MOU) about the strategic forces. They have occurred at six month intervals--mid-1995, end-1995, and mid-1996. After 90 days have elapsed they are made public.

United States Strategic Arms Reductions. There have been increases in the number of operational strategic nuclear weapons over the last two years ago due to the addition of the sixteenth and seventeenth Trident submarines. There are now roughly 8,100 strategic nuclear warheads deployed with U.S. operational forces (Table 1). The number could rise in 1997 when the eighteenth and final submarine joins the force.

ICBMs. In 1995 the Air Force made the decision to consolidate the 500 Minuteman III ICBMs at three bases, from the current four. On 4 October 1995 the first of the Minuteman IIIs to be phased out at Grand Forks AFB, North Dakota began its transfer to Malmstrom AFB, Montana. The transfer will proceed at the rate of about one missile per week over three years. Thus the number of Minuteman III missiles is increasing at Malmstrom while it is decreasing at Grand Forks. The schedule is to complete the emplacement at Malmstrom by April 1998. At that time there will be 200 Minuteman IIIs at Malmstrom, and 150 each at Minot AFB, North Dakota and F.E. Warren AFB, Wyoming.

During 1995 work was completed in removing Minuteman IIs from their silos. On 18 May 1995 the last Minuteman II was removed from its silo at Whiteman AFB, Missouri. On 10 August 1995 the last Minuteman II was removed from its silo at Malmstrom AFB.

Work proceeded in blowing up silos in accordance with START. By the fall of 1997, approximately 150 will have been blown up. One silo at Ellsworth AFB, SD (Delta Nine) is proposed to be a museum, along with its launch control facility (Delta One), eleven miles away. On 28 October 1995 Secretary of Defense William Perry and Russian Defense Minister Pavel Grachev together pushed a button that blew up Silo M-6, three miles south of Centerview, Missouri, west of Whiteman AFB. Eventually the 150 Minuteman III silos at Grand Forks will be blown up.

To comply with the ban on MIRVs under START II, each of the 500 Minuteman III missiles will have the number of warheads reduced from three to one, if the treaty enters into force (Table 2). Currently 300 missiles have the higher yield W78 warhead and 200 have the W62 warhead. The most likely course of action would be to place one W87 warhead on each Minuteman III. Five hundred W87s will be removed from the 50 MX missiles when they are eliminated pursuant to START II. The W87 warhead has the preferred safety features, including insensitive high explosive (IHE), fire resistant pit (FRP), and enhanced nuclear detonation safety (ENDS), whereas the W78 only has ENDS. Other less likely options include using a single W78 or mixing W78s and W87s.

A $5.2 billion program is underway to extend the operational life of the Minuteman IIIs and improve their capability through the year 2020. There are three major parts to the program. First, launch control centers are being updated with Rapid Execution and Combat Targeting (REACT) consoles. The REACT program will be completed by the end of 1996. Second, improvements to the missile's guidance system will be implemented between 1998 and 2002. These measures eventually will increase the accuracy of the Minuteman III to near that of the current MX--a circular error probable (CEP) of 100 meters. The third part involves "repouring" the first and second stages, incorporating the latest solid propellant and bonding technologies. The third stage will either be refurbished or rebuilt.

SSBNs and SLBMs. One new Ohio-class submarine, the USS *Maine* (SSBN -741), the sixteenth of the class, joined the fleet on 29 July 1995. The USS *Wyoming* (SSBN-742) joined the fleet on 13 July 1996 and the USS *Louisiana* (SSBN-743) will be delivered in 1997, completing the nuclear powered ballistic missile submarine (SSBN) fleet.

This is in keeping with the conclusions of the 1994 Nuclear Posture Review. It decided to complete construction of 18 Ohio-class submarines, and to retire four older SSBNs of the same class based in the Pacific at Bangor, Washington. Which four of the eight is under review. The current plan is to retain the four submarines until close to the 2003 target date for full implementation of the START II force reductions.. If START II is implemented sooner, then the retirement dates could be advanced.

Another decision in the NPR was to purchase additional Trident II D-5 SLBMs for the four-Bangor based submarines that will remain. The increased Trident II program now calls for purchase of 462 missiles at a cost of $28.2 billion, or $61 million per missile. This is an increase of 45 missiles and $2.65 billion in costs from previous levels. In the FY 1996 Pentagon budget six missiles were purchased. The Bangor base will have to be adapted to support the Trident II. The backfitting of the four SSBNs will take place from FY 2000 to FY 2005. Eventually two or three submarines will be shifted from Kings Bay, Georgia to Bangor to balance the fourteen submarine fleet. To comply with START II SLBMs will be "downloaded" from eight to five warheads each.

A third decision in the NPR was to have more SSBNs patrolling on "modified-alert" status than "alert" status. Modified alert apparently means that a lower percentage of SSBNs at sea routinely patrol within range of potential targets and maintain continuous communications with command authorities. This is a very minor adjustment. The fact that two thirds of the SSBNs are still at sea at any given time--patrol rates equal to those at the height of the Cold War--remains unaltered, as does the practice of each SSBN having two crews. Reducing the patrol rate and going to one crew would constitute major changes. The Congressional Budget Office estimated that switching to single crews could save $300 million per year--or a total of $4.5 billion through the year 2010.

Like the ICBM force SLBM targeting and retargeting is being improved. The SLBM Strategic Retargeting System (SRS) operational requirement document was approved in 1995. When and if the SRS achieves an operational capability, ballistic missile submarines will have the ability to rapidly target and retarget Trident IIs to any spot on the globe.

Bombers. The first B-2 bomber was delivered to the 509th Bombardment Wing at Whiteman AFB, Missouri on 17 December 1993. The Enola Gay and Bock's Car, the B-29s that dropped the atomic bombs on Hiroshima and Nagasaki in August 1945, were part of the original 509th. The wing will have two squadrons, the 393rd and the 715th, each with eight planes. The first squadron, the 393rd, is scheduled to become operational in FY 1997. During 1994 four B-2s were delivered, and in 1995 three more were delivered. Those delivered in 1995 were, the "Spirit of Kansas" on 16 February, the "Spirit of Nebraska" on 26 June 1995, and the eighth B-2, the "Spirit of Georgia," on November 14. Five are planned to be delivered in 1996, one in 1997, and the 20th and last operational B-2 is scheduled to be delivered on 31 January 1998. In a change of plans all six (instead of five) of the six aircraft now in the test program will be modified to achieve an operational capability. The first of those is planned for delivery in 1998, two in 1999, and two in 2000.

The plane remains controversial. The General Accounting Office concluded in an August 1995 report that, "After 14 years of development and evolving mission requirements, including six years of flight testing, the Air Force has yet to demonstrate that the B-2 design will meet some of its most important mission requirements." How many bombers to buy, and how much they cost, continue to be contentious issue. A congressionally mandated study, done by a Pentagon think tank and provided to Congress on 3 May 1995, concluded that the planned force of 20 B-2s is sufficient to meet future contingencies, a finding in concert with the Air Force and Defense Department positions.[11]

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[11] SASC, DOD FY1996, Hearings, Part 7, p. 366.

According to an Air Force estimate the program acquisition costs for 20 operational aircraft, expressed in then-year dollars totals $44.389 billion, or $2.2 billion a piece. By comparison an average Boeing 747 costs about $155 million, and the new Boeing 777 costs about $130 million. By using other categories, such as "flyaway cost" or "procurement cost," which leave out significant expenses, such as $25 billion in development costs, unit costs for the B-2 can be made to seem half of what they really are.

Under START II the B-1B bombers will no longer be counted as nuclear weapon carriers. This transition to a conventional role is already occurring, though START II has not entered into force. By the end of 1997 the B-1 will be out of the SIOP mission altogether and oriented to conventional missions. However, under the "bomber hedge" option of the Nuclear Posture Review (NPR), sufficient nuclear weapons will be retained in a reserve status to reconvert the B-1Bs to a nuclear role. Currently B-1s are based at Ellsworth, AFB, South Dakota (36 planes), Dyess AFB, Texas (44 planes), and with the Air National Guard at McConnell AFB, Kansas (184th Bomb Group, 12 planes).

The NPR determined that 66 B-52Hs would be retained. Currently the B-52s are consolidated at two bases, with the 2nd Bomb Wing at Barksdale AFB, Louisiana, and the 5th Bomb Wing at Minot, ND. By the end of 1996, two wings of 28 aircraft each, plus 10 for spares and training, will constitute the B-52 force. Twenty eight other B-52s will be retired.

Russian Strategic Arms Reductions. With implementation of START I and the breakup of the Soviet Union, operational strategic nuclear forces in the three former Soviet republics have decreased markedly--over 325 ballistic missiles have been withdrawn from active service and over 3,400 strategic warheads that were deployed in Ukraine, Kazakhstan, and Belarus have been transferred to Russia. All warheads were removed from Kazakhstan by April 1995; and from Ukraine all strategic warheads—some 1,900—were removed between March 1994 and 1 June 1996 (and all non-strategic warheads—some 2,500—were removed by May 1992). Currently the only Russian nuclear warheads that are known to remain outside of Russia are those associated with a few mobile SS-25 ICBMs—a total of 18 as of 1 January 1996—in Belarus; and the SS-25 missiles are scheduled to be removed from Belarus by the end of 1996. The current array of Russian nuclear forces is shown in Tables 4 and 5.

Under START I counting rules, as of 1 January 1996, there were 1,497 operational strategic launchers and 6,681 warheads in Russia (Table 6). In reality, some of the systems are not operational, and the bombers are capable of carrying more warheads than are attributed to them under START counting rules. By our estimates Russia's operational strategic force as of 1 January 1996, consisted of about 1,253 launchers carrying about 6,685 warheads.

In Table 6, we also have projected how Russian operational strategic forces might look in 2003, the agreed date for full implementation of START II reductions. We have projected four scenarios, two that assume START II will not be ratified by the Russian State Duma, and two that assume that it will be ratified. With respect to each of these two assumptions we project force levels based on two budget scenarios: (a) a "High Budget," which assumes sufficient funds will be made available to provide for extending the service life of some existing systems; and (b) and a "Low Budget" that assumes a more rapid retirement of older systems. An interesting result of our projections is that the permitted START II force level of some 3,000-3,500 strategic warheads is not reached under either of these two budget scenarios. This situation should provide incentives for the Russian security establishment to seek a nuclear balance with the U.S. at a lower, and more economically sustainable, level of forces, and for the United States to cuts its own costs by further reductions in the size and operating tempo of its nuclear forces.

ICBMs. At full deployment there were 308 SS-18s in the Soviet Union, 104 in Kazakhstan (at Derzhavinsk and Zhangiz-Tobe) and 204 in Russia (30 at Aleysk, 64 at Dombarosvki, 46 at Kartaly, and 64 at Uzhur). By the end of 1995 all SS-18s in Kazakhstan, and 24 in Russia are assumed to be non-operational, leaving 180 operational SS-18s in Russia as of 1 January 1996. Six silos at Dombarosvki and 12 at Uzhur have been blown up. Under START I Russia is permitted to retain 154 SS-18s. If START II is fully implemented, all SS-18 missiles must be destroyed, but Russia may convert up to 90 SS-18 silos for deployment of single-warhead, non-heavy, SS-25 type ICBMs.

As of 1 January 1996 there were 167 deployed SS-19s in Russia. If START II is not ratified, we assume about 120 SS-19 will be retained with six warheads each. Under the START II limits, Russia could retain up to 105 SS-19 missiles "downloaded" to a single warhead. Some in Russia would like to increase this number. As part of an agreement with Ukraine announced in November 1995, 32 SS-19s will be returned to Russia. After transfer they will be used as spares and for parts to support the SS-19 force that will remain deployed in Russia, with the purpose of extending the service life of the weapon system. The other SS-19s, once deployed in Ukraine, are being withdrawn and put in storage.

Of the original 56 silo-based SS-24 M2s, 46 were in Ukraine at Pervomaysk, and 10 are in Russia at Tatishchevo. Only the 10 in Russia are considered operational. In addition, there are 36 rail-based SS-24 M1s--12 each at Bershet, Kostroma and Krasnoyarsk in Russia. If START II is ratified, these missiles must be converted to single warhead missiles or retired altogether.

SS-25s are deployed in Russia and Belarus. SS-25 deployment in Belarus peaked in December 1991 at 81 missiles at Lida and Mozyr. By the end of 1995 the number had decreased to 18, nine at each base.

The SS-25 is deployed in regiments of nine launchers, as was the SS-20. The SS-25 shares a nearly identical first-stage with the SS-20. Several of the bases (e.g., Kansk and Novosibirsk) were used for the SS-20. The missile can be fired from field deployment sites or through the sliding-roof garage it occupies at its base. The SS-25 has a throwweight of 1,000 kg slightly smaller than the U.S. Minuteman III at 1,150 kg.

The SS-25, which is assembled at Votkinsk in Russia, is the only strategic weapon system still under production and will likely be the mainstay of the ICBM force if and when START II is implemented. On 20 December 1994 the Russians first flight-tested a variant of the SS-25 (called "Topol-M"). Flight tests continued during 1995 and 1996. The Topol-M, unlike earlier models is being produced totally in Russia, under the direction of designer Boris Lagutin. Previously various components were made in Ukraine and other republics. The Topol-M was scheduled to be operational at the end of 1996, but that schedule has now apparently slipped. It is planned for silo-basing but could also supplement or replace the mobile force.

SSBNs and SLBMs. More than one-half of the SSBN fleet have been withdrawn from operational service since 1990. Table 4 and 6 assumes that the all Yankee Is, Delta Is, Delta IIs, and one Delta III have been withdrawn, leaving 26 SSBNs of three classes (13 Delta III, 7 Delta IV and 6 Typhoon). These SSBNs are based on the Kola Peninsula (Typhoons at Nerpichya, all Delta IVs and 4 Delta IIIs at Yagelnaya) and on the Kamchatka Peninsula (9 Delta IIIs at Rybachi, 15 km southwest of Petropavlovsk).

The first Typhoon submarine, which entered the Severodvinsk shipyard in 1991 for overhaul, is still there. Five others await overhaul and missile conversion, giving rise to rumors that the entire class may be retired in the next five to ten years. One of the Typhoons is used for training, after an accident in 1992. No SSBNs or SLBMs are presently in production. The slow process of upgrading the six Typhoon-class submarines with a new missile (the so-called SS-N-26 to replace the SS-N-20) continues. A second new SLBM, for the Delta V, a new class of SSBN that might replace the Typhoon and Delta IV, is also under development.

Strategic Bombers. For the strategic bomber force (*Dalnyaya Aviatsiya*-DA) and tactical aircraft--always lesser priorities to Soviet/Russian armed forces--maintenance and modernization has been cut drastically and in some cases deferred completely. This is, in part, the result of a shrinking budget, but the fighting in Chechnya consumed a large share of the Russian Federation Air Force's (RFAF) operating funds, leaving units without fuel, spare parts, or adequate bases.

The 19 Blackjacks at Priluki air base in Ukraine are poorly maintained and basically non-operational, as are the 25 Bear H bombers at Uzin air base. An agreement, announced on 24 November 1995, calls for Ukraine to eventually return all the Blackjack and Bear bombers, and more than 300 cruise missiles, to Russia. The precise timing of the transfer and the amount of money to be paid were not made public. Bear H and Blackjack production has been terminated. It is likely that most of the planes will be used for spare parts to support the bombers in Russia, with only a very few, if any at all, returning to service.

Bear H bombers are configured in two ways, those that carry 16 ALCMs and those that carry 6 ALCMs. According to the 1 June 1996 START I MOU the bombers are deployed as follows: Bear H16--19 at Mozdok, 16 at Ukrainka, and 21 at Uzin (Ukraine). Bear H6--2 at Mozdok, 26 at Ukrainka, and 4 at Uzin (Ukraine). In addition to the 19 Blackjacks at Priluki there are six at Engels AFB near Saratov in Russia.

Reduction in the Overall Size of Nuclear Weapon Stockpiles

There is a wide disparity in what has been publicly revealed about the history of the nuclear warhead stockpiles of the various weapon states. More is known about the history of the U.S. nuclear warhead stockpile relative than Russia's or those of other weapons states, due in part to the Openness Initiative of the U.S. Department of Energy (DOE). But even in the case of the United States, the Department of Defense (DOD) continues to insist that the inventory of currently stockpiled warheads remain classified.

The U. S. Nuclear Weapons Stockpile

The U.S. nuclear weapons stockpile peaked in 1967 at about 32,200 warheads (Table 3 and Figure 1). The estimated inventory of U.S. nuclear warheads, as of the end of FY 1990 (ending 31 September)—a year before to the breakup of the Soviet Union—was about 22,000 warheads (Table 3). Currently (end FY-1996), there are about 8,200 warheads in DOD's operational (deployed) stockpile and another 2,200 spare and reserve warheads[12] (Table 1). The total DOD stockpile is estimated to be 10,400 warheads. In addition, there are an estimated 2,700 retired warheads in Air Force, Navy and DOE depots that are in a queue, awaiting their turn on the Pantex disassembly line (Table 3). In Table 1 in the reserve category, we have included 192 warheads for the 24 Trident II SLBMs that will be on the eighteenth and final Trident submarine, which is expected to enter the force in July 1997. Even now, the mindless momentum of the arms race continues, as the U.S. operational stockpile has actually *increased* over the past two year with the Navy's addition of a sixteenth and seventeenth Trident submarine, and it will increase again next summer with the addition of the eighteenth.

The number of U.S. nuclear warheads dismantled annually by the DOE is given in Table 3. The dismantlement goal for FY 1995 was 2,000 warheads, but only 1,393 were dismantled in that year, and an estimated 1,166 were dismantled in FY 1996. At the end of FY 1996 (30 September 1996) there was still a backlog of about 2,700 retired nuclear warheads awaiting dismantlement. Under current DOE plans, and assuming no further significant reductions in the stockpile, this backlog should be eliminated in the next three years, i.e., by the end of FY 1999. Currently, there are no further planned reductions in the stockpile beyond those warheads that will be removed for evaluation disassembly and disposal. Between FY 1997-2003, the DOE estimates that the number of warheads that will undergo evaluation disassembly and disposal will reduce from 73 to 42 annually, averaging

12 The "inactive reserve" is reportedly composed of intact warheads stored without the limited-life components, such as plutonium-238 batteries, neutron generators, and deuterium-tritium boost gas reservoirs.

51 warheads annually over this seven year period.[13] An average of 58 warheads annually are projected to undergo evaluation disassembly and reassembly during the same seven year period.

As of 30 April 1996 there were 8,874 pits in storage at Pantex,[14] so we estimate there will be about 9,360 in storage as of end-FY 1996. By the end of FY 1999 there will be about 12,000 pits in storage at Pantex. Between FY 1990 and FY 1996 (through 30 April), 77 pits were sent from Pantex to Los Alamos and Livermore National Laboratories. It is not known how many of these were refabricated into new warheads.

While the public perception is that the U.S. and Russian nuclear weapon stockpiles will be reduced to about 3,500 warheads by 2003 under START II, the truth is the Clinton Administration is planning a stockpile some three times this amount—approximately 10,000 warheads (Tables 2 and 3). In addition to the 3,500 operational strategic warheads in the U.S. arsenal in 2003, the Pentagon plans to retain another 950 warheads for non-strategic forces , i.e., the "strategic reserve" and presumably additional spares which we estimate will equal about 10 percent of the active inventory. The strategic reserve, originally created for use after a nuclear war with Russia, now is conceived as a force allowing the U.S. to resist potential coercion by such nations as China, North Korea, and Iran who might attempt to take advantage of the United States following a nuclear war. The reserve force could also be directed towards these or other countries irrespective of the Russian context, should the national command authorities so decide.

In addition, another 2,500 warheads are destined for what the Department of Defense calls the "hedge." When fully implemented in 2003, the hedge will be a contingency stockpile made up of warheads removed from active strategic forces pursuant to START II, but not dismantled. The purpose of retaining them intact is so that they can be, in Pentagon parlance, "uploaded" on existing strategic delivery systems, thereby "reconstituting" U.S. strategic forces at something close to the START I force levels.

Finally, the Pentagon plans to retain about 2,500 warheads in "inactive reserve." These warheads will be retained without maintaining the tritium inventory, and presumably without servicing other limited life components, such as batteries. DOD has argued that if START II is not ratified by Russia, it intends to retain these warheads in an active status, thus increasing the tritium requirements about 25 percent—equivalent to five years of tritium decay.

13 Tom Walton, Public Affairs Office, Albuquerque Field Office, DOE, to Robert S. Norris, May 9, 1996.

14 Ibid.

The Russian Nuclear Weapons Stockpile[15]

The size of the Russian nuclear weapon stockpile—past, present, and future—is still cloaked in secrecy. Even the best estimates are highly uncertain and conflicting. According to Ministry of Atomic Energy (Minatom) Minister Viktor Mikhailov, the Soviet nuclear weapons stockpile grew rather steadily until it peaked in 1986 at 45,000 warheads;[16] and then declined more than 20 percent to about 35,000 warheads by May 1993.[17] An official CIA estimate given in May 1992 placed the stockpile of the former Soviet Union at 30,000 nuclear weapons with an uncertainty of plus or minus 5,000.[18] The upper limit of the CIA estimate is consistent with the Minatom figures.

According to Russian sources, Russia had 21,700 air defense and tactical warheads in service in 1991 (Table 5). Soviet President Mikhail Gorbachev in October 1991 pledged to dismantle all atomic land mines by 1998, all nuclear artillery shells by 2000, half of the surface-to-air missile warheads by 1996, half the tactical naval warheads by 1995 (with the other half stored ashore), and half of the bombs for the non-strategic air force by 1996. According to a Russian official, as of mid-1996 this schedule is still being followed. Thus, the 1991 Gorbachev initiative called for the elimination of about 14,200 of these warheads (Table 5). Accounting for the 3,000 warheads already withdrawn as a result of the 1988 INF Treaty, brings the total withdrawn to about 17,200.

According to Minatom the stockpile was projected to decline to 40-50 percent of its mid-1992 level as a result of arms control initiatives agreed to through early-1992.[19] Assuming the mid-1992 stockpile was 35,000 warheads, this implies a planned reduction of 14,000 to 17,500 warheads, which is consistent with the estimated reduction of 17,200 warheads. The CIA, on the other hand, stated in May 1992 that:

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15 Thomas B. Cochran, Robert S. Norris and Oleg A. Bukharin, *Making the Russian Bomb: From Stalin to Yeltsin,* (Boulder, CO: Westview Press, 1995, pp. 31-32.

16 Private communication to authors concerning remarks by Viktor Mikhailov. The 45,000 figure was criticized as being too high by a senior official of the Twelfth Main Directorate of the Russian Ministry of Defense (MOD).

17 "According to Minister Viktor Mikhailov approximately 13,000 nuclear munitions have been dismantled in this time [the last eight to 10 years], 2,000 a year on average." Sergei Ovsiyenko, "Weapons-Grade Plutonium Stocks Dwindling," Rossiyskiye Vesti, 19 May 1993, p. 7. Viktor Mikhailov and Evgeni Mikerin, in remarks at the International Symposium on Conversion of Nuclear Warheads for Peaceful Purposes, Rome, Italy, 15-17 June 1992, stated that the stockpile had declined by 20 percent since it peaked in 1986, which implies that the stockpile was 36,000 in 1992. In an interview with Evgeni Panov, Moscow Rossiyskaya Gazeta, in Russian, 11 December 1992, p. 7 (translated in the Foreign Broadcast Information Service series, FBIS-SOV-92-239, 11 December 1992, p. 3), Mikhailov is quoted as having said, ". . . if destruction of nuclear weapons in our country is halted as a result of financial and technical difficulties, by the year 2000 the Americans will be scrapping their own weapons but we will be unable to. They will have 10,000 charges left, we will have 35,000." See also, Trip Report, Senate Armed Services Committee Delegation's Visit to Russia, Kazakhstan and Ukraine, 15-20 January 1992, p. 4. "According to officials of the Ministry and other informed sources, some 8-10 thousand warheads have been disassembled in Russia since 1985."

18 Lawrence K. Gershwin, National Intelligence Officer for Strategic Programs, Central Intelligence Agency, Hearings before the House Committee on Appropriations, DOD Appropriations for 1993, Part 5, 6 May 1992, p. 499.

19 Mikhailov and Mikerin, International Symposium, Rome, 15-17 June 1992.

> . . . the Russians have something on the order of 9,000 to 16,000 nuclear weapons slated for dismantling. They have not given us an official figure for how many weapons are slated for dismantling as a result of the Gorbachev-Yeltsin initiative. This is our estimate. We have a highly uncertain estimate of the size of their tactical nuclear weapon inventory. Their initiative included something on the order of 1,200 strategic [air defense] weapons; 5,000 to 12,000 tactical nuclear weapons, and our estimate of 2,700 weapons remaining from the INF treaty.[20]

The CIA's upper limit of 16,000 warheads slated for dismantlement in 1992 is reasonably consistent with our estimate of 17,200 warheads derived from Minatom and other Russian data.

We assume that 20,350 strategic air defense and tactical warheads will be retired from the operational stockpile by 2003-2004, because most of the remaining fractions of weapons in the stockpile under the Gorbachev initiative will become obsolete. Adding approximately 3,000 INF warheads already retired and 1,900 strategic warheads from Ukraine, gives some 25,250 warheads that were potentially available for disassembly beginning in 1991. These can all be disassembled by about 2004, assuming an average disassembly rate of 2,000 warheads per year. By our estimates this would leave Russia with a stockpile of about 11,000 warheads, at which point it would be comparable in size to the U.S. stockpile.

On 17 June 1992, Presidents Bush and Yeltsin announced that the U.S. and Russian strategic arsenals would each be reduced to 3,000-3,500 strategic warheads no later than 1 January 2003. This agreement was codified as START II. Depending on many decisions about the future composition of Russian forces, the Russian operational, or active, stockpile in the 2003-2004 period could be anywhere from 1,800 to 4,300 warheads (See Tables 6 and 7). Since, at the projected retirement rate of 2,000 warheads per year, it is estimated that the number of intact Russian warheads will be about 11,000 warheads in 2004, it is likely that Russia also will retain a reserve of several thousand intact warheads; and if START II is ratified, Russia surely will follow the U.S. lead and retain a "hedge" category of warheads to enable rapid uploading of SS-19 and SS-24 ICBMs. Our projection of likely candidates for the "hedge" and reserve warhead categories is presented in Table 7.

While we have assumed a disassembly rate of about 2,000 warheads per year, information about the pace and scope of Russian warhead dismantlement is very sketchy. In the United States the public is provided with a detailed accounting of the number and kinds of warheads that have been dismantled, but in Russia, secrecy about such matters is still the rule. Dismantlement work is performed at Sverdlovsk-45 at Nizhnaya Tura,

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20 Gershwin in HAC, DOD FY 1993, Part 5, p. 499.

Zlatoust-36 at Yuruzan, and the Avanguard facility at Arzamas-16. The combined dismantlement rate at these three facilities, according to statements made by Minister Mikhailov in 1992, was about 1,500 to 2,000 per year, or slightly higher than the average rate of dismantlement at Pantex in the United States during the past few years.

In sum, we believe the Russian nuclear stockpile, including retired but still intact warheads awaiting dismantlement, is about 27,000 warheads, and that warheads are being dismantled at a rate of about 2,000 per year. Should Russia continue at this dismantlement rate, the stockpile would reach about 11,000 warheads in about 2004—comparable in size to the currently planned U.S. stockpile level for the same period.

While we are projecting that the process of nuclear weapons disarmament will continue in Russia over the next eight years, the disarmament process could be halted or reversed as a consequence of political changes within Russia, or changes in Western policies toward Russia. In a recent article, Russian Minister of Atomic Energy, Viktor Mikhailov, and two senior colleagues from the Arzamas-16 weapons laboratory have raised the prospect of a radical reworking of Russia's nuclear arsenal to adapt to the changed circumstances of NATO's expansion eastward and the precipitous decline in Russia's capabilities to mount a credible conventional defense. According to Mikhailov, et al.:[21]

> Militarily, Russia's security can only be guaranteed by nuclear deterrence policies. Giving up nuclear arms would leave Russia with no effective military potential (especially in the event of Ukraine adopting a pro-Western orientation.) On the other hand, Europe is extremely vulnerable (as compared to the USA, let alone Russia) to the possibility of a nuclear strike. Therefore, as long as Russia possesses nuclear arms, no direct military action can be undertaken by NATO-integrated Europe against Russia.
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> ...
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> If Russia sees its interests ignored or NATO expansion proves spearheaded against Russia, it will have to take economic and military measures that should be prepared well in advance.
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> ...
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> In the military-technical field, Russia could strengthen its nuclear arms system: its strategic intercontinental missiles and those capable of reaching Europe. If the events take an unfavorable turn, Russia could restore its arsenal of missiles..., which were scrapped under the 1987 medium and shorter-range missiles elimination treaty, develop new-generation battlefield nuclear arms with relatively low capacity and reduced side effects on the environment and population located outside the

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21 Prof. Viktor Mikhailov, Igor Andryushin, and Alexander Chernyshov, "NATO's Expansion and Russia's Security," *Vek*, September 20, 1996.

hostilities area. It could manufacture 10,000 high-safety nuclear warheads with a yield (TNT equivalent) ranging from dozens to hundreds of tonnes, designed for theatre missiles, front-line aviation, and anti-aircraft complexes. Using such arms would not entail serious radiation consequences but this program would equip the armed forces much better than they are now. There should be no doubt that, in the event of any large-scale military attack on Russia involving conventional, let alone mass destruction arms, those arms will be resorted to. It should be borne in mind that the summary yield of such warheads does not exceed 1 megaton, which is much less than 0.1 per cent of the yield of strategic nuclear arsenals and is comparable to the full power of conventional arms.

According to our estimates, to implement this program, Russia would need 300 tonnes of weapon-grade uranium and 30 tonnes of weapon grade plutonium. These materials could be obtained from resources released in the nuclear arms dismantling process under the START-I and START-II treaties.

Nuclear arms modernization can be carried out within the framework of the Comprehensive Test Ban treaty, though this would require maximum mobilization of the Russian Atomic Energy Ministry capacities.

In the military-political field, Russia should not rush to ratify START-II can cut its strategic offensive arms, except for systems which have already exhausted their potential–until the political picture has taken shape.

Perhaps we should reserve for ourselves the right to withdraw from the CTBT if Russia finds that NATO expansion poses a real threat to its security. We may have to announce our withdrawal from the treaty on the elimination of medium- and shorter-range missiles and resume manufacture of these arms, if the threat becomes real.

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We should be aware that for all the pledges and declarations made by the West, in the near future Russia cannot afford to carry out nuclear disarmament, otherwise it may find itself defenseless after a possible turnaround in the West's policies.

Russia could make one move to change the perception of nuclear arms as arms of mass destruction, and the next step – to diminish the nuclear threat. These moves are: modernization of all adopted nuclear arms, creation of an additional yield level not exceeding several hundred tonnes of TNT equivalent. This lower yield level should be the routine state of nuclear warheads. If there were no such means, a nation may prove unable to retaliate for a strike from any point of the globe, its deterrence potential being illusory. If there arises a threat of a full-scale nuclear attack on Russia, its nuclear warheads must be upgraded to a higher yield level. Technically, this is feasible, and the Ministry of Atomic Energy is capable of solving this problem without additional nuclear tests and great expenses. Russia could make these moves even unilaterally.

United Kingdom : Reductions and Trends

Over the past six years British armed forces have given up all but two of their nuclear roles. By 1999 there will be only one British nuclear weapon system, the submarine launched ballistic missile.

British reductions came in the aftermath of the dissolution of the Soviet Union. Following the Bush-Gorbachev initiatives of 27 September and 5 October 1991, British Secretary of State Tom King said that, "we will no longer routinely carry nuclear weapons on our ships". On 15 June 1992 the Defence Minister announced that all nuclear weapons --- the WE177C -- had been removed from surface ships and aircraft, that this nuclear mission would be eliminated and that the "weapons previously earmarked for this role will be destroyed". The C version of the WE177 bomb was assigned to selected Royal Navy Sea Harrier FRS.1 aircraft and ASW helicopters and was thought to number about 25. It existed in both a free-fall and depth-bomb modification and had an estimated yield of approximately 10 kilotons (kt).

The Royal Air Force (RAF) has been progressively decreasing its stockpile of nuclear bombs over the past few years, and the number of aircraft squadrons with nuclear missions. Currently the RAF operates eight squadrons of dual-capable, strike/attack Tornado GR.1/1A. Each squadron has 12 aircraft. These include four squadrons at RAF Bruggen, Germany (Nos. 9, 14, 17, 31). The three strike/attack Tornado squadrons at RAF Laarbruch, Germany were disbanded between September 1991 and May 1992, and the base will be closed in 1999. Two squadrons previously at RAF Marham were redeployed to RAF Lossiemouth in 1994. They replaced the Buccaneer S2B in the maritime strike role. Tornado reconnaissance squadrons 2 and 13 are at RAF Marham. It is likely that less than a full complement of bombs is assigned to the Tornadoes that have maritime strike and reconnaissance roles.

The total number of WE177 nuclear gravity bombs produced was estimated to have been about 200, of which 175 were versions A and B. The 1992 White Paper stated that, "As part of the cut in NATO's stockpile we will also reduce the number of British free-fall nuclear bombs by more than half." A number of British nuclear bombs were returned to the UK from bases in Germany. The 1993 White Paper stated that the WE177, "is currently expected to remain in service until well into the next century," but the government announced in March 1994 that this meant until the year 2007. On 4 April 1995 the government announced that the remaining WE177s would now be withdrawn from service by the end of 1998. On 1 May 1996 Defence Secretary Michael Portillo announced that RAF Bruggen would close in 2002. The Tornadoes (four years after becoming non-nuclear) will be reassigned to bases in the UK.

Britain also ended its involvement in operating several tactical nuclear weapon systems. The U.S. nuclear weapons for certified British systems have been removed from Europe and returned to the United States, specifically for the 11 Nimrod ASW aircraft based at RAF St Magwan, Cornwall, UK, the 1 Army regiment with 12 Lance launchers and the 4 Army artillery regiments with 120 M109 howitzers in Germany. Squadron No. 42, the Nimrod maritime patrol squadron, disbanded in October 1992. The 50 Missile Regiment (Lance) and the 56 Special Weapons Battery Royal Artillery were disbanded in 1993.

Britain built and deployed four *Resolution*-class SSBNs, commonly called Polaris submarines after the missiles they carry. The first boat (HMS *Resolution*) went on patrol in mid-June 1968, the fourth (HMS *Revenge*) in September 1970. *Revenge* was retired on 25 May 1992. *Resolution* was retired in 1994 and *Renown* and *Repulse* were retired in 1996.

Construction, training, testing, and sea trials continue with the Vanguard-class SSBN system. Each Vanguard-class SSBN carries sixteen U.S. produced Trident II D-5 SLBM. The first submarine of the class, the HMS *Vanguard*, went on its first patrol in December 1994. The second submarine, *Victorious* entered service in December 1995. The third submarine, *Vigilant* was launched in October 1995 and will enter service in the summer or fall of 1998. The fourth and final boat of the class, *Vengeance* is under construction. Its estimated launch date is 1998 with service entry in late 2000 or early 2001. The current estimated cost of the program is $18.8 billion.

We estimate that the British stockpile as of the end of 1996 to be approximately 260 warheads of two types. The British stockpile peaked in the mid-1970's at some 350 warheads. We estimate that it will increase slightly to about 275 warheads of only one type at the turn of the century.

France: Reductions and Trends

On 22 and 23 February 1996 President Jacques Chirac announced several dramatic reforms for French armed forces for the period 1997 to 2002. The most significant will be the introduction of a professional armed forces and the phasing out of conscription over a six year period, ending in 2001. The size of the armed forces will decrease from almost 400,000 to 260,500.

The decisions in the nuclear area were a combination of the withdrawal of several obsolete systems with a commitment to modernize those that remain. Already many of the programs announced in the early 1980's to increase the size of the French stockpile had been canceled, modified, or scaled back for budgetary and geopolitical reasons. More recently, in May 1992 it was announced that the number of new *Triomphant*-class SSBN would be reduced from six to four. There was some speculation that President Chirac might not purchase the fourth boat, but he reaffirmed that he would and also stated that a new ballistic missile, the M51, would replace the M45 in the 2010-2015 time period.

The lead SSBN, *Le Triomphant* was rolled out from its construction shed in Cherbourg on 13 July 1993. It is scheduled to depart on its first patrol by the end of 1996 armed with the M45 SLBM and new TN 75 warheads. The second SSBN, *Le Téméraire* is under construction, and will not be ready until 1999. The schedule for the third, *Le Vigilant* has slipped and will not be ready until 2001. The service date for the fourth SSBN is approximately 2005. We estimate that eventually there will be 288 warheads for the fleet of four new *Triomphant*-class SSBNs, because only enough missiles and warheads will be purchased for three boats. This loading is the case today with five submarines in the fleet--only four sets of M4 SLBMs were procured.

After considering numerous plans to replace the silo-based S3D IRBM during President Mitterrand's tenure, President Chirac announced in February that the missile would be retired and there would be no replacement. On 16 September, all 18 missiles on the Plateau d'Albion were deactivated.

The number of Mirage 2000N aircraft committed to nuclear missions was scaled back in 1989 from 75 aircraft in five squadrons to 45 aircraft in three squadrons. On 11 September 1991, President Mitterrand announced that as of 1 September the AN 52 gravity bomb, once carried by Mirage IIIEs, Jaguar As and Super Etendards, had been withdrawn from service. From that point on France no longer had a nuclear gravity bomb. The Air-Sol-Moyenne-Portée (ASMP) supersonic missile was deployed in 1988 and today there are 45 ASMPs with two Mirage 2000N squadrons at Luxeuil and one at Istres. The number of nuclear-armed Super Etendard aircraft scheduled to carry the ASMP was also decreased due to budgetary constraints, from about 50-55 to 24 planes with 20 ASMPs allocated to them.

The Pluton short range ballistic missile was retired by the end of 1993. The longer range Hadès was to have replaced it. The original program called for 60 launchers and 120 missiles (and warheads). The program was reduced several times, eventually to 15 launchers and 30 missiles. The first regiment was activated at Suippes, in eastern France, on 1September 1991. Further introduction was impossible given geopolitical events and the Hadès was shelved. The missiles and warheads were stored intact allowing them to be reintroduced if need be. In a significant action President Chirac announced that the Hadès system would be dismantled and the regiment reassigned to other duties.

In July 1996, after thirty two years of service, the Mirage IVP relinquished it nuclear role and was retired. Five Mirage IVPs will be retained for reconnaissance missions at Istres. The other planes will be put into storage at Chateaudun.

The three squadrons of Mirage 2000N have now assumed the "strategic" role, in addition to their "pre-strategic" one. A fourth Mirage 2000N squadron at Nancy--now conventional--is scheduled to be replaced with Mirage 2000Ds. Those aircraft may be modified to carry the ASMP and distributed to the three 2000N squadrons at Luxeuil and Istres, along with the Mirage IVP's ASMP missiles. President Chirac also said that a longer-range ASMP (500 km vs. 300 km, sometimes called the "ASMP plus") will be developed for service entry in about a decade.

The Rafale is planned to be the multi-purpose Navy and Air Force fighter/bomber for the 21st century. Its roles include conventional ground attack, air defense, air superiority and nuclear delivery of the ASMP and/or ASMP+. The carrier-based Navy version will be introduced first with the air force Rafale D attaining a nuclear strike rôle in approximately 2005.

We estimate that the French stockpile as of the end of 1996 is approximately 450 warheads of three types. The historical peak of 538 was reached in 1991-92. We estimate that the future stockpile of 2005 will decrease slightly to around 400 of two types.

China: Trends

The Chinese have been very effective in keeping secret the details about the size and composition of their nuclear stockpile. Thus there remains uncertainty about the size of the nuclear bomber force, the number of ballistic missiles deployed, and whether or not there are "tactical" nuclear weapons. We estimate that the Chinese stockpile, as of the end of 1996, is approximately 400 warheads in two basic categories: some 250 "strategic" weapons structured in a "triad" of land-based missiles, bombers, and submarine-launched ballistic missiles; and about 150 "tactical" weapons — low yield bombs for tactical bombardment, artillery shells, atomic demolition munitions, and possibly short range missiles.

The mainstay of Chinese nuclear forces is the ballistic missile, which varies in range from 1,700 to 13,000 kilometers, with only a handful capable of hitting targets in North America. More advanced systems have long been under development with emphasis on improved accuracy and guidance, increased range, mobile launch platforms, solid fuel technology, and multiple warheads. It is logical to assume that the recent series of nuclear tests are aimed at providing warheads with improved yield-to-weight ratios for the next generation of ballistic missiles. The yield estimates of the 11 nuclear tests since 1990 suggests that one warhead may be in the 100 to 200 kt range and a larger one in the 600 to 700 kt range.

One feature of all Chinese weapon system programs is that it takes a long time for the missile, submarine or bomber to enter service. From initial research through development and testing to deployment can take a decade or two, by which time it is largely obsolete. It is important to keep China's military modernization in perspective. Is its purpose a routine upgrade or, as some would have it, evidence of aggressive designs in the region. As a close observer of China, David Shambaugh, has recently written, "It is important . . . not to confuse ambition with capability." "The PLA's current weapons inventory remains 10 to 20 years or more behind the state of the art in almost all categories, although some gaps are being closed."[22] While the size of China's military budget is difficult to calculate, many Western experts believe it is in the $28 to $36 billion range, seven to nine times smaller than the U.S. military budget.

The bomber force is antiquated, as it is based on Chinese produced versions of 1950s-vintage Soviet aircraft. The Hong-5, a redesign of the Soviet Il-28 Beagle, has been retired from air force service. The main bomber is the Hong-6, based on the Tu-16 Badger, which entered service with Soviet forces in 1955. Under a licensing agreement the Chinese began producing the H-6 in the 1960s. It was used to drop live weapons in two nuclear tests in 1965 and 1967.

For more than a decade China has been developing a new supersonic fighter-bomber, the Hong-7 (or FB-7) at the Xian Aircraft Company. According to a 1995 Rand study on China's Air Force, the FB-7 is for the Chinese navy and does not have air force participation.[23] The FB-7 will not be ready for deployment until the late 1990s and then only produced in very small numbers--not more than 20. It will not have a nuclear mission.

A quicker route for China to modernize its bomber force would be to adapt aircraft for a nuclear role that it has already purchased from abroad, or may purchase in the future. In the former category are 26 Soviet/Russian Su-27 Flankers that were delivered in 1992 at a cost of $1 billion. They are currently with the 3rd Air Division at Wuhu airfield, 250 kilometers west of Shanghai. Under a new agreement Russia intends to sell production rights to China to assemble and produce Su-27s in China. The Su-27 does have an air-to-ground capability though there is no evidence that the PLAAF is modifying it for a nuclear role. Many reports of purchases or licensed manufacturing of other types of Russian aircraft (e.g., MiG-31, Tu-22M, and Su-25) remain unsubstantiated.

With only one operational SSBN to date China has had a difficult time with developing and deploying this leg of its Triad. Technical difficulties with solid fuel for the missiles and nuclear reactors have slowed the program. The Julang-1 SLBM was China's first solid fueled ballistic missile. A second generation SLBM is also under development. It seems unlikely that a future fleet will number more than four to six submarines.

Information on Chinese tactical nuclear weapons is limited and contradictory, and there is no confirmation from official sources of their existence. China's initial interest in such weapons may have been spurred by worsening relations with the Soviet Union in the 1960s and 1970s. Several low yield nuclear tests in the late 1970s, and a large military exercise in June 1982 simulating the use of tactical nuclear weapons by both sides, suggests that they have been developed.

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22 David Shambaugh, "China's Military: Real or Paper Tiger?" *The Washington Quarterly*, Spring 1996, p. 24

23 Kenneth W. Allen, Glenn Krumeland, Jonathan D. Pollack, *China's Air Force Enters the 21st Century* (Santa Monica, CA: Rand, 1995).

Comprehensive Test Ban Treaty (CTBT)

Following two years of negotiations, in August 1996 the United Nations Conference on Disarmament (CD) in Geneva completed the text of a CTBT. Final approval by the 61 member CD was blocked by India, whose veto on 22 August 1996 prevented the consensus vote necessary for final adoption of the treaty by the CD. India cited its concerns that (1) nothing in the treaty obligated the nuclear weapon powers to eliminate their arsenals; (2) the treaty did not prohibit further refinement of these arsenals by non-nuclear explosive simulations and experiments; and (3) the Entry Into Force provisions (Article XIV) infringed upon its sovereignty by leaving open the possibility that India could be subjected to unilateral or multilateral sanctions in the event that it does not join the treaty.

Led by Australia, 120 cosponsoring countries successfully sought approval of the treaty text by the UN General Assembly. On 10 September 1996, by a vote of 158 to three with five abstentions, the UN General Assembly approved the treaty without amendment. Voting against the treaty were India, Libya and Bhutan, whose foreign policy India controls. The five abstentions were Cuba, Lebanon, Mauritius, Syria and Tanzania. The CTBT is now open for signature. President Clinton signed first on 24 September 1996.

The treaty will not enter into force unless signed and ratified by 44 specified countries—the five declared weapon states and 39 others members of the CD having power and research reactors—including Iran and North Korea and the three undeclared weapon states: India, Pakistan and Israel. Unless the entry into force provisions are modified within the next few years, this could be a very long while indeed. India has indicated it will not sign the treaty, which obviously creates uncertainties about Pakistan's long term adherence to the treaty even it elects to sign it in the short term (Pakistan voted for the General Assembly Resolution endorsing the CTBT).

Until the treaty formally enters into force, its parties cannot fully implement the treaty's International Monitoring System and on-site inspection provisions, increasing uncertainties about compliance that may erode confidence in the treaty.

Technically, a state that signs or votes for the adoption of a treaty is not bound by it until it ratifies the treaty. However the Vienna Convention provides that between the time of the signing and ratification, a state has a legal obligation not to act in a manner inconsistent with the treaty. For treaty ratification by the United States, much work will remain to be done in order to achieve the two-thirds approval of what is likely to remain a conservative U.S. Senate. While the Clinton Administration strongly supports the CTBT, under the National Defense Authorization Act for FY 1997 (H.R. 3230, Section 3163 (a)(6)), the United States is committed to maintaining the ability to resume underground nuclear testing at the Nevada Test site within one year of a national decision to do so.

The annual expenditures by the DOE and its predecessor agencies on nuclear warhead research, development, testing, production and surveillance activities are presented in Figure 2. On 11 August 1995, President Bill Clinton announced:

> I am assured by the Secretary of Energy and the Directors of our nuclear weapons labs that we can meet the challenge of maintaining our nuclear deterrent under a Comprehensive Test Ban Treaty through a Science-Based Stockpile Stewardship program without nuclear testing...
>
> In order for this program to succeed, both the Administration and the Congress must provide sustained bipartisan support for the stockpile stewardship program over the next decade and beyond. I am committed to working with the Congress to ensure this support.

What the President failed to mention was that in order to gain support for a CTBT from the Pentagon and the nuclear weapons laboratories, the Administration had secretly committed to spend $40 billion on the Science-Based Stockpile Stewardship and Management Program over the ensuing ten years. To place this rate of spending in prospective, it is noted that the planned rate of expenditure, some $4 billion annually in a period of no nuclear testing and no new warhead development or production, exceeds the $3.6 billion (in 1996 dollars) average annual expenditure for nuclear weapon design, testing, and production (and exclusive of nuclear material production) during the cold war period, 1948-1990 (see Figure 2).

In the FY 1997 National Defense Authorization Act (H.R. 3230, Section 3137), Congress prohibited DOE from working with China on "any activity associated with the conduct of cooperative programs relating to nuclear weapons or nuclear weapons technology, including stockpile stewardship, safety, and use control." The bill also requires DOE to report to Congress on past or planned "discussions or activities" with the China regarding nuclear weapons activities. This effectively halted a budding U.S.-China lab-to-lab cooperative transparency programs that was recently initiated by the three U.S. weapons laboratories and the Chinese Academy of Engineering Physics.

Data Exchange, Transparency and Verification Measures

On 10 May 1995 Presidents Clinton and Yeltsin issued a "Joint Statement on the Transparency and Irreversibility of the Process of Reducing Nuclear Weapons" (reproduced in Appendix A). This joint statement represents the fullest and most recent description of the intentions of the two countries with regard to warhead dismantlement and transparency. Among the key provisions of this joint statement, the U.S. and Russia agreed to establish:

- An exchange on a regular basis of detailed information on aggregate stockpiles of nuclear warheads, on stocks of fissile materials and on their safety and security;
- A cooperative arrangement for reciprocal monitoring at storage facilities of fissile materials removed from nuclear warheads and declared to be excess to national security requirements to help confirm the irreversibility of the process of reducing nuclear weapons, recognizing that progress in this area is linked to progress in implementing the joint U.S.-Russian program for the fissile material storage facility at Mayak: and
- Other cooperative measures, as necessary to enhance confidence in the reciprocal declarations on fissile material stockpiles.

With respect to transparency, the agreement also states that:

The United States of America and the Russian Federation will also examine and seek to define further measures to increase the transparency and irreversibility of the process of reducing nuclear weapons, including intergovernmental arrangements to extends cooperation to further phases of the process of eliminating nuclear weapons declared excess to national security requirements as a result of nuclear arms reduction.

The United States of America and the Russian Federation will seek to conclude in the shortest possible time an agreement for cooperation between their governments enabling the exchange of information as necessary to implement the arrangements called for above, by providing for the protection of that information. No information will be exchanged until the respective arrangements enter into force.

Unfortunately, there has been no progress between the United States and Russia on implementation of the agreed upon data exchange, or any warhead dismantlement and fissile material storage transparency and verification measures, since October 1995, when without explanation Russia cut off bilateral talks directed toward concluding an Agreement for Cooperation, the legal instrument that would permit the data exchange and transparency measures to go forward. Russian hard-liners among President Yeltsin's inner circle were apparently responsible for this turn of events.

Russia's refusal to move forward with an Agreement for Cooperation has brought to a halt virtually all reciprocal transparency initiatives related to nuclear warhead dismantlement and warhead component storage, including (a) a U.S. proposal for mutual inspections of warhead storage and dismantlement sites to verify the rate at which nuclear warheads are being dismantled, the number that await dismantlement, and the number that have been dismantled already, and (b) the demonstration of techniques for verifying the presence of pits and other nuclear weapon components in sealed storage containers.

Even if these political issues are resolved, the U.S. DOD and the Russian Ministries of Defense and Atomic Energy likely will seek to keep most, if not all of the data classified and available only to the two governments, even though most of the data could be publicly released without harm to either side's national security. Moreover, the U.S. proposal was weakened considerably by the exclusion of operational nuclear warheads and tritium inventories from the proposed categories of data to be exchanged.

As discussed in Appendix B, the two countries could have implemented the data exchange and extensive transparency with regard to warhead dismantlement had the United States availed itself of a window of opportunity and moved on these issues in 1991 and 1992 instead of waiting until 1994.

Cut-Off in the Production of Nuclear-Weapon-Usable Nuclear Materials

Proposals to limit or end the production of fissile materials for nuclear weapons date back at least to 1956, when President Eisenhower proposed a freeze in the production of fissile material (principally plutonium and highly-enriched uranium (HEU))--at a time when U.S. inventories of HEU and plutonium exceeded those of the Soviet Union, and the United States wished to lock in its nuclear weapons advantage. Through the Carter administration the United States from time to time proposed to the Soviet Union variations of the cut-off idea, but these were met without success. Although the issue was kept alive by the non-government arms control community, the Reagan and Bush administrations (1980-1992), showed no interest in "fissile material cut-off" proposals.

With the end of the Cold War and the retirement and dismantlement of tens of thousands of nuclear weapons each, the United States and Russia have acquired huge surplus stocks of weapon-usable fissile material. Consequently, both countries have announced that they no longer produce fissile material for weapons. Actually, the United States stopped producing HEU for weapons in 1964, and stopped (involuntarily) producing plutonium for weapons in 1988, when the aging production complex shut down for reasons related to environment, safety, and public health. The Bush administration announced in 1992 that the United States would no longer produce plutonium or uranium for weapons, making a formal policy of a suspension in production that was already in place.

The Soviet Union announced in October 1989 that "this year it is ceasing the production of highly-enriched uranium," and that it had adopted a program to close down the remaining plutonium-producing reactors by the year 2000. This policy was reaffirmed by President Boris Yeltsin on 29 January 1992. The last three Russian plutonium production reactors still in operation are dual purpose reactors—two at

Seversk (Tomsk7) and one at Zheleznogorsk (Krasnoyarsk-26)—producing heat and electricity. The year 2000 production cut-off was chosen as a date by which new power plants could be brought on line to replace these last three production reactors.

The United Kingdom and France have also announced that they have stopped producing fissile material for weapons, and China has indicated privately that it has stopped as well. This leaves the undeclared nuclear weapon states -- India, Pakistan and Israel -- as possibly the only states that continue to produce unsafeguarded fissile material for use in weapons.

Fissile Cut-Off Negotiations by the Conference on Disarmament

No longer needing new fissile material production for U.S. nuclear weapons, the "fissile material cut-off" emerged as one of President Clinton's principal arms control initiatives announced in August 1993. Recognizing that it would have no immediate impact on the United States and Russia, the Administration's principal objective was to constrain nuclear weapon arsenals of the undeclared nuclear weapon states by capping the supply of fissile material produced outside of international safeguards. Urged by the United States, in 1995 the CD in Geneva set up a committee on 23 March 1995 to negotiate a convention to prohibit the production of fissile material (principally HEU and plutonium) for nuclear explosive purposes or outside of international safeguards. These negotiations are going nowhere, primarily due to opposition by Pakistan and India, which want any ban tightly linked to disarmament negotiations and the reduction of existing stocks, by the non-participation of Israel, and by the obvious lack of enthusiasm by such important states as China and France.

The non-government arms control community continues to press for a formal ban on the production of fissile material for weapons, not only because of the constraint it would impose on the threshold states, but also because it is an important compliment to other arms control initiatives designed to constrain renewed weapons production by the declared weapon states following deep reductions of their arsenals, and by all nations in a nuclear-weapon-free-world. However, a number of organizations take the view that a ban on the production of weapon-usable fissile materials *per se* (i.e., separated plutonium and HEU), or at least a ban on the production of such materials under national auspices, would be a far more effective limitation, particularly in view of the ultimate goal of transitioning to, and maintaining, a nuclear weapons free world.

United States and Russian Bilateral Efforts

In parallel with efforts to achieve a fissile cut-off in the CD, since early-1993 the United States and Russia have been cooperating to secure an end to the production of weapon-grade plutonium at the three remaining plutonium production reactors in Russia. Progress on this front has been slow and disappointing.

On 23 June 1994 Vice President Albert Gore and Russian Prime Minister Viktor S. Chernomyrdin signed an intergovernmental agreement whereby the United States and Russia agreed to shut down all plutonium production reactors in the two countries "no later than the year 2000," and that after the agreement entered into force, plutonium produced in the reactors could not be used in nuclear weapons. The list of reactors covered by this agreement excluded two operating tritium production reactors at Chelyabinsk-65 in Russia and the K-Reactor, on cold standby, at the Savannah River Site in the United States. Russia subsequently announced that it had stopped using plutonium for weapons on 1 October 1994, meaning that while weapon-grade plutonium continued to be produced at the three remaining plutonium production reactors, and continued to be separated from the spent fuel, it is no longer chemically converted to metal for weapon use.

In 1995 the United States and Russia jointly undertook three feasibility studies--one to examine nuclear power reactor replacement alternatives at Tomsk and Krasnoyarsk, a second to examine fossil fuel plant replacement alternatives, and the third to examine the feasibility of converting the production reactor cores to use fuel capable of operating at a higher burnup, so that they would produce fuel-grade or reactor-grade plutonium instead of weapon-grade plutonium. Three years earlier, Minatom Deputy Minister Yegorov and the Pacific Northwest Laboratory (PNL) had proposed a collaboration to study the reactor core conversion option and to improve the safety of the reactors, but this option was initially rejected by the United States, fearing that it would prolong the life of the reactors. The United States, instead, favored the fossil fuel plant replacement option.

In their joint summit statement of 10 May 1995 (see Appendix A), Presidents Clinton and Yeltsin,

> urged progress in implementing current agreements affecting the irreversibility of the process of reducing nuclear weapons such as the June 23, 1994, agreement concerning the shutdown of plutonium production reactors and the cessation of use of newly produced plutonium for nuclear weapons, in all its interrelated provisions, including, *inter alia*, cooperation in creation of alternative energy sources, shutdown of plutonium production reactors mentioned above, and development of respective compliance procedures.

By the end of 1995, the two sides had completed two of the three feasibility studies–the nuclear reactor alternative study and the core conversion study. At the 26 January 1996 Gore-Chernomyrdin meeting, the two sides agreed that it was no longer feasible to replace the three production reactors by the year 2000, as required under earlier agreements. Conversion of the reactor cores to fuel capable of achieving higher burnup was seen as the only viable option for ending weapon-grade plutonium production. Consequently, the two sides agreed to proceed in parallel with a fossil fuel feasibility study and with Phase II of the core conversion study. Under Phase II, the two sides are to develop a detailed design of the alternative core and proceed through a regulatory review by the Russian Federal Nuclear Safety and Radiation Authority (Gosatomnadzor, or GAN). Phase III would involve the actual core conversions at the three reactors. Phase II was estimated to cost $6 million, and Phase III an additional $70 million.

Phase II of the core conversion study was to begin in March 1996--according to U.S. experts, in time to complete the core during the summer of 1999. The Clinton administration failed to find funds in the FY 1996 budget to initiate Phase II, and so work has been stalled at least until 1 October 1996, the beginning of the next fiscal year. Although the final FY 1997 budget has not been approved by Congress, it appears that the necessary funding will be forthcoming to initiate Phase II.

Storage and Disposition of Nuclear Weapon-Usable Fissile Materials

United States

Plutonium. Table 8 summarizes the amount of plutonium acquired and utilized by the DOE (and its predecessor agencies). The existing inventory of 99.5 metric tons (t), by our estimates consists of 85.1 t of weapon-grade plutonium (WGPu is < 7% Pu-240), 13.2 t of fuel-grade plutonium (FGPu is from 7% to < 19% Pu-240), and 1.2 t of reactor-grade plutonium (RGPu is ≥ 19% or greater Pu-240).

The location of the existing inventory is given in Table 9, as best we can discern from recent DOE waste management reports. The U.S. government has declared that 38.2 t of WGPu are in excess of military needs and are being permanently withdrawn from the United States nuclear weapons stockpile. However, 16.9 t of this "excess" material – much of it scrap and residues – are not in pit form and are stored at various sites that are no longer part of the nuclear weapons program. The U.S. government also has declared that none of the 14.4 t of FGPu and RGPu will be used for nuclear weapons (Table 10).

The FGPu and RGPu were used primarily for peaceful purposes— including, for example, some 5.2 t of FGPu in unprocessed irradiated N-Reactor fuel at Hanford, about 0.5 t of FGPu in fresh FFTF fuel assemblies at Hanford, and 3.8 t of fuel elements at the Zero Power Plutonium Reactor (ZPPR) complex, a critical assembly facility, at Argonne National Laboratory-West (ANL-West at the Idaho National Engineering Laboratory (INEL). Thus, the total plutonium of all types declared excess is 52.6 t, leaving 46.9 t of WGPu for weapons, of which 44.8 t is currently in weapons and intact pits stored at Pantex.

By the end of FY 1999 DOE will have recovered some 12,000 pits since FY 1990. The vast majority of these pits will be stored at Pantex--the exception being a few tens of pits sent to the national labs for analysis and reassembly, and any pits dismantled as part of DOE's long-term plutonium disposition program. Currently Pantex has the capacity to store 20,000 pits, but DOE has agreed to store no more than 12,000 pending completion of a site-wide Environmental Impact Statement (EIS). We estimate the mass of the 12,000 pits will total about 36 t of WGPu. Since only 21.3 t of the WGPu in pits at Pantex and in yet to be dismantled warheads has been declared excess, we estimate that the United States currently is planning to retain as a strategic reserve, some 5,000 intact pits containing approximately 15 t of WGPu.

The United States since 1993 has been moving forward with a process for determining how to dispose of its excess plutonium. Key decision documents are identified in Appendix C. To establish a framework for selecting plutonium disposition options which would achieve a high degree of proliferation resistance, the National Academy of Sciences (NAS) endorsed as one of its recommendations the "spent fuel standard." Adopting this recommendation, the DOE defines this criterion as,

> A concept to make plutonium as unattractive and inaccessible for retrieval and weapons use as the residual plutonium in the spent fuel from commercial reactors.

The DOE completed a screening process in March 1995, and a Draft Programmatic Environmental Impact Statement in February 1996, and has narrowed the surviving plutonium disposition options to three categories:

(1) Plutonium burning in a once-through reactor cycle as mixed oxide (MOX) fuel followed by disposal in a repository;

(2) Immobilization in an acceptable matrix to create an environmentally benign form for disposal in a repository;

(3) Disposal in deep boreholes (with or without prior fixation).

There are several sub-options under each of the categories that are still in contention:

(1) MOX Options:
- a. Using existing LWRs
- b. Using a partially completed LWR
- c. Evolutionary LWR
- d. Using Canadian CANDU reactors

(2) Immobilization Options:

a. Vitrification:
    i. Greenfield glass
    ii. Adjunct Melter
    iii. Can-in-canister
b. Ceramic
    i. Greenfield ceramic
    ii. Can-in-canister
c. Electrometallurgical Treatment

(3) Deep Borehole Options:
a. Direct Emplacement
b. Immobilized Emplacement

(4) Combinations of two or more of the above alternatives.

Given that there is no constituency for disposal of surplus plutonium in deep boreholes (the third category), this method of disposal is unlikely to be selected. Nevertheless, in deference to earlier recommendations by the NAS, two deep borehole disposal options are still under consideration by DOE.

The surplus plutonium is currently in a wide variety of chemical and physical forms. Some plutonium is in metal, oxide or solutions, some already in spent fuel, and some is in scrap and residues with plutonium concentrations less than 50 percent. Conversion of plutonium from spent fuel or residues to MOX is not an attractive alternative from the standpoint of the purity of the feed material. Thus, DOE appears to be leaning toward a "hybrid option," a combination of one of the MOX options and one of the immobilization options. In Table 11, we have broken down the surplus plutonium by category. As seen from the table, approximately 37 t of plutonium appears suitable for conversion to MOX from the standpoint of the purity of the feed material, about 7 t is likely to be immobilized, and the remaining 8 t is already in the form of reactor fuel.[24]

The United States currently has no operating MOX fabricating capability. Thus implementation of the MOX option in the United States is several years away in any case.

Highly-Enriched Uranium. DOE has announced that it produced through 1992 for all purposes, 994 t of HEU, defined as uranium having an enrichment above 20% U-235.[25] In Table 12 we present our accounting of DOE's HEU inventory. The uncertainties

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24 According to DOE, approximately 32.5 t of the surplus plutonium comprises "plutonium metals and oxides from weapon dismantlements and other high purity weapons-grade oxides and metal," and 17.5 t is "lower-purity or non-weapons grade metals and oxides, and various plutonium materials including fresh fuel forms, halides, and compounds;" DOE, Office of Fissile Material Disposition, "Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition," DOE/MD-0003, July 17, 1996, p. 2-3.

25 DOE, Openness Press Conference Fact Sheets, June 27, 1994; 483 t was produced at the Oak Ridge K-25 site and 511 at the Portsmouth Gaseous Diffusion Plant in Portsmouth, Ohio.

associated with some of our HEU inventory estimates are large. We look forward to improved estimates, as DOE is in the process of reconciling U.S. HEU production, usage and existing inventories in order to publicly release additional HEU data.

We have assumed that in recent years the U.S. had about 500 t of oralloy (~93.5% U-235) in weapons or assigned for weapon use.[26] We believe this estimate is accurate to within ± 10 t. In addition, some thermonuclear secondaries contain uranium that has been enriched to something between 20% and 90% U-235, as evidenced by the fact that the DOE in 1995 transferred to the U.S. Enrichment Corporation (USEC) 50 t of weapons HEU, of which 5 t was 70%-enriched and 45 t of 37.5%-enriched.[27] Although technically this is HEU because it is enriched to ≥20% U-235, we will refer to it as medium-enriched uranium (MEU), to distinguish it from oralloy (~93.5% U-235). The amount of MEU produced for weapons is not known by us. We have assumed it was on the order of 100 t of oralloy equivalent, and further assumed that 10 percent was at 70%-enriched and 90 percent was 37.5%-enriched, similar to the material turned over to USEC. Thus, we assume that there were about 23 t of 70%-enriched uranium and 206 t of 37.5%-enriched uranium.

On 27 June 1994, DOE also released the HEU inventories at various DOE sites (totaling 258.8 t HEU), but continued to classify the HEU in weapons, weapon components stored at Pantex, and naval fuel (Table 12). These estimates serve as a basis for NRDC's estimate of the HEU inventories as of October 1996, also shown in Table 12.[28]

On 6 February 1996, DOE announced the locations of 174.3 t of HEU that the United States has declared is in excess of military requirements—about 33 t enriched to over 92% U-235, and about 142 t enriched to between 20% and 92% U-235—of which 104 t was in a form that could be blended down for use as commercial reactor LEU fuel (Table 12). Thus, only about one-half of the HEU that has been declared excess was ever in weapons or meant for weapons. The remainder includes 26.2 t of HEU at INEL and ANL-West, and 22 t, containing about 50% U-235 and about 25-35% U-236, at the Savannah River Site. The latter started as fresh 97.3%-enriched naval reactor fuel, was subsequently recovered from spent naval fuel, then used to make fresh Savannah River production reactor fuel, and then recovered again, which accounts for the high concentration of U-236. Also declared excess was some very highly-enriched uranium that was intended to be naval fuel but which did not meet Navy specifications. The 84.9 t of excess HEU at the Y-12 plant included 10 t of HEU oxide in Vault 16 already under IAEA safeguards.

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26 Thomas B. Cochran, William M. Arkin, Robert S. Norris and Milton M. Hoenig, *Nuclear Weapons Databook*, Volume II: U.S. *Nuclear Warhead Production* (Cambridge, MA: Ballinger Publ. Co., 1987), p. 191.

27 William Broad, "Quietly, U.S. Converts Uranium into Fuel for Civilian Reactors," *New York Times*, 19 June 1995, p. A10.

28 See also, *Nuclear Weapons Databook*, Volume II: *U.S. Nuclear Warhead Production*, Appendix D.

In the last four columns of Table 12, we give our estimate of the planned future use of the U.S. government HEU. We have assumed that about 340 t of HEU will be retained in and for weapons, including about 275 t in approximately 10,000 warheads that will remain intact, and a strategic reserve which we estimate at 60 t—sufficient for an additional 2,000 warheads. "Currently, secondaries shipped from Pantex to the Y-12 Plant are scheduled for interim storage and subsequently disassembly, except those secondaries designated as part of the strategic reserve that are placed directly into storage."[29]

We are told that the Navy has refused to permit any oralloy metal from being included in the excess HEU category, in order to retain it for future use as naval reactor fuel. We estimate the Navy is reserving about 320 t of oralloy to future use. While this estimate is highly uncertain, we have heard that the amount currently being reserved for navy use represents a 100+ year reserve.

Perhaps as much as 100 t of HEU is currently earmarked for future commercial use. About 50 t of MEU from weapons—part of the excess—has already been turned over to the U.S. Enrichment Corporation (USEC) for blending to make low-enriched uranium (LEU) fuel for future use in commercial power reactors.

Russia

Plutonium. Soviet/Russian nuclear weapon plutonium production, which began in 1948, probably amounts to some 150-170 t, of which an estimated 115-130 t was actually fabricated into weapon components (the rest is assumed to be in production scrap, solutions, residues).[30] In addition, Russia has about 30 t of separated reactor-grade plutonium in storage at Chelyabinsk-65 that was recovered primarily fromVVER-440 and naval reactor spent fuel.[31]

Russia has not made any public declaration regarding how much weapons plutonium was produced, the amount in the current inventory, the amount now believed to be excess to Russia's national security needs, the number of plutonium pits currently in storage and the locations of these sites, the total number of pits disassembled, or the

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29 DOE, Defense Nuclear Facilities Safety Board, "Status of Highly Enriched Uranium Processing Capability at Building 9212 Oak Ridge Y-12 Plant," DNFSB/TECH-9, December 8, 1995, p. 5.

30 The upper limit of Soviet plutonium production is from Cochran, et al., *Making the Russian Bomb: From Stalin to Yeltsin*, Appendix C. The lower limit is from Anatoli S. Diakov, "Disposition of Separated Plutonium: an Overview of the Russian Program," paper presented at the Fifth International Conference on Radioactive Waste Management and Environmental Remediation, September 3-8, 1995, Berlin, Germany. The fraction of pipeline materials, i.e., solutions, scrap, and residues, in the Russian weapon program is assumed to be comparable to that in the U.S. weapon program.

31 The U.S. General Accounting Office (GAO) also estimates that "The Soviet Union produced up to 1,200 metric tons of HEU and 200 metric tons of plutonium." U.S. General Accounting Office (GAO), "Nuclear Nonproliferation: Status of U.S. Efforts to Improve Nuclear Material Controls in Newly Independent States," GAO/NSIAD/RCED-96-89, March 1996, p. 17. The authors of this report have stated privately that this is a U.S. DOE estimate based on Russian sources.

rates of warhead and pit disassembly. The U.S. government believes most of the pits from disassembled Russian warheads are stored intact.

In July 1992, Minatom put forward a conceptual program of development of nuclear power in Russia that called for the constriction of up to four BN-800 liquid metal fast breeder reactors—completion of up to three reactors at the South-Ural site at Chelyabinsk-65 and construction of an additional reactor at Beloyarsky.[32] Senior Minatom officials over the past several years have expressed a strong preference for using excess military plutonium as MOX fuel, preferably in the yet to be built BN-800s. However, within the last year or two they have come to recognize that funding is unavailable to support an ambitious fast reactor construction program. Breeders are now viewed by Minatom as potentially needed in 20-30 years.

However, senior Minatom officials still favor the MOX option and oppose direct geologic disposal following immobilization of the plutonium in glass. They now recognize that the only viable MOX option is to use existing reactors, namely VVER-1000 reactors and the single BN-600 at Beloyarsky. There are seven operating VVER-1000 in Russia and an additional 10 in Ukraine. VVER-440 reactors are not an option in Minatom's view. If modified to accept a full core load of MOX, VVER-1000s can burn about one tonne of plutonium per reactor-year. For safety reasons Minatom believes the BN-600 is limited to one-fourth core loading.

Requested by Presidents Yeltsin and Clinton at their January 1994 summit meeting, a joint study that examines various plutonium disposition options will be released by the two governments prior to the G-7 Experts Meeting in Paris on 28-30 October 1996. This study examines the feasibility of various reactor and immobilization options, including MOX in light water reactors, HTGR, Candu, and fast reactors, as well as vitrification and geologic disposal. The United States and Russia have also been meeting to discuss plutonium pit conversion, and the United States will probably devote a few million dollars from the Nunn-Lugar account to move these efforts from paper studies to joint technical work, e.g., fabrication of MOX pellets for testing, and computer code development to study the safety of MOX use in VVER and the single existing BN-600 reactor.

One of the most important guidelines for this joint study by the two governments is that the U.S. and Russian plutonium disposition programs should proceed in parallel with the goal of reducing to equal levels of military plutonium. Since the United States is currently planning to retain about 50 t of plutonium for weapons and dispose of about 50 t, and since Russia has about 200 t, this joint statement implies that Russia should dispose of its plutonium at a rate at least three times that of the United States. It is unlikely that this goal can be met if Russia relies primarily on the MOX option. Russia, like the

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32 The Concept of Development of Nuclear Power in the Russian Federation, 14 July 1992, The Council (Kollegia) of the Minatom RF.

United States, has no large-scale operating MOX fabrication plant and lacks funds to construct a new one. Even if a new MOX fabrication facility is financed by the West, after it becomes operational, for Russia to reduce its separated plutonium inventory from 200 t to 50 t in 10 years would require full-core loading of about 15 VVER-1000 reactors—all seven VVER-1000 reactors in Russia, and most of the 10 operating VVER-1000 reactors in the Ukraine.

Both the United States and Russia have agreed to place excess plutonium and HEU under IAEA safeguards, and DOE and Minatom are meeting jointly with the IAEA staff to discuss implementation of this offer. The United States has already placed token amounts of excess plutonium and HEU under IAEA safeguards. Minatom has not done so. Neither the United States nor Russia have declared how much plutonium or HEU will ultimately be placed under IAEA safeguards.

The U.S. National Academy of Sciences and the Russian Academy of Sciences are sponsoring a parallel joint U.S.-Russian study addressing the plutonium disposition issue. This independent "non-government" experts group will be making joint recommendation to the two governments, as opposed to merely laying out the various disposition options. This group hopes to have an interim report by the 28-30 October 1996 G-7 Experts Group Meeting, and a final report in 1997. The two governments, however, are under no obligation to follow their recommendations.

Highly-Enriched Uranium. As with plutonium, Russia has not declared how much HEU it has produced, how much it is reserving for weapons use, or how much is in excess of military needs. While the total production of Soviet/Russian HEU for weapons is not accurately known, the DOE believes it is on the order of 1200 t.[33] Assuming Russia retains about 10,000-11,000 warheads in 2004, these will contain about 300-330 t of HEU. In 1993 Russia agreed to sell to the United States 500 t of HEU (90 percent U-235 equivalent) from weapons. This leaves an estimated 400 t of HEU that will not be in weapons in 2004, and has not been offered for sale.

Although in 1993 Russia agreed to sell 500 t of HEU to the United States, the contract signed in January 1994, called for the sale of *up to* 500 t of HEU equivalent--at a rate of up to 10 t per year for the first five years, and 30 t per year for the next 15 years. Thus far, the U.S. Enrichment Corporation (USEC), the executive agent for the United States government in managing the contract, has taken delivery in 1995 of LEU equivalent to 6 t of HEU, and contracted for an additional 12 t of HEU equivalent in 1996 (more than half of which has been delivered to date).

In January 1996, Russia offered to sell 18 t of HEU as LEU in 1997, rather than the previously agreed 12 t. USEC, with DOE approval, initially refused to accept the larger amount. Following pressure from Capitol Hill, The Department of Energy

33 See footnote 30 above.

subsequently pressured USEC to accept the full 18 t, but USEC had not yet negotiated a price as of mid-September 1996. Minatom would like to sell 24 t of HEU equivalent in 1998.

The United States is in the process of privatizing its uranium enrichment enterprise. The relevant legislation on privatization of USEC was passed in April 1996. Once the privatization is completed, depending on market conditions, USEC may continue to have a strong financial incentive to offer Minatom an unacceptably low price, or stall future deliveries by other means, for some of the HEU Minatom offers for sale. How this plays out, and the extent to which the HEU purchase agreement is affected, remains to be seen. The U.S. government always has the option of removing USEC as the executive agent, and designating the DOE to supervise an open auction of the Russian material to bidders qualified to handle it.

Treaty on the Non-Proliferation of Nuclear Weapons (NPT)

The NPT is the centerpiece of the global non-proliferation regime, a series of interlocking international treaties, bilateral undertakings, and multilateral inspections aimed at halting the spread of nuclear weapons.[34] The NPT was opened for signature in 1968 and entered into force in 1970 for an initial 25 year period, necessitating a decision on the future duration of the Treaty at the time of the 1995 NPT Review and Extension Conference which opened on 17 April. Canada formally proposed the indefinite extension of the Treaty, and enlisted 103 countries to support that position. Although 11 non-aligned countries submitted a proposal calling for 25 year rolling extensions, there was a clear majority in favor of indefinite extension, and in the end, on 11 May 1995, the parties to the NPT voted unanimously to extended the Treaty indefinitely, making it a permanent treaty.

In an effort to insure passage of the indefinite extension vote, the United States, prior to the conference, rounded up additional signatories to the treaty. By 4 May 1995 there were 178 parties, and as of 25 June 1996 the treaty had 182 parties, of which 5 (US, Russia, UK, France, and China) are declared weapon states.

With the collapse of the Soviet Union in the fall of 1991, three newly independent states, Belarus Kazakhstan, and Ukraine, inherited nuclear weapons. All three states have now joined the NPT as non-nuclear weapon states and have agreed to place their civil nuclear activities under IAEA safeguards. All nuclear weapons have been removed from Ukraine and Kazakhstan and transferred to Russia. Only Belarus has nuclear weapons remaining on its soil. All remaining nuclear weapons in Belarus are destined to be transferred to Russia by the end of 1996.

34 For periodic reviews of the status of non-proliferation efforts, see Leonard S. Spector, Mark G. McDonough, "Nuclear Proliferation: A Guide in Maps and Charts, 1995," Carnegie Endowment for International Peace, Washington, D.C. (updated annually) and *The Nonproliferation Review*, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA (issued twice yearly).

Israel, India, and Pakistan have nuclear weapons (or are able to assemble and deploy them rapidly), but are not nuclear weapon state parties to the NPT, a class limited to those nations that had detonated a nuclear explosive device prior to January 1, 1967.

Iraq, Iran, Libya, and North Korea are parties to the NPT as non-nuclear weapon states. All deny seeking nuclear weapons, but all generally are believed to be seeking such weapons. Iraq's nuclear ambitions have been thwarted by the Gulf War and sanctions imposed following the war. Russia is completing a large power reactor in Iran – originally supplied by Germany and damaged during the Iran-Iraq war -- that will operate under IAEA safeguards. Separation of weapon-grade plutonium by North Korea has stopped following an agreement with the United States to supply North Korea with two power reactors, which will be supplied by South Korea.

Appendix A

JOINT STATEMENT ON THE TRANSPARENCY AND IRREVERSIBILITY OF THE PROCESS OF REDUCING NUCLEAR WEAPONS

The President of the United States of America and the President of the Russian Federation,

After examining the exchange of views which took place during the December 1994 meeting of the Gore-Chernomyrdin Commission in regard to the aggregate stockpiles of nuclear warheads, stocks of fissile materials, and their safety and security, as well as a discussion of the Joint Working Group on Nuclear Safeguards, Transparency and Irreversibility of further measures to improve confidence in and increase the transparency and irreversibility of the process of reducing nuclear weapons,

Reaffirm the commitment of the United States of America and the Russian Federation to the goal of nuclear disarmament and their desire to pursue further measures to improve confidence in and increase the transparency and irreversibility of the process of nuclear arms reduction, as they agreed in January and September 1994;

Reaffirm the desire of the United States of America and the Russian Federation to exchange detailed information on aggregate stockpiles of nuclear warheads, on stocks of fissile materials and on their safety and security and to develop a process for exchange of this information on a regular basis; and

Express the desire of the United States of America and the Russian Federation to establish as soon as possible concrete arrangements for enhancing transparency and irreversibility of the process of nuclear arms reduction.

Taking into account the proposal by President B.N. Yeltsin for a treaty on nuclear safety and strategic stability among the five nuclear powers, they declare that:

- Fissile materials removed from nuclear weapons being eliminated and excess to national security requirements will not be used to manufacture nuclear weapons;

- No newly produced fissile materials will be used in nuclear weapons; and

- Fissile materials from or within civil nuclear programs will not be used to manufacture nuclear weapons.

The United States of America and the Russian Federation will negotiate agreements to increase the transparency and irreversibility of nuclear arms reduction that, *inter alia*, establish:

- An exchange on a regular basis of detailed information on aggregate stockpiles of nuclear warheads, on stocks of fissile materials and on their safety and security;

- A cooperative arrangement for reciprocal monitoring at storage facilities of fissile materials removed from nuclear warheads and declared to be excess to national security requirements to help confirm the transparency and irreversibility of the process of reducing nuclear weapons, recognizing that progress in this area is linked to progress in implementing the joint U.S.-Russian program for the fissile material storage facility at Mayak; and

- Other cooperative measures, as necessary to enhance confidence in the reciprocal declarations on fissile material stockpiles.

The United States of America and the Russian Federation will strive to conclude as soon as possible agreements which are based on these principles.

The United States of America and the Russian Federation will also examine and seek to define further measures to increase the transparency and irreversibility of the process of reducing nuclear weapons, including intergovernmental arrangements to extend cooperation to further phases of the process of eliminating nuclear weapons declared excess to national security requirements as a result of nuclear arms reduction.

The Presidents urged progress in implementing current agreements affecting the irreversibility of the process of reducing nuclear weapons such as the 23 June 1994, agreement concerning the shutdown of plutonium production reactors and the cessation of use of newly produced plutonium for nuclear weapons, in all its interrelated provisions, including, *inter alia*, cooperation in creation of alternative energy sources, shutdown of plutonium production reactors mentioned above, and development of respective compliance procedures.

The United States of America and the Russian Federation will seek to conclude in the shortest possible time an agreement for cooperation between their governments enabling the exchange of information as necessary to implement the arrangements called for above, by providing for the protection of that information. No information will be exchanged until the respective arrangements enter into force.

Appendix B

The History of the Failure to Achieve A Nuclear Warhead and Fissile Material Data Exchange Between the United States and Russia

Non-government organizations have been advocating since 1989 that nuclear weapon states, particularly the superpowers, should reciprocally exchange data on nuclear weapons, tritium, and weapon-usable fissile material and update the exchanged data bases periodically. In October 1991, shortly after Presidents Bush and Gorbachev had each made unilateral commitments to eliminate thousands of tactical nuclear warheads, and shortly after the failed putsch to oust Gorbachev--an international workshop was held in Washington, D.C. on verified storage and elimination of nuclear warheads. The workshop participants included then deputy MAPI Minister Viktor Mikhailov, Evgeniy Avrorin, Scientific Leader of Chelyabinsk-70, and Sergei Kortunov, then Counselor for Arms Limitations, Foreign Ministry of the USSR.

The workshop participants reached general agreement on a number of steps that the two countries should undertake: (a) each should declare at an early stage that the fissile material removed from weapons would not be used for new weapons; (b) each should exchange and make public the total number of warheads in their respective stockpiles, the number of warheads, by class, that are planned to be eliminated, and the total quantity of plutonium and HEU removed from these warheads; (c) the two sides should establish at the earliest possible time bilateral safeguards over warheads to be dismantled; and (d) the two nations should discuss what additional steps should be undertaken at the dismantlement facilities to insure that the warheads in safeguarded storage are actually dismantled and the fissile material recovered from warheads is placed under safeguards.

As a direct consequence of this workshop, two months later--on 12 February 1992 in Geneva--Russian Foreign Minister Andrei Kozyrev formally proposed a reciprocal exchange of data among all nuclear weapon powers on inventories of nuclear weapons and fissile materials, and on nuclear weapons production, storage, and elimination facilities. Neither President Bush, nor later President Clinton, responded positively to this Russian initiative. This failure did not go unnoticed by the Congress. On 2 July 1992, the Senate Committee on Foreign Relations adopted a condition to the ratification of the START I Treaty--approved by the full Senate in October 1992--known as the "Biden condition." It directed the President to seek an appropriate arrangement, "in connection with any further agreement reducing strategic arms," for monitoring nuclear stockpile weapons and fissile material production facilities, through the use of reciprocal inspections, data exchanges, and cooperative measures. And in late-1994, the Congress included in the conference report of the National Defense Authorization Act for FY 1994 the following language (*Congressional Record*, 10 November 1993, p. H9559):

> The conferees do believe that the United States must have the ability to track nuclear materials. Therefore the conferees are disappointed that, despite the inclusion of section 3151(b) in the National Defense Authorization Act for Fiscal Year 1993, there has been no discernible progress between the United States and the states of the former Soviet Union on an agreement to reciprocally release information on their nuclear stockpiles.

Thus, prodded by the Congress, the Clinton Administration finally, in the fall of 1994, endorsed the idea of a data exchange with Russia. To facilitate such an exchange, in the National Defense Authorization Act for FY 1995 (Section 3155), Congress amended Section 144 of the Atomic Energy Act of 1954, to allow DOE and DOD to release "Restricted Data" and "Formerly Restricted Data", as necessary, to further fissile material and other weapons material control and accountability programs. At their Summit meeting in September 1994 Presidents Clinton and Yeltsin agreed to "exchange detailed information at the next Gore-Chernomyrdin Commission on aggregate stockpiles of nuclear warheads, an stocks of fissile materials and on their safety and security."

It was then realized by both countries that the data exchange necessitated an formal "Agreement for Cooperation"—the legal instrument that would permit the data exchange to go forward under agreed procedures for protecting classified material—similar to agreements the U.S. has with the U.K. and France. At the December 1994 Gore-Chernomyrdin meeting the U.S. tabled a draft Agreement for Cooperation and a draft list of warhead stockpile information the U.S. was willing to exchange. In January 1995 U.S. Ambassador James E. Goodby tabled a proposed list of fissile material data to be exchanged. On 10 May 1995, President's Clinton and Yeltsin issued a "Joint Statement on the Transparency and Irreversibility of the Process of Reducing Nuclear Weapons," wherein they renewed their pledge "to exchange on a regular basis" detailed information on their stockpiles of nuclear weapons and nuclear materials. Regrettably, to date, some two years since Presidents Yeltsin and Clinton initially agreed to a data exchange, the Russian government has refused to renew bilateral talks to resolve any outstanding differences, or to conclude an Agreement for Cooperation despite the fact that most of the details of the proposed Agreement have been worked out, and has not responded to the U.S. proposed list of data to be exchanged.

The initial Russian excuse for delay was to say that they need more time to organize themselves. Then Russian negotiators cited a new interagency policy review involving Russia's Foreign, Defense and Atomic ministries. The anti-Western tone of some candidates in Russia's June 1996 presidential elections may have caused further delay; and there has been concern over opposition from within the Duma. It is unclear whether the Agreement for Cooperation and the subsequent data exchange will require approval by the Duma. Getting parliament's approval for such agreements may be difficult. On the U.S. side, Congress provided a grace period through calendar 1995, subsequently extended through 1 October 1996, during which the agreement for cooperation would not have to be submitted to the Senate for approval.

Appendix C
Key Decision Documents Related to the Long-Term Storage and Disposition of U.S. Government-Owned Plutonium

National Academy of Sciences, Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium*, Executive Summary and Main Report, (Washington, D.C.: National Academy Press, 1994.

National Academy of Sciences, Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium, Reactor-Related Options*, (Washington, D.C.: National Academy Press, 1995).

DOE, Office of Fissile Materials Disposition, *Storage and Disposition of Weapons-Usable Fissile Materials, Draft Programmatic Environmental Impact Statement, Vol. 1-III*, DOE/EIS-0229-D, February 1996.

DOE, Office of Fissile Material Disposition, *Technical Summary Report For Long-Term Storage of Weapons-Usable Fissile Material*, DOE/MD-0004, July 17, 1996.

DOE, Office of Fissile Material Disposition, *Technical Summary Report For Surplus Weapons-Usable Plutonium Disposition*, DOE/MD-0003, July 17, 1996.

DOE, Office of Arms Control and Non-Proliferation, *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*, DRAFT, October 1, 1999.

Lawrence Livermore National Laboratory, Fissile Materials Disposition Program, *Alternative Technical Summary Report: Ceramic Can-In Canister Variant*, UCRL-ID-122661, L-20219-1, August 26, 1996.

Lawrence Livermore National Laboratory, Fissile Materials Disposition Program, *Alternative Technical Summary Report: Ceramic Greenfield Variant*, UCRL-ID-122662, L-20218-1, August 26, 1996.

Lawrence Livermore National Laboratory, Fissile Materials Disposition Program, *Alternative Technical Summary Report: Electrometallurgical Treatment Variant*, UCRL-ID-122664, L-20220-1, August 26, 1996.

Lawrence Livermore National Laboratory, Fissile Materials Disposition Program, *Alternative Technical Summary Report: Vitrification Adjunct Melter to DWPF Variant*, UCRL-ID-122660, L-20217-1, August 26, 1996.

Lawrence Livermore National Laboratory, Fissile Materials Disposition Program, *Alternative Technical Summary Report: Vitrification Can-In Canister Variant*, UCRL-ID-122659, L-20216-1, August 26, 1996.

Lawrence Livermore National Laboratory, Fissile Materials Disposition Program, *Alternative Technical Summary Report: Vitrification Greenfield Variant*, UCRL-ID-122663, L-20215-1, August 26, 1996.

Table 1. U.S. Nuclear Forces, End-FY 1996.

Type	Name	SSBNs/ Launchers	Warheads x yield (kilotons)	Total Warheads	Total Megatons
Operational Forces					
Strategic					
ICBMs					
LGM-30G	Minuteman III:				
	Mk-12	200	3 W62 x 170 (MIRV)	600	102
	Mk-12A	325	3 W78 x 335 (MIRV)	975	327
LGM-118A	MX/Peacekeeper	50	10 W87 x 300 (MIRV)	500	150
Subtotal		**575**		**2075**	**579**
SLBMs					
UGM-96A	Trident I C-4	8/192	8 W76 x 100 (MIRV)	1,536	154
UGM-113A	Trident II D-5	9/216			
	Mk-4		8 W76 x 100 (MIRV)	1,344	134
	Mk-5		8 W88 x 475 (MIRV)	384	182
Subtotal		**17/348**		**3,264**	**470**
Bomber/Weapons					
B-1B	Lancer	82	ALCM x 50-150	1,000	150
B-2	Spirit	8	B53/61/83 bombs	1,400	950
B-52H	Stratofortress	76	ACM x 5-150	400	60
Subtotal				**2800**	**1160**
Total Operational Strategic				**8,139**	**2,209**
Non-strategic					
SLCM			W80-0 x 0.5-150	350	53
AirForce Tactical Bombs			B61-3,4,10	600	102
Total Operational Non-strategic				**950**	**155**
Spares				**725**	**189**
Reserves					
For One New SSBN			8 W76 x 100(MIRV)	192	19
GLCM (Inactive)			W84 x 0.2-150	400	60
Total Reserve				**592**	**79**
Grand Total				**10,406**	**2,631**

Table 2. U.S. Nuclear Forces, 2003 (START II).

			Warhead Type	Total Warheads
Operational				
Strategic				
ICBMs	500 Minuteman III		W87-0, W78, W62	500
SLBMs	336 Trident II on 14 SSBN x 5		W76	1,280
			W88	400
Bombers	21 B-2A Spirit		B53,B61-7,-11	400
	32 B-52H x 20		B83	500
	32 B-52 x 12		W80-1	400
Subtotal Strategic				**3,480**
Non-strategic				
SLCM			W80-0	350
Air Force Tactical Bombs			B61-3,-4,-10	600
Subtotal Non-strategic				**950**
Spares				**570**
"Hedge"				
ICBM warheads to upload Minuteman III			W62, W78	
SLBM warheads to upload Trident II			W76	
Bomber weapons for B-1 and B-52H			B53, B61, B83, W80	
Subtotal "Hedge"				**2500**
Inactive				
ICBM			W62	
SLBM			W76	
Bomber Weapons			B61, W80-1	
GLCM			W84	
Subtotal Inactive				**2500**
Grand Total				**10,000**

Table 3. U.S Nuclear Weapons Stockpile.

(NRDC Revised: 13 August 1996)

End-FY	Total New Builds	DOD Retired	DOD Stockpile	Yield (Mt)	DOE Disassemblies	Awaiting Disassembly	Intact Warheads
1945	2	0	2	0	0	0	2
1946	7	0	9	0	0	0	9
1947	4	0	13	0	0	0	13
1948	43	6	50	1	?	?	?
1949	123	3	170	4	?	?	?
1950	264	135	299	10	?	?	?
1951	284	145	438	35	?	?	?
1952	644	241	841	50	?	?	?
1953	345	17	1,169	73	?	?	?
1954	535	1	1,703	339	?	?	?
1955	806	87	2,422	2,880	?	?	?
1956	1,379	109	3,692	9,189	?	?	?
1957	2,232	381	5,543	17,546	?	?	?
1958	2,619	817	7,345	17,304	?	?	?
1959	7,088	2,135	12,298	19,055	?	?	?
1960	7,178	838	18,638	20,491	?	?	?
1961	5,162	1,571	22,229	10,948	?	?	?
1962	4,654	766	26,117	12,825	?	?	?
1963	3,813	830	29,100	15,977	?	?	?
1964	3,950	2,534	30,516	16,944	?	?	?
1965	3,519	1,936	32,099	15,153	?	?	?
1966	2,429	2,357	32,171	14,037	?	?	?
1967	1,893	1,849	32,215	12,786	?	?	?
1968	586	2,194	30,607	11,836	?	?	?
1969	734	3,045	28,296	11,714	?	?	?
1970	269	1,936	26,629	9,695	?	?	?
1971	1,223	1,347	26,355	8,584	?	?	?
1972	2,035	1,541	26,849	8,532	?	?	?
1973	1,794	644	28,099	8,452	?	?	?
1974	1,507	807	28,799	8,425	?	?	?
1975	1,238	2,240	27,797	7,368	?	?	?
1976	777	2,181	26,393	5,936	1,458	?	?
1977	221	998	25,616	5,845	1,295	?	?
1978	50	1,148	24,518	5,721	1,080	?	?
1979	353	730	24,141	5,696	593	?	?
1980	904	904	24,141	5,619	732	?	?
1981	987	1,887	23,241	5,363	1,577	?	?
1982	1,337	1,537	23,041	5,359	1,535	?	?
1983	949	749	23,241	5,232	1,120	?	?
1984	1,543	1,143	23,641	5,192	994	?	?
1985	1,241	1,322	23,560	5,217	1,075	?	?
1986	1,024	1,224	23,360	5,415	1,015	?	?
1987	1,158	958	23,560	4,882	1,189	?	?
1988	669	1,023	23,206	4,790	581	?	?
1989	951	1,794	22,363	4,743	1,208	?	?
1990	291	1,000	21,654	4,519	1,154	407	22,061
1991	0	2,500	19,154	3,796	1,595	1,312	20,466
1992	0	5,450	13,704	3,168	1,866	4,906	18,610
1993	0	2,500	11,204	2,847	1,556	5,850	17,054
1994	0	650	10,554	2,375	1,369	5,131	15,685
1995	0	58	10,496	2,362	1,393	3,796	14,292
1996	0	88	10,408	2,330	1,166	2,718	13,126
1997	0	73	10,335	2,281	1,221	1,570	11,905
1998	0	48	10,287	2,224	1,084	534	10,821
1999	0	45	10,242	2,158	415	164	10,406
2000	0	49	10,193	2,084	49	164	10,357
2001	0	54	10,139	2,002	54	164	10,303
2002	0	47	10,092	1,914	47	164	10,256
2003	0	42	10,050	1,823	42	164	10,214
Total:	70,814	60,414					

Bold data are from U.S. Government sources; other data represent NRDC estimates:
The DOD stockpile for 1945-1961; DOE, Openess Press Conference, 27 June 1994.
The DOD stockpile for 1962-1994 are fitted to DOD/Sandia laboratories graphs, May 1994.
Annual new builds of warhead types now fully retired are from DOE, Openess Press Confrence, 27 June 1994.
Annual new builds of warhead types now in the stockpile were estimated by NRDC.
Dismantlement data were obtained from DOE, Openess Press Conference, 27 June 1994, and by private communication with Pantex officials; 1975 entry is for Pantex only.
Thre were 3796 warheads awaiting disassembly at end FY 1995 according to the Albuquerque Operations Office, Public Affairs.

Table 4. Russian Nuclear Forces, October 1996.

Category/Type	*Weapon System*	*Launchers*	*Warheads*
Strategic Offense			
ICBM	SS-18 (186), SS-19 (150), SS-24 (46), SS-25 (345)	727	3,750
SLBM	SS-N-18 (208), SS-N-20 (120), SS-N-23 (112)	440	2,350
Bomber	6 Blackjack, 27 Bear-H6, 36 Bear-H16 (AS-15 ALCMs, AS-16 SRAMs, bombs)	69	1,400
Subtotal			**7,500**
Strategic Defense			
ABM	SH-08 Gazelle (64), SH-11 Gorgon (36)	100	100
SAM	SA-5B Gammon, SA-10 Grumble	1,100	1,100
Subtotal			**1,200**
Land-based Non-strategic			
Bomber and fighter	Backfire (80), Blinder (42), Badger (24), Fencer (280)	426	1,600
Subtotal			**1,600**
Naval Non-strategic			
Attack aircraft	Backfire (135), Blinder (30), Badger (50), Bear G (25) (AS-4 ASM, bombs)	240	600
SLCM	SS-N-9, SS-N-12, SS-N-19, SS-N-21, SS-N-22	--	500
ASW	SS-N-15, SS-N-16, torpedoes, depth bombs	n/a	500
Subtotal			**1,600**
Grand Total			**11,900**

ABM: anti-ballistic missile; **ALCM**: air-launched cruise missile; **ASM**: air-to-surface missile; **ASW**: anti-submarine weapons; **ICBM**: intercontinental ballistic missile; **SAM**: surface-to-air missiler; **SLBM**: submarine-launched ballistic missile;**SLCM**: submarine-launched cruise missile; **SRAM**: short-range attack missile; **SSBN**: nuclear powered ballistic missile submarine.

Table 5. Russian Non-strategic Nuclear Forces.

Category/Type	Weapon System (Numbers in 1996)	Operational Warheads 1991	Committed to Eliminate	1996	1997	2003
Air Defense						
ABM	SH-08 Gazelle (64), SH-11 Gorgon (36)	250		100		
SAM	SA-5B Gammon, SA-10 Grumble	2,750		1,100		
Subtotal (Air Defense)		**3,000**	**-1,500**	**1,200**	**600**	**0**
Air Force, Frontal Aviation						
Bomber and fighter	Backfire (80), Blinder (42), Badger (24), Fencer (280)	7,000	-3,500	1,600	1,000	1,000
Subtotal (Air Force, Frontal Aviation)		**7,000**	**-3,500**	**1,600**	**1,000**	**1,000**
Naval Non-strategic						
Attack aircraft	Backfire (135), Blinder (30), Badger (50), Bear G (25) (AS-4 ASM, bombs)	2,000	-1,000	600		
SLCM	SS-N-9, SS-N-12, SS-N-19, SS-N-21, SS-N-22	1,500	-750	750	750	350
ASW	SS-N-15, SS-N-16, torpedoes, depth bombs	1,500	-750	750	750	
Subtotal (Naval Non-Strategic)		**5,000**	**-2,500**	**2,100**	**1,500**	**350**
Ground Forces						
Rocket Forces	Frog-7, SS-1 Scud B, SS-21	4,000	-4,000			
Artillery	152mm, 203 mm, 240mm	2,000	-2,000			
Corp of Engineers	ADMs (landmines)	700	-700	200	200	
Subtotal (Ground Forces)		**6,700**	**-6,700**	**200**	**200**	**0**
Grand Total		**21,700**	**-14,200**	**5,100**	**3,300**	**1,350**

ABM: anti-ballistic missile; **ALCM**: air-launched cruise missile; **ASW**: anti-submarine weapons; **SAM**: surface-to-air missile; **ADM**: atomic demolition munition.

Table 6. Russian Operational Strategic-Offense Nuclear Forces, 1996 and 2003.

Deployed Category/Type	Weapon System	1 January 1996 – START Accountable – SSBNs	1 January 1996 – START Accountable – Launchers	1 January 1996 – START Accountable – Warheads	1 January 1996 – Actual – SSBNs	1 January 1996 – Actual – Launchers	1 January 1996 – Actual – Warheads	2003 – Without START II – Optimistic Budget – SSBNs	2003 – Without START II – Optimistic Budget – Launchers	2003 – Without START II – Optimistic Budget – Warheads	2003 – Without START II – Deteriorating Budget – SSBNs	2003 – Without START II – Deteriorating Budget – Launchers	2003 – Without START II – Deteriorating Budget – Warheads	2003 – Under START II – Optimistic Budget – SSBNs	2003 – Under START II – Optimistic Budget – Launchers	2003 – Under START II – Optimistic Budget – Warheads	2003 – Under START II – Deteriorating Budget – SSBNs	2003 – Under START II – Deteriorating Budget – Launchers	2003 – Under START II – Deteriorating Budget – Warheads
ICBM	SS-18 M4/M5/M6 Satan (RS-20)		180	1,800		180	1,800		40	400		40	400						
	SS-19 M3 Stiletto (RS-18)		167	1,002		167	1,002		120	720		120	720		105	105		105	105
	SS-24 M1/M2 Scalpel (RS-22)		46	460		46	460		46	460		46	460		46	46		46	46
	SS-25 Sickle (RS-12M)		351	351		351	351		415	415		270	270		415	415		270	270
	SS-25M (Topol)								45	45		20	20		45	45		20	20
Subtotal (ICBM)			744	3,613		744	3,613		666	2,040		496	1,870		611	611		441	441
SLBM	SS-N-6 Serb (RSM-25) on Yankee I	1	16	16															
	SS-N-8 Sawfly (RSM-40) on Delta I	12	144	144															
	SS-N-8 Sawfly (RSM-40) on Delta II	4	64	64															
	SS-N-18 M1 Stingray (RSM-50) on Delta III	13	208	624	13	208	624	3	48	144	3	48	144	3	48	144	3	48	144
	SS-N-23 Skiff (RSM-54) on Delta IV	7	112	448	7	112	448	7	112	448	4	64	256	7	112	448	4	64	256
	SS-N-23 M1 Skiff (RSM-54) on new Delta V							1	16	128	1	16	128	1	16	128	1	16	128
	SS-N-20 M1/M2 Sturgeon (RSM-52) on Typhoon	6	120	1,200	6	120	1,200	4	80	800	2	40	400	4	80	800	2	40	400
Subtotal (SLBM)		43	664	2,496	28	440	2,272	15	256	1,520	10	168	928	15	256	1,520	10	168	928
Bomber	Bear-H (Tu-95MS)		23	20															
	Bear-H6 (Tu-95MS6)		29	224		28	168												
	Bear-H-16 (Tu-95MS16)		35	280		35	560		37	592		22	352		37	592		22	352
	Blackjack (Tu-160)		6	48		6	72		6	96		6	96		6	96		6	96
	(AS-15 Kent ALCMs, AS-16 SRAMs, bombs)																		
Subtotal (bomber)			89	572		69	800		43	688		28	448		43	688		28	448
Grand Total			1,497	6,681		1,253	6,685		967	4,248		694	3,246		912	2,819		639	1,817

ALCM: air-launched cruise missile; ICBM: intercontinental ballistic missile; SLBM: submarine-launched ballistic missile; SRAM: short-range attack missile; SSBN: nuclear powered ballistic missile submarine.
Excludes all systems stationed in Ukraine, Belarus and Kazakhstan and all Russian missiles at test and dismantlement sites and spares.
Some SS-18 currently carry a single warhead, although under START all are counted as carrying 10.

Table 7. Russian Nuclear Force Scenarios, 2003-2004.

	Without START II				Under START II			
	High Budget		Low Budget		High Budget		Low Budget	
	Launchers	Warheads	Launchers	Warheads	Launchers	Warheads	Launchers	Warheads
Operational Strategic								
ICBMs	666	2,040	496	1,870	611	611	441	441
SLBMs	256	1,520	168	928	256	1520	168	928
Bombers	45	688	30	448	45	688	30	448
Subtotal (Strategic)	**967**	**4248**	**694**	**3246**	**912**	**2819**	**639**	**1817**
Operational Non-strategic								
SLCM		350		350		350		350
Tactical Bombs		1,000		1,000		1,000		1,000
Subtotal (Non-strategic)		**1,350**		**1,350**		**1,350**		**1,350**
Spares (10%)		**560**		**460**		**417**		**317**
"Hedge" Warheads								
ICBM warheads to upload SS-19 and SS-24					151	939	151	939
Subtotal ("Hedge")					**151**	**939**	**151**	**939**
Possible Inactive Warheads								
ICBM (SS-18, SS-19)		2962		2962		3452		3452
SLBM (SS-N-18, SS-N-20, SS-N-23)		880		1,472		880		1,272
Strategic Bomber Weapons		612		812		612		812
Subtotal (Inactive)		**4,454**		**5,246**		**4,944**		**5,536**
Grand Total		**10,612**		**10,302**		**10,469**		**9,959**

Table 8. U.S. Government Owned Plutonium Material Balance (metric tons).

	WGPu (t)	FGPu (t)	RGPu (t)	Total Pu (t)
Production Reactors:				
Hanford (9 reactors)	54.5	12.9		67.4
Savannah River Site (5 reactors)	36.1			36.1
Subtotal (Production)	90.5	12.9	0.0	103.4
Blending	2.8	-2.8		
Fuel Segregation	0.4	-0.4		
Total Production Reactors	**93.8**	**9.7**	**0.0**	**103.4**
Gov. Non-Production Reactors	0.1		0.5	0.6
Total Government Reactors	**93.8**	**9.7**	**0.5**	**104.0**
Acquitions:				
NFS-West Valley (Commercial)		0.6	0.3	0.9
Vallecitos Boiling Water Reactor		0.0		0.0
U.S. Commercial/Research Reactor Spent Fuel	0.2	0.1	0.4	0.7
Conmmercial Industry, Universities, Hospitals		0.1		0.1
Acquisitions Subtotal - U.S. Civilian Industry	**0.2**	**0.8**	**0.7**	**1.7**
UK Mutual Defense Agreement	0.1	5.3		5.4
Classified Military Agreements (Net additions)	0.1			0.1
Agreements for Cooperation-for Peaceful Uses	0.0	0.3	0.1	0.4
Acquisitions Subtotal - Foreign Countries	**0.2**	**5.6**	**0.1**	**5.8**
Total Acquitions	**0.3**	**6.4**	**0.7**	**7.5**
Total Production and Acquitions	**94.2**	**16.1**	**1.2**	**111.4**
Removals:				
Testing	3.4	0.0		3.4
Inventory Differences (MUFs)	2.7	0.1		2.8
Waste (Normal Operating Loss)	2.6	0.8		3.4
Fission and Transmutation	0.1	1.0	0.1	1.2
U.S. Civilian Industry (sold or permanently transferred)		0.1		0.1
Export (Agreements for Cooperation)		0.7		0.7
Radioactive Decay	0.2	0.1	0.0	0.3
Losses and Write-offs	0.0			0.0
Total Removals	**9.0**	**2.9**	**0.1**	**12.0**
Remaining Inventory	**85.1**	**13.2**	**1.2**	**99.5**

Source: Total Pu values from U.S. Department of Energy, "Plutonium: The First Fifty Years, February 1996. The breakdown into WGPu, FGPu, and RGPu are NRDC estimates.

Table 9. Location of U.S. Government Owned Plutonium Inventory (kg).

(DOD and Pantex data are estimates as of October 1996; data for other sites are for February 6, 1996)

Category	DOD	DOE														Total
		Pantex	Rocky Flats	Hanford	SRS	LANL	LLNL	INEL	ANL-West	Sandia	Oak Ridge	Mound	LBL	West Valley	Fort St. Vrain	
Weapons and Pits:																
Pits		27,576														27,576
Warheads awaiting dismantlement		8,008														8,008
Stockpiled warheads	30,516															30,516
Total in Weapons and Pits	**30,516**	**35,584**														**66,100**
Separated Pu:																
WGPu			12,700	1,517	1,800	1,950	300	1		8	5	32	1			18,314
FGPu				2,640		680										3,320
RGPu																0
Total Separated Pu			**12,700**	**4,157**	**1,800**	**2,630**	**300**	**1**	**0**	**8**	**5**	**32**	**1**			**21,634**
Unirradiated Fuel:																
WGPu									200							
FGPu				497		50			3,600							4,147
Irradiated Spent Fuel:																
WGPu				220	200			167								587
FGPu				5,205				1	200					126		5,532
RGPu				958	2			340							1	1,301
Total Pu in Fuel				**6,880**	**202**	**50**	**0**	**508**	**4,000**					**126**	**1**	**11,766**
Total Pu at Site	**30,516**	**35,584**	**12,700**	**11,037**	**2,002**	**2,680**	**300**	**509**	**4,000**	**8**	**5**	**32**	**1**	**126**	**1**	**99,500**

Source: Total Pu values from U.S. Department of Energy, "Plutonium: The First Fifty Years," February 1996.
The breakdown into WGPu, FGPu, and RGPu are NRDC estimates derived from other DOE documents.

Table 10. U.S. Plutonium Inventories Excess to National Security Needs (Metric Tons).

Location	Weapon-Grade Plutonium						Fuel and Reactor-Grade Plutonium			Total Plutonium Inventory
	Metal	Oxides	Reactor Fuel	Irradiated Fuel	Other Forms	Total	Separated (all forms)	Spent Fuel	Total	
Pantex /future dismantlements	21.3	-	-	-	-	21.3				21.3
Rocky Flats	5.7	1.6	-	-	4.6	11.9				11.9
Hanford Site	<0.1	1.0	-	0.2	0.5	1.7	2.9	6.4	9.3	11.0
Los Alamos	0.5	<0.1	<0.1	-	1.0	1.5	0.3		0.3	1.8
Savannah River	0.4	0.5	-	0.2	0.2	1.3	0.4	0.1	0.5	1.8
INEL	<0.1	-	0.2	0.2	<0.1	0.4	3.6	0.4	4.0	4.4
Other Sites	<0.1	-	-	<0.1	<0.1	0.1	0.2		0.2	0.3
Total	**27.8**	**3.1**	**0.2**	**0.6**	**6.4**	**38.2**	**7.5**	**6.9**	**14.4**	**52.6**

Sources: U.S. Department of Energy, "Plutonium: The First Fifty Years," February 1996, p. 76.
U.S. Department of Energy, "Taking Stock: A Look at the Opportunities and Challenges Posed by Inventories from the Cold War Era," DOE/EM-0275, January 1996, p. 45.

Table 11. U.S. Excess Plutonium by Category.

Category:	Pu (t)
Separated High-Purity Pu	
WGPu Metal, Oxides and Solutions:	
Dismantlements and Pantex, Excess Pits	21.3
Rocky Flats	7.4
Hanford	1.4
Los Alamos	0.5
Savannah River	0.9
INEL	<0.1
Other Sites	<0.1
Subtotal (WGPu Metal and Oxides)	**31.6**
Separated FGPu and RGPu	
Hanford	1.2
Los Alamos	0.3
Savannah River	0.4
INEL	3.6
Other Sites	0.2
Subtotal (Separated FGPu and RGPu)	**5.7**
Subtotal (Separated High Purity Pu)	**37.3**
Separated Low-Purity Pu	
Rocky Flats, Excess WGPu Scrap and Residues	4.5
Hanford, Excesss WGPu Residues	1.6
Los Alamos, Excess WGPu, Other Forms	1.0
Savannah River Site, Excess WGPu, Other Forms	0.2
INEL, Excess WGPu, Other Forms	<0.1
Other Sites, Excess WGPu, Other Forms	<0.1
Subtotal (Separated Low-Purity Pu)	**7.3**
Fresh Reactor Fuel	
Hanford	0.5
Los Alamos	<0.1
ANL-West (at INEL)	0.2
Subtotal (Unirradiated Reactor Fuel)	**0.7**
Irradiated Fuel	
Hanford, Production Reactor and FFTF	6.4
Savannah River, Mostly Production Reactor	0.3
INEL	0.6
Other Sites	<0.1
Subtotal (Irradiated Reactor Fuel)	**7.3**
Subtotal (Low-Purity Pu and Reactor Fuel)	**15.3**
Total (Excess Pu)	**52.6**

Table 12. Highly Enriched Uranium Inventories (Metric Tons).

Location	Average Enrichment (% U-235)	HEU Inventory: DOE Data 27-Jun-94	HEU Inventory: NRDC Est. 1-Oct-96	Excess HEU (February 6, 1996): Metal	Oxide	Fresh Fuel	Irradiated Fuel	Other Forms	Total	2003: Weapons	Reserved for Navy	Available for Civil Fuel	Disposal Only	Unresolved	Total	Transferred to USEC
In Warheads and at Pantex:																
	93.5	Classified	196.9							150.0					150.0	
Secondaries	70.0	Classified	13.3						1.7	12.5					12.5	
Secondaries	37.5	Classified	119.8						15.0	112.3					112.3	
Subtotal - Warheads and at Pantex	.	Classified	330.0	16.7	-	-	-	-	16.7	274.7					274.7	
Oak Ridge Y-12 Plant:	93.5	Classified	303.1							30.0	320.0				350.0	
	70.0	Classified	9.6							10.5					10.5	5.0
	37.5	Classified	86.7							22.5		71.8			94.3	45.0
Production Reactor Fuel (25.7% U-236)	58.0		12.8	12.4				0.4	12.8			12.8				
Subtotal - Oak Ridge Y-12 Plant		168.9	399.5	63.1	2.7	10.6	0.6	7.9	84.9	62.9	320.0	87.3	18.1		464.8	50.0
Rocky Flats		6.7	6.7	1.9	<0.1	0.6	-	0.4	2.8			2.5	0.4	3.9	6.7	
Portsmouth Gaseous Diffusion Plant		23.0	23.0	-	7.3	-	-	15.2	22.5			7.3		15.7	23.0	
Oak Ridge K-25 Gaseous Diffusion Plant		1.5	1.5											1.5	1.5	
Oak Ridge National laboratory		1.4	1.4											1.4	1.4	
Hanford Reservation		0.8	0.6	<0.1	0.1	0.1	0.3	0.1	0.5			0.2	0.3	0.1	0.6	
Savannah River Plant (25.7 to 34% U-236)	50-60	24.4	22.0	12.2			9.5	0.2	22.0				22.0	0.0	22.0	
Idaho National Engineering Lab. & ANL-West		26.2	26.2	1.6	1.7	2.8	16.6	0.6	23.4			6.1	16.6	3.4	26.2	
Los Alamos National Laboratory		3.2	3.2	<0.1	0.3	0.1	<0.1	0.1	0.5			0.4		2.8	3.2	
Lawrence Livermore National Lavoratory		0.2	0.2											0.2	0.2	
Brookhaven National Laboratory		0.2	0.3	-	-	-	0.2	<0.1	0.3				0.3		0.3	
Sandia National Laboratories		0.9	0.9	<0.1	0.1	<0.1	0.1	<0.1	0.2			0.1	0.1	0.7	0.9	
Knowles Atomic Power Laboratory	97.3	1.6	1.6								1.6				1.6	
Other DOE Sites		.	0.5	<0.1	0.2	0.2	<0.1	<0.1	0.5			0.4			0.4	
Total Inventory (exclusive of Commercial and naval fuels)		258.[illegible]	819.4	95.5	12.4	14.4	27.3	34.5	174.3	337.7	321.6	104.3	56.8	29.7	817.5	50.0
Naval Reactor Fuel Production	97.3		120													
Pu Production Reactor Fuel			30													
Nuclear testing			5													
Produced for Civil Reactor Fuel and R&D			20													
Total HEU Produced			994													

Source: HEU Excess from DOE, Openess Press Confrence, Fact Sheet, Feburary 6, 1996;
HEU inventories are from DOE, Openess Press Confrence, Fact Sheet, June 27, 1994,
except for HEU in weapons and at Pantex and production for nuclear testing civil and naval reactor fuel,
which are NRDC estimates. The amounts of HEU reserved for weapons, the naval fuel
and civil fuel are also NRDC estimates. The amount of intermediate enriched uranium in weapons is highly uncertain.
Of the 174.3 t excess, DOE claims 103 t is in a form that can be blended down into LEU fuel for reactors.

Figure 1. U.S. Nuclear Weapon Stockpile

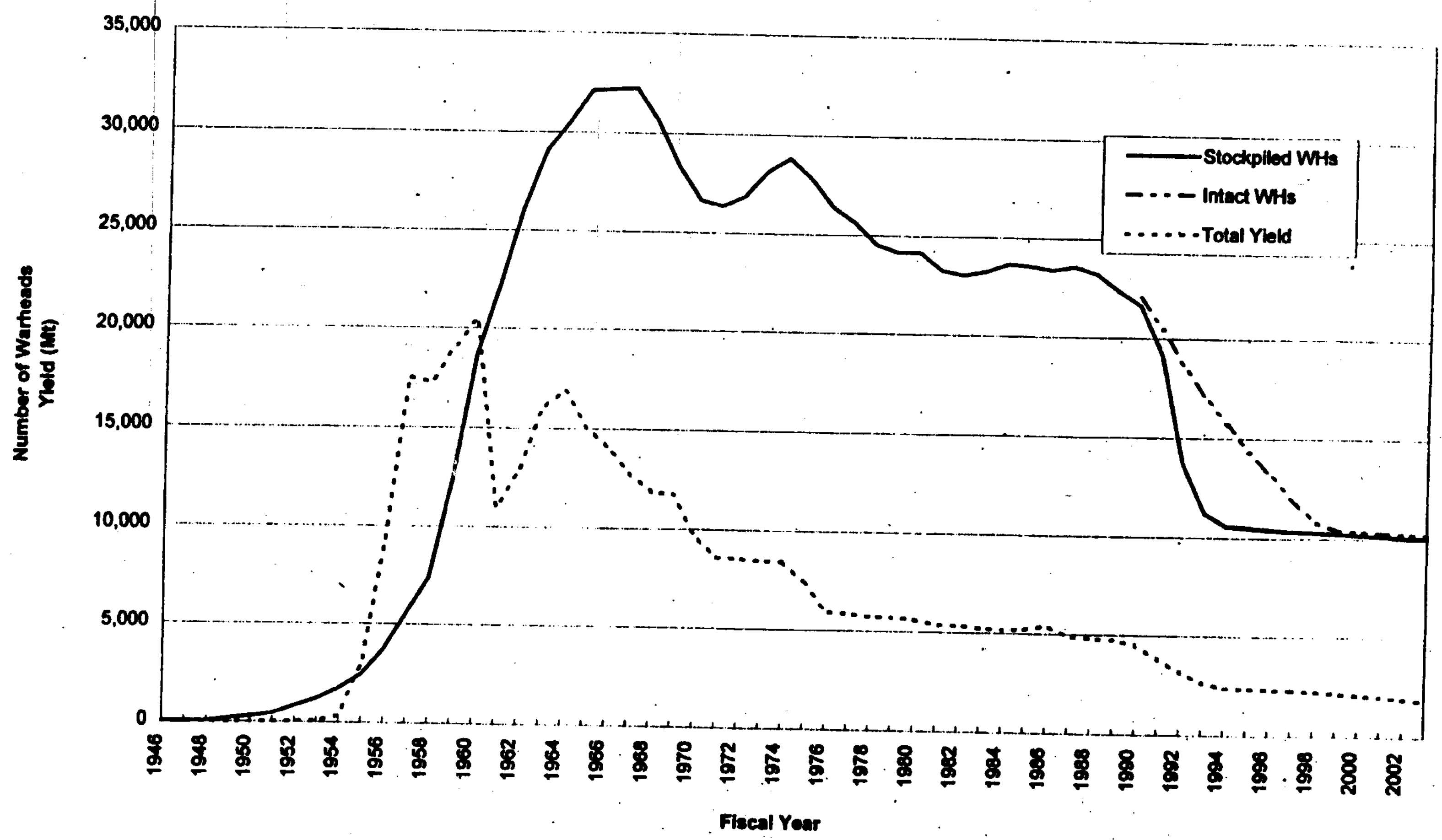

Figure 2.
U.S. DOE Nuclear Weapons Activities - Annual Budget Authority.
(Constant FY1996 Dollars -- millions)
1948-1995: Weapons Research, Development, Testing and Production
1996-2002: "Science Based Stockpile Stewardship" and "Stockpile Management"