NUCLEAR WARHEAD DESTRUCTION

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I. INTRODUCTION: VERIFICATION OF THE NUCLEAR WARHEAD ELIMINATION PROCESS IN WEAPONS STATES

When the Ministry of Defense of the former Soviet Union began removing thousands of tactical nuclear weapons from the Ukraine in December 1991, no U.S. or United Nations inspectors were on hand to verify the process, despite the desire of the new Ukrainian government for international inspection to assure elimination of Russian warheads, and the willingness of at least some senior political authorities in the new Russian government to grant it. The main problem, as it turned out, was not in Moscow or Kiev but in Washington, where erstwhile advocates of "effective verification" had suddenly reversed field, arguing that U.S.-Soviet "unilateral" arms reductions did not require any mutual verification measures.

As of December 1993, the U.S. government has yet to advance a coherent program for verifying elimination of tens of thousands of former Soviet warheads and tracking the ultimate disposition of hundreds of tons of surplus bomb-grade materials in the Russian nuclear stockpile. Once invoked as a kind of magic mantra to ward off unwanted arms control agreements, "on-site inspection" is now viewed by some in the national security establishment as a dangerous Trojan horse that will pry open the gates to global nuclear disarmament. But to reject extensive cooperative monitoring measures on nuclear warheads and materials now, at the very moment when the international community is seeking to upgrade similar controls in non-weapon and threshold nuclear states, would do more than perpetuate the "do as I say, not as I do" dichotomy that has plagued U.S. nonproliferation efforts for decades. It could undermine the technical and political basis for achieving even deeper reductions in the future. A failure to properly account for disposition of the vast Cold War excess of nuclear destructive power now being "eliminated" could actually make the proliferation problem worse, by increasing uncertainty about who does or does not have access to nuclear weapons materials and technology. At the very least, this uncertainty creates a lofty floor for nuclear arms reductions below which, it will be argued, "a prudent national security posture" can not go.

At the very moment of maximum political opportunity -- and genuine technical need -- for extensive nuclear inspections throughout Russia and the other states of the CIS with nuclear weapons on their territory, the Bush Administration ducked the chance to establish verification arrangements that would assure nuclear warhead elimination and monitoring of the nuclear explosive materials removed from dismantled warheads. These monitoring arrangements could lay the groundwork for a universal nuclear inspection regime under the UN Security Council and truly radical arms cuts down to a few hundred weapons in each nuclear weapon state. Instead of trying to move the U.S.-CIS nuclear monitoring regime closer to the current international nuclear inspection regime -- now receiving increased understanding and support worldwide as a result of the UN Special Commission inspections in Iraq -- the Bush Administration continued to place future U.S. freedom of action with respect to its own nuclear arsenal ahead of the global nonproliferation agenda. A few days after his retirement in August 1992 as Assistant to the Secretary of Defense for Atomic

Energy, Dr. Robert Barker testified against mutual verification of nuclear stockpiles as follows:

> A concern about Russian nuclear weapons security should not result in a mandate for Russian inspection of U.S. facilities. An automatic requirement for reciprocity is, frankly, old-think.[1]

However, as matters now stand, an indeterminate number of former Soviet warheads have been returned to storage sites in the Russian heartland east of the Urals, an indeterminate number of these may be dismantled, and an indeterminate amount of nuclear explosive (fissile) material from the weapons will go who knows where. Intact warheads, weapon components, or bulk fissile material could disappear from this process at any time and the international community would be none the wiser.

That uncertainty is the price we are paying today for the Bush Administration's failure to pursue negotiations, first with Gorbachev, and then with Yeltsin, on a fissile material production cutoff and verified storage and destruction of nuclear warheads. Since the spring of 1989, House and Senate peppered the Administration with report requirements, research programs, and "sense of the Congress" resolutions urging preparations for these initiatives, but the Bush national security team sidetracked or ignored all of these efforts.

Eleven months into the new administration, it still remains unclear whether President Clinton's national security team will pursue a substantially different policy with respect to the monitoring of nuclear warhead and fissile material inventories. A number of the key players in the process are holdovers from the Bush administration, and presumably will continue to support the same policies. In his September 27 address to the United Nations unveiling the administration's long-awaited nonproliferation policy initiatives, President Clinton omitted any reference to the 1995 NPT extension conference and the disarmament responsibilities of the nuclear weapons states under Article Six. He also had nothing to say about monitoring the destruction of warheads and the disposition of fissile materials pursuant to the reductions to be carried out under the START and START II treaties and the various mutual unilateral initiatives to eliminate tactical nuclear weapons. In fact, the speech's only reference to the entire process of nuclear arms reduction and denuclearization in the U.S. and the states of the former Soviet Union was a vague rhetorical flourish:

> "President Kennedy warned this Chamber that humanity lived under a nuclear sword of Damocles that hung by the slenderest of threads. Now the United States is working with Russia, Ukraine, Belarus and others to take that sword down, to lock it away in a secure vault where we hope and pray it will remain forever."

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[1] Testimony of Dr. Robert Barker before the Senate Armed Services Committee, August 4, 1992 (committee transcript), subsequently printed as "Military Implications of START I and START II," SASC Hearings, 102nd Cong., 2nd Sess., USGPO, 1992, p.173.

In reality, there is no joint program, involving the U.S. and the newly independent states, to lock nuclear weapons away in a secure vault. Although Defense Secretary Aspin did suggest this idea during a June 1993 visit to Ukraine, the idea was subsequently dropped in the face of Russian criticism that the U.S. plan was too narrowly focused on land-based weapons and lacking in reciprocity. Nor is there a program even to comprehensively account for the inventory of weapons that currently exist. What exists is merely a framework under the "Nunn-Lugar assistance program" for a U.S.- Russian project -- now largely stalled as a result of the recent political turmoil -- to build a modern secure storage facility for fissile material components from an unknown fraction of the obsolete weapons to be dismantled by Russia, a program which, even if brought to a successful conclusion five to seven years hence, will not begin to approximate "locking away" the nuclear sword of Damocles, and begs the question of what will be done in the interim, especially prior to April 1995.

In the place of a serious proposal for comprehensive warhead and fissile material controls, the Clinton Administration has cautiously advanced a kind of nonproliferation placebo involving a unilateral U.S. offer to make "excess highly-enriched uranium (HEU) and plutonium (Pu) subject to the U.S.-IAEA voluntary safeguards agreement." A White House "Fact Sheet" issued well before the President's UN speech noted that "material offered for IAEA safeguards will include that which is neither currently in nuclear weapons nor required to support the maintenance of our nuclear weapons stockpile."

> Because any material the U.S. places under IAEA safeguards will not be withdrawn for nuclear weapons purposes, the U.S. will need to carefully segregate material offered for IAEA safeguards from material required for the strategic reserve.
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> ....The United States believes that it is important to place some initial quantity of nuclear material under the U.S. - IAEA voluntary safeguards agreement prior to the 1995 Non-Proliferation Treaty Review Conference. Placing an initial quantity under IAEA safeguards in this time period will demonstrate American leadership and set an example for other states to follow in accepting IAEA safeguards on their stockpiles of fissile material.[2]

There is considerable uncertainty surrounding the number and status of former Soviet weapons. According to Minatom Minister Mikhailov, the Soviet nuclear weapons stockpile

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[2] "Fact Sheet on U.S. Excess Fissile Materials and Safeguards," The White House, Office of the Press Secretary, September 11, 1993. While this proposal may be sincere and well-intentioned, it is hardly the basis for an appropriate global norm. Viewed in isolation, it is an invitation, particularly in nuclear weapon and threshold states, to create a safeguards "Potemkin Village", where some weapons-usable material is placed with great fanfare under safeguards while unknown quantities are openly or covertly kept in a "strategic reserve," in line with the U.S. proposal. The only way around this problem is to seek a comprehensive accounting for all past production and inventories of fissile materials, and to require all materials not already physically located in weapons (declared or undeclared) to be irrevocably committed to peaceful use or disposal under safeguards.

grew rather steadily until it peaked in 1986 at 45,000 warheads;[3] and then declined by 20 percent to 35,000 warheads as of mid-1992.[4] This implies an average dismantlement rate of 1670 warheads per year. 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.[5] The upper limit of the CIA estimate is consistent with the Mikhailov figures. According to senior Minatom officials in June 1992, the FSU stockpile was projected to decline to 40-50 percent of its mid-1992 level as a result of arms control initiatives through early 1992.[6] This implies a 17,500 to 21,000 reduction, bringing the stockpile down to 14,000 to 17,500 warheads.

The CIA, in contrast, informed Congress in May 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 weapons; 5,000 to 12,000 tactical nuclear weapons, and our estimate of 2,700 weapons remaining from the INF treaty.[7]

The CIA upper limit on the number of warheads slated for dismantlement is 1,500 warheads less than that derived from the Minatom statements.

As a consequence of the Bush/Gorbachev initiative of September/October 1991, and the Strategic Arms Reduction Treaty (START I), the "active" (operational) Russian stockpile would be reduced to 10,500-13,000 warheads by the year 2000. On June 17, 1992, Presidents

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[3] Viktor Mikhailov, remarks at a meeting in Washington, D.C. hosted by the Committee on International Security and Arms Control of the National Academy of Sciences, February 17, 1993.

[4] Viktor Mikhailov and Evgeniy Mikerin, in remarks at the International Symposium on Conversion of Nuclear Warheads for Peaceful Purposes, Rome, Italy, June 15-17, 1992, stated that the stockpiled had declined by 20 percent since it peaked in 1986. In an interview with Yevgeniy Panov, *Moscow Rossiyskaya Gazeta*, in Russian, December 11, 1992, p. 7 (Translated in *Foreign Broadcast Information Service*, FBIS-SOV-92-239, December 11, 1992, p.3), Viktor 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."

[5] 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, May 6, 1992, p. 499.

[6] Viktor Mikhailov and Evgeniy Mikerin, Rome, June 15-17, 1992.

[7] Lawrence K. Gershwin, Hearings before the House Committee on Appropriations, DOD Appropriations for 1993, Part 5, May 6, 1992, p. 499.

Bush and Yeltsin announced that the U.S. and Russian strategic arsenals would each be reduced by 2003 to 3000-3500 warheads associated with deployed strategic delivery vehicles. This agreement was codified as the second Strategic Arms Reduction Treaty (START II) -- signed in Moscow by Yeltsin and Bush on January 4, 1993.

II. The Status of the Warhead Dismantlement Process

Russia: Between 1986 and mid-1993, we estimate that the CIS/Russian nuclear weapons stockpile declined by about 25 percent from its peak level, leaving an estimated 33,000 warheads intact in Russia, Ukraine, Belarus, and Kazakhstan. Although its capacity is said to be much greater, Russia is believed to be dismantling warheads at the rate of 2000 to 2500 per year, comparable to the U.S. rate. There are probably only a handful of people in Russia that know the true figures.

Compiled by our colleague, Dr. Robert Standish ("Stan") Norris, Table I shows our estimate of the composition of the "operational" CIS stockpile of some 15,000 warheads. The other 16,000 warheads (45,000-15,000=16,000), are primarily tactical warheads that are either awaiting dismantlement, or beirg held in an "inactive reserve" status. At the current rate of dismantlement it will be six to eight years -- from 1999 to 2002 -- until all of these 16,000 warheads could be destroyed.

The Russian Ministry of Atomic Energy (Minatom) has sole responsibly for the design, testing, construction, and dismantlement of nuclear warheads of the former Soviet Union. There are three major Russian assembly/disassembly plants: Sverdlovsk-45 at Nizhnaya Tura; Zlatoust-36 at Yuryuzan; and Penza-19 at Kuznetsk, a small city 115 kilometers east of Penza. Small scale production and disassembly also takes place at Arzamas-16, one of the two design laboratories. The U.S. Defense Intelligence Agency describes Sverdlovsk-45 as a "very large plant," Zlatoust-36 as a "much smaller facility," and Penza-19 as a "small component fabrication and assembly plant." Minatom Minister Viktor Mikhailov has said the total capacity of the complex is about 7000 warheads per year (assembly and disassembly), but many experts believe that the complex is not at full capacity, which would probably require a highly efficient, three-shift, 24-hour-a-day operation. Officials have said it takes more time to take a weapon apart than to assemble one, and some capacity is being used to modify existing warheads and assemble new ones, probably for the SS-25 ICBM. Finally, there is the issue of whether a high rate of dismantlement could be sustained in a safe and environmentally responsible manner. These factors, lead us to estimate that the current dismantlement rate is probably between 2000 and 2500 warheads per year.

United States: The stockpile of U.S. nuclear warheads peaked in 1967 at just over 32,000 warheads. By the time the Soviet stockpile peaked in 1986, the U.S. stockpile had been reduced to 23,400 warheads. No new warheads have been produced in the United States since the summer of 1990.[8] By mid-1993 the inventory of assembled nuclear warheads had been reduced to about 17,000 warheads. The U.S. nuclear stockpile is now at the lowest level since late 1958 or early 1959.

Table 2 shows our estimate of the composition of the current U.S. "operational" stockpile of approximately 10,500 warheads. There are two other stockpile categories: the "inactive reserve," and warheads awaiting eventual disassembly. According to the U.S. Department of Defense (DOD), "the IR [inactive reserve] holds the Nation's only capacity for augmenting our significantly reduced active nuclear forces in response to a reversal in current geo-political trends or the emergence of a new strategic threat." At present only the W84, the warhead for the former ground-launched cruise missiles, is known to be in inactive reserve. We estimate that 400 of these were built before production ceased in January 1988. Though the INF Treaty banned the missiles and other supporting equipment, the warheads were retained. Two other warheads, the W69 for the bomber-launched Short Range Attack Missile (SRAM) and the B53 nine-megaton bomb, are ambiguous cases. They may be in the inactive category as well.

We estimate that some 6000 warheads are in retirement category, stored at DOD or DOE depots awaiting dismantlement. In the two years, thousands of warheads have returned to central military storage depots in the United States and funneled to DOE's Pantex facility for final disassembly and disposal. They are being dismantled at the rate of 1500 to 2000 per year. Thus, it will take the United States only three or four years to dismantle the 6000 warheads now in the dismantlement category.

Under current plans--premised on Ukraine ratifying START and Russia and The United States ratifying START II--the future U.S. "operational" stockpile is scheduled to be 5100 warheads, comprised of some 3500 strategic and 1600 non-strategic weapons. This future operational stockpile will likely have six warhead types (B61, W76, W80, B83, W87, and W88).

But this accounting is misleading. There is nothing in START, START II, or any other existing agreement between the United States and the CIS that limits the number of warheads to be held in reserve, or that limits the fissile weapon components or materials, also held in reserve. Even if the U.S. "operational" stockpile reaches 5100 warheads by the year 2000, the U.S. could still retain another 5800 warheads in inactive reserve, and retain fissile material components for thousands of additional weapons. For example, the Clinton

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[8] The U.S. Department of Energy (DOE) is responsible for the design, testing, construction, and dismantlement of U.S. nuclear warheads. Before production ceased in November 1989, plutonium "pits" were produced at DOE's Rocky Flats plant in Colorado, and shipped to the Pantex plant in Texas where final assembly of warheads took place. By the summer of 1990 the supply of pits from Rocky Flats was exhausted.

Administration has reported to Congress on the types of nuclear weapons that will be retained in the U.S. nuclear stockpile as of September 30, 1996, the statutory cutoff date for U.S. underground test explosions, and based on that report we estimate that "active" and "inactive reserve" stockpile will total some 10,950 weapons (see Table 3). The Russian, or CIS, situation is likely to mirror that of the United States.

III. The Need for Greater Transparency in the Dismantlement Process

There are only two verification, or transparency, agreements related to nuclear warhead dismantlement. The first, between Russia and Ukraine, ostensibly permits Ukraine to confirm that the tactical warheads removed from Ukraine after the breakup of the Soviet Union are in fact being dismantled. The second is an agreement signed by Vice President Albert Gore and Russian Premier Viktor Stepanovich Chernomyrdin in Washington, D.C. on September 2, 1993. It ostensible objective is to confirm that the 500 tonnes of high-enriched uranium (HEU) purchased by the United States comes from dismantled warheads, and permits Russia to confirm that this material, after blending down to low-enriched uranium (LEU) will only be used as civil power reactor fuel. Neither the text of these agreements, nor details regarding how either is being, or will be, implemented, has been made public. However, it has become clear in recent weeks that the administration has quietly abandoned the objective of confirming that the HEU actually comes from dismantled warheads, and is now pursuing the objective of assuring itself that the material being used for blending in Russia to make low-enriched reactor fuel is actually HEU.

There are currently no verification, or transparency, procedures in place that permit the United States and Russia to determine, or confirm, the number of warheads retired from active service, the number slated for dismantlement, the number that have been dismantled, or the number being retained in a "reserve stockpile" status. There is not even an exchange of unverified data in this regard.

Why is more transparency desirable? The primary reason is that failure of the United States and Russia to carefully track each other's dismantlement process will leave large uncertainties in the knowledge each side has with regard to the size and disposition of the other's inventories of residual warheads and fissile materials. To place this in perspective, at the recent annual symposium of the Uranium Institute in London, Minatom Minister Mikhailov revealed that Russia's sale of 500 tonnes of HEU to the United States represented only about 40 percent of the inventory of HEU in weapons and in stockpiles.[9] This means the CIS HEU inventory is about 1250 tonnes, which is greater than the upper limit of previous U.S. intelligence estimates. The difference between the size of the HEU stockpile as revealed by Minister Mikhailov, and the mid-point of the U.S. intelligence community's estimate, is comparable to the entire U.S. HEU stockpile! Under these

[9] Elizabeth Martin, "A Conversation with Viktor Mikhailov," NUKEM Market Report, October 1993, p.21.

circumstances, without further transparency, the U.S. military establishment may be able to effectively argue that further nuclear warhead reductions would be imprudent, and that large warhead reserves and fissile material inventories must be retained. Similar arguments may be made in Russia, and in any case Russia will likely retain a large reserve if the United States does.

Should the United States and Russia maintain large stocks of warheads in inactive reserve and large stockpiles of fissile material as weapon components, there will be little incentive for other nuclear powers, such as France, China, U.K. and Israel, to join in the disarmament process. Chinese nuclear experts, with their far smaller nuclear stockpile, have already expressed the view that the START agreements do not represent genuine nuclear disarmament, but merely a shifting of the nuclear superpower stockpiles from active to reserve status. We need to devise mechanisms to increase international confidence that nuclear warhead destruction is being accomplished in an irreversible manner.

A second reason additional transparency is desirable--at least from the U.S. standpoint--is to increase confidence that no warheads or fissile materials are being diverted from the CIS for sale or other unauthorized use. There are numerous reports of attempted sales of weapons-usable materials in the CIS. Fortunately, most have been hoaxes. Minatom, however, has reportedly registered three cases of theft of uranium in Podolsk, Glazov, and at Arzamas-16. Two cases involved LEU and one involved HEU. The U.S. government does not have any independent means of confirming evidence of diversion in Russia. Instead the U.S. government is forced to rely on statements by the Russian government, which is not always on top of the facts. This concern also applies to Ukraine, Belarus, and Kazakhstan.

IV. Technical Challenges

The technical requirements to verify nuclear warhead inventories, the dismantlement process, storage of fissile materials, and a cutoff in the production of fissile materials for weapons have been studied extensively and are well understood.[10]

The first step is for the countries involved to exchange date on inventories of warheads and fissile material, and to periodically update this data exchange. We have prepared, in Table 4, a matrix showing the type of data that might be exchanged. We have been careful to construct it so that the fissile material inventory in a given warhead type

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[10] See, for example, "Ending the Production of Fissile Materials for Weapons; Verifying the Dismantlement of Nuclear Warheads," Federation of American Scientists, June 1991; "Report on the Third International Workshop on Verified Storage and Destruction of Nuclear Warheads," held in Moscow and Kiev, December 16-20, 1991, Natural Resources Defense Council; "Report on the Fourth International Workshop on Nuclear Warhead Elimination and Nonproliferation," held in Washington, D.C., Federation of American Scientists and Natural Resources Defense Council; William G. Sutcliffe, "Fissile Materials from Nuclear Arms Reductions: A question of Disposition,"Lawrence Livermore National Laboratory, CONF-910208, CTS-31-92, February 18, 1991.

could not be derived from the exchanged data. The next step is to negotiate procedures for verifying the data exchange.

On February 12, 1992, Russian Foreign Minister Russia Andrei Kozyrev formally proposed a reciprocal exchange of data between all nuclear weapon powers on inventories of nuclear weapons and fissile materials, and on nuclear weapons production, storage, and elimination facilities. The Bush Administration failed to respond positively to this Russian initiative at the time, and ignored the offer for the remainder of its term in office.

The Clinton Administration should seriously examine the following measures for inclusion in supplemental monitoring arrangements that meet the verification objectives of the Senate START condition:

-- a data exchange, including the total number of warheads of each type, and the total masses of plutonium and highly-enriched uranium metal within and outside of nuclear weapons;

-- an exchange of serial numbers and storage locations of warheads and bombs, which could be updated at six- or twelve-month intervals;

-- application by the owning party of tamper-resistant, laser-readable bar-codes and/or "intrinsic fingerprint" tags on all nuclear weapons (or on their containers sealed with tamper-indicating locks), accompanied by immediate provision of these data to the verifying party at the inspection site;

-- random on-site inspection of weapon storage sites to verify the disposition of warheads as set forth in the periodic exchanges of data; identification of all nuclear weapons or sealed weapon canisters entering a dismantlement facility or leaving a production facility by matching the serial number to a unique barcode and/or "fingerprint" tag;

-- international safeguards over fissile material permanently removed from weapons use, civil stocks, and plants capable of producing such material.

The Clinton Administration and the Congress should also consider exchanging the following or similar categories of data (shown in **Table 4**), on an annual or semi-annual basis:

(1) the numbers of CIS/Russian and U.S. nuclear stockpile weapons added, retired, dismantled, and remaining in service (if any) in each of the following categories:

(i) total stockpiles;

(ii) strategic ballistic missile warheads;

(iii) strategic bomber weapons;

(iv) non-strategic land-based missiles (incl. air defense), artillery, mines;

(v) gravity bombs;

(vi) ship-launched weapons/sea mines;

(2) the total masses of CIS/Russian and U.S. plutonium and highly-enriched uranium in:

(i) the total nuclear weapons stockpile

(ii) weapons on or available for strategic nuclear delivery vehicles;

(iii) all other nuclear stockpile weapons;

(iv) other stocks outside of but available for weapons

(v) irrevocably transferred from weapons use to peaceful use;

(vi) recovered from spent fuel

(vii) fresh (>20%) enriched uranium (unirradiated)

(viii) the combined total inventory of potentially weapons-usable fissile material.

(3) the current status, fissile material inventories, and output of all known CIS/Russian and U.S. facilities with the capacity for producing or processing significant quantities of fissile materials.

In developing the verification arrangements required by the Biden condition, Executive Branch agencies, particularly the DOE and its national laboratories, should seek to engage nuclear weapon experts of the former Soviet Union in the joint development and implementation of:

(1) reliable techniques and procedures for verifying a global ban on the production of fissile materials for weapons purposes;

(2) reliable techniques and procedures for permanently transferring agreed quantities of fissile materials out of the nuclear weapons production cycle, and

for safeguarding the secure storage of these materials pending future nonweapon uses or permanent disposal;

(3) techniques to permanently dispose of nuclear weapons components and materials in a verifiable and safe manner so as to prevent recovery for use in weapons;

(4) increased technical assistance to the IAEA to aid in the accomplishment of its global safeguards and inspection responsibilities.

The technology for verifying warheads in storage and transport involves mechanical locks, electronic and fiber optic seals, intrinsic fingerprint techniques for metal surfaces, bar codes, and surveillance devices. Most of these technologies are commercially available and many are presently in use by the International Atomic Energy Agency (IAEA) to verification the disposition of nuclear fuel.

Verifying the warhead dismantlement process itself presents unique problems due to the need to protect sensitive warhead design information. But here again, procedures for doing so have already been worked out. Using gamma-ray spectroscopy and computer algorithms, it is possible to confirm that warheads entering a dismantlement facility are authentic, and that all the fissile material removed from the facility is accounted for. The fissile material would be transferred to a safeguarded storage in sealed containers. The procedure could be greatly simplified if each side is willing to reveal to the other the quantity of fissile material in each warhead of a given type or class. While these data would not have to be revealed to other governments or made public for non-proliferation reasons; an exchange of these data by the United States and Russia would hardly threaten the national security of either country. If these data were exchanged there would be no need to closely monitor the portals to the dismantlement facility, or to authenticate each warhead prior to dismantlement. Each side would simply deliver periodically to the safeguarded storage facility the amount of fissile material consistent with the total number of warheads dismantled during a specified period.

The procedures and technology for verifying fissile material inventories and a cut-off in the production of fissile material for weapons are the same as those already being applied by the IAEA to the commercial fuel cycle. There will be special requirements to permit the continued supply of naval reactor fuel and replacement tritium for weapons. But these problems have been studied and are fairly well understood.

In sum, there are simply no technological show stoppers to verifying nuclear warhead inventories, the dismantlement process, storage of fissile materials, or a cutoff in the production of fissile materials for weapons. The difficulty is deciding what level of verification is desired, taking into account the need to reduce the uncertainties mentioned

above, the cost of verification, and the need to protect some warhead design details. Once this is decided the procedures and technical requirements are straight forward.

V. Political Challenges

Two years ago, October 17-19, 1991, the Second International Workshop on Verified Storage and Elimination of Nuclear Warheads was held in Washington, D.C.[11] This was shortly after Presidents Gorbachev and Bush had each made unilateral commitments to eliminate thousands of tactical nuclear warheads, and shortly after the failed putsch to oust Gorbachev. The workshop participants included Viktor Mikhailov, then deputy Minister of Atomic Power and Industry and now Minister of the Ministry of Atomic Energy (Minatom), Evgeniy Avrorin, Scientific leader of Chelyabinsk-70, and Sergei Kortunov, then Counsellor 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 numbers 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 nations 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 that the fissile material recovered from warheads is placed under safeguards.

Despite the expressed Soviet interest in a data exchange and verification of warheads and fissile material, the Bush Administration chose not to pursue any of these options, arguing that the validity of the data exchanged could not be confirmed without intrusive inspections and that such inspections could compromise sensitive U.S. facilities and information and excessively complicate day-to day-operations of the U.S. nuclear weapons complex. In reality, Bush Administration officials feared that Russian oversight over U.S. weapon facilities and fissile materials would restrict future U.S. nuclear weapons policy.

In December of 1991, the Third International Workshop on Verified Storage and Destruction of Nuclear Warheads" was held in Moscow and here in Kiev.[12] At that meeting NRDC offered to supply all materials and equipment to permit Ukraine and Russia to jointly tag and seal all tactical warheads slated to be transported to Russia for

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[11] This conference was organized on the U.S. side by the Federation of American Scientists, and on the Soviet side by the USSR Foreign ministry.

[12] Organized on the Soviet side by the Arms Control Directorate of the USSR Foreign Ministry and the Ministry of Atomic Power and Industry; and on the U.S. side by the Federation of American Scientists and the Natural Resources Defense Council.

dismantlement. This idea was rejected by both the Russian and Ukrainian military representatives, in part because this was not part of a government-to-government agreement between the U.S. Russia and Ukraine which would involve reciprocity on the part of the United States.

On July 2 1992, the Senate Committee on Foreign Relations (SFRC) adopted a condition to the resolution of ratification for the START I Treaty -- approved by the full Senate in October -- that directs 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 other cooperative measures (text of the so-called "Biden Condition" is included in a footnote below.)[13]

Now, eleven months into the Clinton Administration, no effort has been made to reverse the Bush policy on warhead verification. In fact, in September 1993 the Clinton Administration asked the House Foreign Affairs Committee to drop a provision in a comprehensive non-proliferation bill sponsored by Congressmen McCloskey and Stark that would have required the Administration to report to Congress on progress being made to comply with the Biden Condition.

VI. Conclusion

In sum, the obstacle to improving transparency, or verification, in the nuclear warhead dismantlement process is not technical, but political. With political chaos in Russia, the initiative now will have to come from the United States. But for the past two years the Bush and Clinton Administrations have sought to shield the U.S. nuclear establishment from rigorous inspection by adopting a policy approaching benign neglect toward the disposition of the Russian nuclear weapons stockpile, production complex, and fissile material inventories. Had there been a modicum of political initiative by the United States, it is at least possible that today we could have had scores of bilateral and international inspectors tracking the disposition of nuclear weapons and weapons-usable materials. Instead we are losing track of materials, and increasing the likelihood that the disarmament process will bog down over future uncertainty regarding how many warheads were built, how many destroyed,

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[13] Condition Eight to the Resolution of Ratification for START Adopted by the Senate Committee on Foreign Relations, July 2, 1992:

"(8) Nuclear Weapon Stockpile 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 inventory of facilities on the territory of the parties to this treaty capable of producing or processing significant quantities of fissile materials."

See "The Start Treaty," Report of the Committee on Foreign Relations, U.S. Senate, USGPO: 1992, p. 101.

and whether all the weapons usable material can be accounted for. What is lacking is national and international leadership with wisdom and foresight to create the verification infrastructure that will insure that we can continue the process toward truly deep reductions in nuclear weapons, and the secure storage of small remaining stockpiles under international monitoring, a process we call the "virtual abolition" of nuclear weapons.

As deep nuclear and conventional force reductions proceed and international control mechanisms are built-up, it should become both possible and desirable to shift the international security role of nuclear weapons from day-to-day deterrence of nuclear and large-scale conventional attacks to passive discouragement of potential proliferant nations. This shift can be achieved initially through international commitments to "no-first-use" of nuclear weapons, and through the retention of modest internationally-monitored nuclear reserve forces, the size and combat readiness of which are steadily diminished over time. Over the long term, as greater confidence is achieved in a comprehensive nuclear explosive materials control system, this proliferation "discouragement" mission could be performed by secure deep underground storage of small residual nuclear warhead inventories -- under international monitoring -- that could be remated with their delivery systems in the event a serious nuclear threat to international security emerged that justified redeployment of a nuclear deterrent force.

TABLE 1: ESTIMATED RUSSIAN (C.I.S.) NUCLEAR STOCKPILE (JULY 1993)

Category/type	*Weapon system*	*Launchers*	*Warheads*
Strategic offense			
ICBMs	SS-18, SS-19, SS-24, SS-25	1,003	5,800
SLBMs	SS-N-18, SS-N-20, SS-N-23	456	2,400
Bombers	Blackjack, Bear H (AS-15 ALCMs, AS-16 SRAMs, bombs)	100	1,300
Subtotal			**9,500**
Strategic defense			
ABMs	SH-08 Gazelle (64), SH-11 Gorgon (36)	100	100
SAMs	SA-5B Gammon, SA-10 Grumble, SA-12B Giant	1,350	1,350
Subtotal			**1,450**
Land-based nonstrategic			
Bombers and fighters			
	Backfire, Blinder, Fencer, Flogger, Fitter, Bear G (AS-4 ASM, AS-16 SRAM, bombs)	1,650	2,000
Subtotal			**2,000**
Naval nonstrategic			
Attack aircraft			
	Backfire, Blinder, Fencer, Flogger, Fitter (AS-4 ASM, bombs)	450	600
SLCMs	SS-N-9, SS-N-12, SS-N-19, SS-N-21, SS-N-22	800	500
ASW aircraft	May, Bear F, Hormone A, Helix A (depth bombs)	250	150
ASW weapons	SS-N-15, SS-N-16, FRAS-1, Type 65 and ET-80 torpedoes	500	600
Subtotal			**1,850**
Total			**15,000**

TABLE 2: U.S. NUCLEAR WEAPONS STOCKPILE (JUNE 1993)

Category/type	*Weapon system*	*Launchers*	*Warheads*
Strategic			
ICBMs	Minuteman III, MX/Peacekeeper	550	2,000
SLBMs	Trident I, II	440	3,520
Bombers	B-52H, B-1B	190	3,100
Subtotal			**8,620**
Nonstrategic			
Bombers and fighters			
	F-16C/D, F-15E, F-111F, A-6, F-18, Non-U.S. NATO aircraft	500	1,525
Sea-launched cruise missiles		184	350
Subtotal			**1,875**
Total			**10,500**

TABLE 3: PROJECTED US NUCLEAR WEAPONS STOCKPILE AT STATUTORY CUTOFF DATE FOR US NUCLEAR WEAPONS TESTING - 30 September 1996[1]

STOCKPILE CATEGORY	USERS	WEAPON	YIELD (KT)	First Produced	STATUS	NO.	ENDS	IHE	FRP
Strategic Bomb	USAF	B53/1	9000	8/62	Reserve	50	yes[2]	no	no
Tactical Bomb	USAF/US NATO	B61 Mods 3/4/10	1-150?	5/79	Active & Reserve	1525	yes	yes	no
Strategic Bomb	USAF	B61/7	10-350?	10/66	Active	900	yes	yes	no
Strategic Bomb	USAF	B83	low to 1200	6/83	Active	450	yes	yes	yes
ICBM/MM III	USAF	W62	170	3/70	Reserve	610	no	no	no
ICBM/MM III	USAF	W78	335	8/79	Active	920	yes	no	no
ICBM/MX/MM.I	USAF	W87/0	300	4/86	Active	525	yes	yes	yes
SLBM C4/D5	USN	W76	100	6/78	Active & Reserve	3,125	yes	no	no
SLBM D5	USN	W88	475	9/88	Active	410	yes	no	no
Air-Launched Cruise Missile	USAF	W80/1	5 & 150	12/81	Active	1200	yes	yes	no
Advanced Cruise Missile	USAF	W80/1	5 & 150	?/90	Active	460	yes	yes	no
Cruise Missile	USAF	W84	<1 & 150	6/83	Reserve	400	yes	yes	yes
Sea-Launched Cruise Missile	USN	W80-0	5 & 150	12/83	Active	375	yes	yes	no
Total as of 30/9/96					Active+ Reserve	10,950			

[1] Table Sources: Report to the Committees on Armed Services and Appropriations of the Senate and the House of Representatives on Nuclear Weapons Testing, Required by Section 507 of the FY 1993 Energy and Water Development Appropriations Act, August 1993; R.S. Norris and W.M. Arkin, "U.S. Nuclear Weapons Stockpile (June 1993)," Nuclear Notebook, *Bulletin of the Atomic Scientists*, June 1993, p.57; and NRDC Nuclear Program estimates.

[2] Contains one rather than two independent electrical safety subsystems to protect the firing circuit.

Sample U.S. - C.I.S Nuclear Stockpile Data Exchange under Biden Condition to START

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	DATA CATEGORY	Weapon and Fissile Material Inventories				Weapons Committed/Scheduled for Elimination				Nuclear Weapons Dismantled			
2		(Status as of 9/30/91 and each year thereafter)				(cumulative weapons and fissile material since 9/30/91)				(cumulative number of weapons and fissile material)			
3		# of weapons	Pu (kgs)	HEU (>20% U-235)		# of weapons	Pu (kgs)	HEU (>20% U-235)		# of weapons	Pu (kgs)	HEU (>20% U235)	
4				U-235 (kg)	Total (kg)			U-235 (kg)	Total (kg)			U-235 (kg)	Total (kg)
5	Warheads/bombs for SNDV's												
6	on strategic ballistic missiles												
7	at bases for operational strategic bombers												
8	in storage												
9	*Total - strategic weapons*												
10													
11	Nonstrategic Nuclear Weapons												
12	land-based missiles/artillery/mines/air-defense												
13	gravity bombs (Navy and Air Force)												
14	ship-launched weapons/sea mines												
15	*Total - nonstrategic weapons*												
16													
17	Other stocks available for weapons												
18													
19	Total nuclear weapons stockpile												
20													
21	Non-weapons Stockpile												
22	Transferred from weapons use												
23	Recovered from spent fuel												
24	In fresh enriched uranium (unirradiated)												
25													
26	Total weapons-usable												
27	fissile material inventory												
28													

Cell: A1
Note: Only Data in Unshaded Boxes would be exchanged, protecting specific weapons design information.

Cell: A17
Note: "Other stocks available for weapons" includes stored fissile material components of previously dismantled and any other fissile materials usable in weapons without further chemical separation or isotopic enrichment.

Cell: A23
Note: "Recovered from spent fuel" category includes fissile material recovered from naval propulsion, research, test, and defense production reactors, and from nuclear power generating stations.

Cell: A24
Note: "In fresh enriched uranium" category includes fresh HEU fuel elements for naval propulsion, research, test, isotope production, and prototype power reactors, HEU fuel fabrication pipeline inventory, and stored inventories of highly-enriched product.