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New Approaches to Arms Control and Nonproliferation

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Introduction

The legacy of the Cold War nuclear weapons programs in the United States and Russia represent serious continuing threats to each countries national security. Today, the primary danger to the United States from Russia's possession of nuclear weapons is not from a deliberate attack, but form from a mistaken, unauthorized or accidental missile launch. In addition, the Russian nuclear weapons program—more so than that of the United States—represents a continuing global proliferation threat, as well as a public health and environmental hazard. The proliferation threat stems from the fact that Russia is still producing and separating plutonium, has some 15,00 to 20,000 assembled nuclear weapons and about 1,700 metric tons of separated nuclear weapon-usable fissile materials (much of it under inadequate security), and does not have alternative jobs to offer the 67,000 workers who live in 10 closed nuclear cities. Russia suffers from the most severe environmental pollution of any country and lacks the funds to clean it up. A failing economy and widespread corruption compound these problems. To reduce these risks the United States and Russia have been engaged in a variety of programs that can be loosely described as a program of "denuclearization."

In this paper I first examine a new approach for establishing priorities and measuring progress in denuclearization. The second part addresses a new method of funding a portion of the denuclearization effort.

The Denuclearization Metric

A useful, albeit limited, technical metric for measuring progress in denuclearization would be a curve displaying the cumulative number of nuclear weapons that a state could launch or use as a function of the time it would take to use them without regard to employment policy (Figure 1). By this metric, denuclearization is the process of reducing the area under the curve and shifting the curve and the area under it to the right. This is tantamount to reducing the number of nuclear warheads, reducing warhead potential, and increasing the time to achieve "use ready" status, e.g., "to achieve launch ready" status of strategic weapons, or operational status of non-strategic weapons. One can compare various denuclearization strategies by examining how the curve shifts over time under various proposals.

To accurately plot such a curve one needs to know the number of warheads and the amounts of fissile materials in various categories of warheads, warhead components and fissile materials. For example, today the United States has over 2,600 warheads on "Launch Ready" alert that can be launched in a matter of minutes. Within a few days the

United State could bring its strategic forces to “Generated I” alert status by moving some five or so additional SLBMs on station, thereby adding another 960, or so, warheads to “use ready” status.

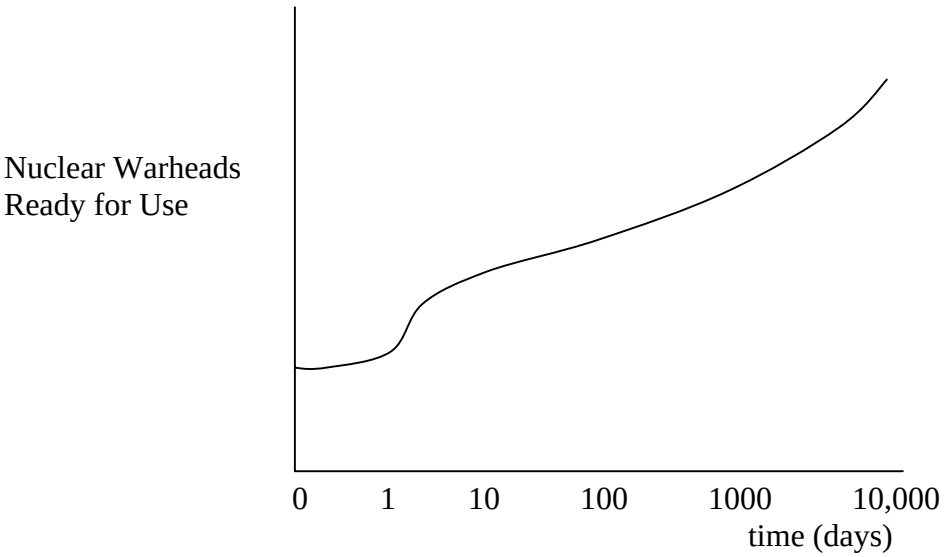

Figure 1. Notional representation of the number of nuclear warheads that can be brought to launch ready or use status a function of time.

One can continue this exercise by including the strategic bomber force, non-strategic bomber weapons and hedge weapons some of which would take progressively longer to bring to “launch ready” status. It would take even longer to activate inactive warheads, still longer to reassemble pits and canned subassemblies into usable warheads, and even longer still to manufacture new warheads from fissile and other materials.

Table 1 ranks various categories of warheads, warhead components and fissile materials in terms of how long it would take to attain use ready status. As seen from the table, denuclearization is more complicated than just eliminating nuclear weapons. Denuclearization is the process of moving warheads and materials from categories high on the Table 1 list, to categories lower on the list. Moreover, the movement between any two categories is not of equal worth. For example, when there are numerous warheads in the higher ranked categories, as is the case today in the United States and Russia, then progress in moving fissile materials down through the lower ranks will not substantially alter the risks associated with a state’s use of nuclear weapons. In general, the “worth” of each step becomes progressively less as one moves down through the list of categories in Table 1. In order to make the area under the curve more representative of the “worth” of the weapons and weapon materials, I have selected a logarithmic scale for the abscissa in Figure 1.

So far, I have discussed denuclearization in the context of reducing the risks

Table 1. Warheads, warhead components, and fissile material stocks ranked more or less according to the time it takes to achieve launch ready warhead status.

Launch Ready Alert Level Warheads
Warheads Added by Bring Forces to Generated Alert Status
Other Deployed Warheads
Non-Deployed Warheads in the Active Stockpile
Inactive Stockpiled Warheads
Warheads Awaiting Disassembly
Stored Pits and Canned Subassemblies
Plutonium (Pu) and High-Enriched Uranium (HEU) in Metallic Form
Pu and HEU Oxides and Other Chemical Forms
Pu and HEU in Fresh Fuel Assemblies
Pu and HEU in Spent Fuel Assemblies
Low-Enriched and Natural Uranium
Spent Fuel in Geologic Repositories
Uranium Ore

associated with a weapons-state's use of nuclear weapons, either deliberately or accidentally. I also want to reduce the risk that non-weapon states and non-state entities will acquire nuclear weapons, for example, by diverting nuclear weapons, weapon-usable materials or expertise from a weapon state. The nonproliferation risks associated with a weapons-state's nuclear weapons program can be reduced by:

- reducing the total stocks of weapon-usable nuclear materials available for diversion;
- improving the security of existing stocks of fissile materials; and
- reducing the likelihood of transfer of nuclear expertise for unauthorized purposes.

Note that reducing the total stocks of nuclear weapons and weapon-usable nuclear materials reduces both the weapons-state threat and the non-weapons state threat associated with these materials. The denuclearization metric therefore has some utility in measuring progress in reducing the risk of diversion. The denuclearization metric, however, is not useful for establishing priorities or measuring progress in improving security of fissile material or reducing the likelihood of transfer of nuclear expertise—the last two bullets above.

U.S. Denuclearization Priorities

The United States is pursuing several somewhat independent denuclearization and nonproliferation efforts with Russia: a) nuclear arms reduction negotiations—the START II/III treaty negotiation process, which the Bush administration may replace by unilateral actions; b) the START I verification program; c) the Cooperative Threat Reduction (the so-called "Nunn-Lugar") Program, under which launch vehicles are dismantled; d) the 500 tonne highly-enriched uranium (HEU) purchase agreement, under which HEU from weapons is blended down into non-weapon use fuel for power reactors; e) the joint U.S.-

Russian plutonium disposition program, and f) various efforts to improve the security of existing stock of nuclear weapons and fissile materials.

In broad terms there are several shortcomings with these efforts. First, the various program elements, a) through f) above, were not developed as part of a comprehensive integrated package. The United States has neither a comprehensive nor an integrated strategy for achieving progress in denuclearization. Rather the United States attaches high priority to efforts that have the lower worth, e.g., the plutonium disposition program, and little priority to efforts that have the highest worth, i.e., removing warheads from launch ready status. Moreover, the United States attaches little priority to achieving a data exchange with Russia in order to identify the number of nuclear warheads, warhead components, and fissile material stocks in the various categories in Table 1. The United States does not know, within plus or minus a few thousand, how many tactical nuclear warheads Russia has retained in its arsenal. Without a data exchange, the United States cannot measure or verify progress in denuclearization.

Let us now turn to an analysis of some of the specific ongoing U.S. funded denuclearization and non-proliferation initiatives in Russia.

U.S. Non-Proliferation Initiatives in Russia

Since the collapse of the Soviet Union, almost a decade ago, the U.S. government has initiated a variety of Russian-based programs with the following objectives:

- improve the security of existing stocks of fissile materials in Russia to reduce the likelihood of theft and unauthorized use;
- reduce the total stocks of weapon-usable nuclear materials; and
- provide alternative employment opportunities to nuclear, chemical and biological weapons experts to reduce the likelihood that they would sell their expertise abroad.

In addition, the ongoing programs provide transparency with respect to nuclear weapon and other activities in Russia.

The United States has been spending about $500 million a year on the Russian safeguarding effort. The Bush administration has initiated a "comprehensive review" of these programs. I do the same here beginning with a brief summary of the principal ongoing initiatives.

Improving the Security of Fissile Materials. There are several ongoing efforts, primarily:

- *Russian Fissile Material Storage Facility at Ozersk*—assistance in the construction of a large storage facility at Ozersk (Mayak, Chelyabinsk-65) and construction of 10,000 special fissile material containers for use in this facility. The construction of the first of two wings is almost complete, and loading of this

wing is scheduled to commence in FY2002. When both wings are complete the facility will hold the fissile materials from approximately 12,500 warheads. Construction costs of the first wing were capped by Congress at $460 million. Funded by DOD's Defense Threat Reduction Agency under the Cooperative Threat Reduction (CTR) budget (FY2001 - $57.4 million);

- *International Materials Protection, Control and Accounting (MPC&A*—a program to install improved security systems at civilian nuclear sites, naval fuel and weapon sites, and nuclear weapon laboratory sites and consolidate nuclear materials at fewer sites; funded by DOE/National Nuclear Security Administration (FY2001-$169.7 million; FY2002-$138.8 million); and
- *Improve Security at 12 GUMO Nuclear Weapon Storage Sites*—assistance to the Russian Ministry of Defense's 12th Main Directorate (12th GUMO) to improve security at nuclear weapon storage sites (other than Russian Navy sites); funded by DOD under the CTR budget (FY2001 - $89.7 million).
- *Improve Nuclear Weapon Transportation Security*—assistance to the Russian Ministry of Defense's 12th Main Directorate (12th GUMO) to improve nuclear weapon transportation security; funded by DOD under the CTR budget (FY2001 - $14 million).
- *Pit Conversion and Fissile Material Packaging*—assistance to the Russian Ministry of Defense's 12th Main Directorate (12th GUMO) to facilitate packaging of fissile materials from dismantled warheads for subsequent shipment to and storage at the storage facility at Ozersk now under construction; funded by DOD under the CTR budget (FY2001 - $9.3 million).

These five initiatives all deserve support. A problem, however, with respect to all of these efforts is that the United States (and possibly Russia) does not know how many nuclear weapons or how much fissile material exists in Russia, and the United States does not know where much of it is stored. The United States has failed to make a high priority effort to secure a bilateral data exchange of date on weapon and fissile material inventories.

Reducing Stocks of Weapon-Usable Nuclear Materials. The principal ongoing efforts here are:

- *Highly-Enriched Uranium (HEU) Purchase Agreement*—a U.S.-Russian agreement whereby 500 tonnes (t) of HEU from Russian weapons is to be blended down into low-enriched uranium (LEU) for use as power reactor fuel, and the purchase by the United States of the SWU (separative work unit, or enrichment values) of the LEU. To date just over 100 t of the 500 t have been sold and delivered to the United States—to the United States Enrichment Corporation (USEC), the government appointed executive agent for the HEU purchase agreement. DOE provides funds for implementation of transparency agreements associated with the blend down of HEU into LEU in Russia (FY2001- $14.6 million; FY2002 - $14.0 million)

- *Plutonium Disposition*—under this program 34 t of weapon-grade plutonium (WGPu) is to be eliminated by both Russia and the United States by first converting it to mixed plutonium oxide and uranium oxide (MOX) fuel and then using the MOX fuel in nuclear power reactors, thereby converting it into spent reactor fuel; funded by DOE/National Nuclear Security Administration (FY2001-$56.5 million; FY2002-$62.0 million; less use of prior years balances, the totals are reduced to: FY2001- $41.5 million; FY2002 - $20.0 million);
- *Plutonium Production Reactor Core Conversion*—an effort designed to assist Russia in converting the three remaining dual-purpose (plutonium and energy production) reactors to reduce or eliminate weapon-grade plutonium production. There are three options under consideration, converting the reactor cores to LEU fuel, HEU fuel, and now back on the table, replacement of the reactors with non-nuclear power plants. Funded by DOD's Defense Threat Reduction Agency under the Cooperative Threat Reduction (CTR) budget (FY2001 - $32.1 million)

There are two problems with the HEU purchase Agreement that should be rectified. First, the U.S. Government has turned this program over to what is now a private company, the US Enrichment Corporation, which serves as the government's executive agent for implementing the program. Under this arrangement to the detriment of the program, the profit motive of USEC has become a higher priority than the denuclearization objective of the United States. Second, the United States does not know the quantity and disposition of Russian HEU, so the worth of this effort difficult to gage.

The plutonium disposition program is an example of misplaced priorities. It would be far more productive for the United States to spend its diplomatic capital and tax-payer funds on converting plutonium pits into plutonium "pucks" (unclassified shapes) and putting the plutonium pucks under international safeguards, than trying to fund and construct a Russian MOX fuel fabrication plant. The proposed MOX plant will not even keep up with the current rate at which Russia is separating new plutonium from dual-purpose plutonium production reactors and from commercial power reactors. Moreover, Russia has so few VVER-1000 reactors, it cannot convert more than a few tons of plutonium into spent fuel annually, even if a MOX fabrication plant were build in Russia. Finally, a Russian MOX program will likely increase proliferation risks in the long run.

The Plutonium Production Reactor Core Conversion program has been stymied by the failure of Russia and the United to reach agreement on what the end point of the conversion effort should be—use of LEU or HEU fuel, or replacement of the three reactors. The proposal to convert the reactor to HEU fuel is ill conceived in that the proliferation risks associated with the HEU fresh fuel are no less than the risks associated with the separated plutonium.

Alternative Employment Opportunities for Nuclear Workers. The principal ongoing efforts here are:

- *International Science and Technology Center (ISTC)*—an intergovernmental organization established in 1992 by agreement between the European Union, Japan, Russian Federation, and United States of America. The Center, headquartered in Moscow, provides weapons scientists from CIS countries with opportunities for redirecting their scientific talents to peaceful science. In 1999 there were 201 projects covering 17,815 participants funded at $42.6 million, with the U.S. contributing $13.2 million. The participants worked an average of 63 days on the ISTC funded projects, so the participation was more like 4,800 full-time equivalents. The ISTC paid the 17,815 project participants $22.6 million in grant money, which works out to an average salary of about $4,700 per year ($20 per day).
- *Initiatives for Proliferation Prevention (IPP, formerly called the Industrial Partnering Program)*—a program to facilitate and promote employment and economic development opportunities for displaced nuclear weapon scientists and engineers. Efforts focus on cooperative projects involving DOE laboratories and research institutes in Russia, Ukraine, Kazakhstan and Belarus. Every dollar the U.S. Government provides for a project in is matched by industry; the federal contribution is funded by DOE/National Nuclear Security Administration (FY2001-$24.1 million; FY2002-$22.1 million);
- *Nuclear Cities Initiatives (NCI)*—a program of cooperation with the Russian Ministry of Atomic Energy (Minatom), commercial entities, and local and state governments to create civilian ventures in one of the ten closed nuclear cities; funded by DOE/National Nuclear Security Administration (FY2001-$26.6 million; FY2002-$6.6 million);

While these three initiatives have not prevented senior Minatom and Russian institute officials from providing nuclear weapon related assistance to Iran, they are nevertheless useful and cost effective. This is particularly the case with respect to the ISTC and IPP programs. The NCI initiative is too new to have established a track record. This program will likely suffer from the fact that DOE and the national laboratories have very limited expertise in commerce, and therefore will have difficulty in identifying potential commercial markets and the requirement to succeed in business, particularly in Russia. All three programs, ISTC, IPP and NCI, have effective programs in place to prevent the misallocation of funds and all provide useful transparency at institutes where funded research is conducted.

All three programs require the identification of a scientific project, or alternative employment opportunity, before the Russian participant can receive financial support. None provide an incentive for Minatom or its workers to shut down entire weapon related facilities, e.g., a fuel reprocessing or chemical separation plant. To provide such an incentive the United States should consider establishing a trust fund to pay for the early retirement of Russian nuclear workers. The workers at targeted facilities would take early retirement and be permitted to pursue other non-weapons employment. The trust would not be required to provide alternative employment projects as a condition for shifting from weapons work.

The ten closed cities[1] that host most of the Russian nuclear weapons program have a total population of about one million people. The total number of weapon workers in these cities in 2000 was about 60,000-67,000, a number that is projected to drop by about 50 percent over the next five years as Minatom downsizes its nuclear weapon workforce.[2] If the 32,000 person projected workforce (or projected workforce reductions) were to be paid at the rate that the ISTC paid project participants in 1999 ($4,700 per year) the total cost would be $150 million per year. Comparatively, this represents 2.8 percent of FY2002 DOE Stockpile Stewardship Program budget.

Funding Denuclearization

In January 2001, a DOE appointed nonproliferation task force co-chaired by former senator Howard Baker, Jr. and Lloyd Cutler concluded that "[c]urrent nonproliferation programs of the Department of Energy, the Department of Defense and related agencies have achieved impressive results thus far, but their limited mandate and funding fall short of what is required to fully address the threat. . . . the current budget levels are inadequate and the management of the U.S. government's involvement is too diffuse."

The proposal of a private initiative called the Nonproliferation Trust (NPT) offers an alternative source of substantial funding to augment the U.S. government funded security efforts. In that Western governments have demonstrated that they are unwilling to invest the necessary resources to adequately address the security problems in Russia, NPT's goal is to step into the breach by augmenting government funds with private capital associated with nuclear spent fuel management.

The Non-Proliferation Trust, Inc., is a Delaware corporation whose purpose is to foster global nuclear nonproliferation, environmental and humanitarian aims. NPT proposes to raise $15 billion by taking title to 10,000 metric tons of foreign (non-U.S. and non-Russian) nuclear spent fuel and storing it in Russia. The project would require $3.45 billion to safely manage the spent fuel, which includes purchasing spent fuel storage casks, constructing and managing a dry cask storage facility, and transporting the fuel. The project would allocate more than 75 percent of the revenues—the remaining $11.55 billion—to nonproliferation, environmental and humanitarian causes in Russia.

NPT currently plans to allocate $11.55 billion as follows:

Environmental Cleanup	$3.0 billion
Fissile Material Security	1.5
Geologic Repository Siting and Construction	1.8
Spent Fuel Escrow/Repository	0.5
Alternative jobs for nuclear weapon workers	2.0

[1] Sarov (Arxzamas-16), Snezhnisk (Chelyabinsk-70), Ozersk (Chelyabinsk-65), Sversk (Tomsk-7), Zheleznogorsk (Krasnoyarsk-26), Novouralsk (Sverdlovsk-44), Zelenogorsk (Krasnoyarsk-45), Lesnoy (Sverdlovsk-45), Trekhgorny (Zlatoust-36), Zarechny (Penza-19).

[2] Oleg Bukharin, et al., « Helping Russia Downsize its Nuclear Complex : A Focus on the Closed Nuclear Cities," Princeton University, June 2000.

Regional economic support	0.5
Humanitarian (pensioners and orphans)	2.25
Total	**$11.55 billion**

To prevent the misuse of these funds, the monies will be managed by three U.S.-based charitable trusts: the Minatom Development Trust, the Russian Environmental Trust and the Russian Humanitarian Trust.

The NPT project is still in a conceptual stage. Much work and additional negotiations are required to develop it more fully. For example, the project cannot go forward unless there is an Agreement for Cooperation on nuclear matters between the United States and Russia.