CHAPTER 3

U.S. Nonproliferation Assistance Programs

Origins of U.S. Nonproliferation Assistance to the Former Soviet Union

THE U.S. PROGRAM to use funds from the Departments of Defense, Energy, and State to address proliferation risks from the former Soviet Union originated in the U.S. Congress in the fall of 1991, shortly after the coup attempt against Soviet President Mikhail Gorbachev. The 1991 coup attempt convinced congressional leaders, including Senator Sam Nunn, that the United States must take a more active role in assisting the Soviet Union in controlling its huge stockpile of nuclear weapons, materials, technology, and knowledge. Senators Nunn and Richard Lugar, with the cooperation of House Armed Services Committee chair Les Aspin, built bipartisan congressional support for using a small amount of Department of Defense (DOD) funding (up to $400 million annually) to assist the Soviet Union with the safe transportation, storage, and destruction of its weapons of mass destruction (WMD).

In a dramatic departure from the cold war legacy of confrontation, the assistance package legislation (P.L. 102–228), initially known as the Nunn-Lugar program, passed the Senate 86 to 8 and was approved by acclamation in the House. President George Bush signed it into law in December 1991. The new law had three explicit purposes: (1) to assist the Soviet Union and its successor countries in destroying nuclear, chemical, biological, and other sophisticated weapons; (2) to assist in safely transporting, storing, disabling, and safeguarding such weapons; and (3) to establish verifiable safeguards against the proliferation of those weapons.

The process of building bipartisan congressional support required that the legislation include strict conditions on the use of U.S. funds for these purposes. First, all funds were to be reprogrammed from existing Department of Defense budget accounts at the discretion of the secretary of defense and with the prior approval of four congressional committees. Second, wherever feasible, funds were to be used for the purchase of U.S. technology and know-how (the "Buy-American" provisions). Third, the president was required to certify annually that each recipient country was committed to (1) investing a substantial amount of its resources in dismantlement programs; (2) forgoing any military modernization program exceeding legitimate defense requirements; (3) forgoing any use of components of destroyed nuclear warheads in new nuclear weapons; (4) facilitating U.S. verification of weapons destruction; (5) complying with all relevant arms control agreements; and (6) observing an internationally recognized standard of human rights, including the protection of minorities.

Initial implementation of the Nunn-Lugar program was slow, in part because the Bush administration was not enthusiastic about this congressional initiative, and in part because of the difficulties inherent in starting up an unprecedented cooperative activity involving weapons of mass destruction. Once the necessary bilateral agreements were in place, the early focus was on upgrading the safety of nuclear weapons transport within Russia and to Russia from Belarus, Kazakhstan, and Ukraine.

Under the Clinton administration, the Nunn-Lugar program was transformed from a novel but low-priority activity to a key policy tool for addressing core U.S. national security concerns. These included the transition of Belarus, Kazakhstan, and Ukraine to non-nuclear status; Russia's adherence to arms control dismantlement obligations; and stemming the proliferation of weapons of mass destruction from the former Soviet Union. The Clinton administration adopted the phrase *cooperative threat reduction* as more descriptive and politically more palatable to the House of Representatives than "Nunn-Lugar." The administration included Cooperative Threat Reduction (CTR) in its DOD budget requests, as well as in the budget requests of the Departments of Energy and State, eliminating the need for the cumbersome reprogramming process. Now in its ninth year, more than $3 billion has been appropriated for the CTR program, which thus far has weathered the vicissitudes of U.S.-Russian relations to become by far the largest U.S. assistance program in the former Soviet Union.

The three sections below describe the current U.S. nonproliferation assistance programs that have evolved from the initial Nunn-Lugar legislation: (1) projects involving weapon systems and associated infrastructure, which are administered by the Department of Defense; (2) programs involving nuclear materials and their associated infrastructure, which are administered primarily by the Department of Energy; and (3) programs designed to address the leakage of WMD-related knowledge and technology, or the "brain drain" of weapons scientists, and the development of export controls, which are administered by the Departments of State and Energy.

Dismantling and Securing Former Soviet Weapons and Associated Infrastructure

The U.S. Department of Defense is responsible for administering and implementing programs to eliminate weapons systems and infrastructure through the CTR program. These projects focus on the core task of the original Nunn-Lugar legislation: assisting in the destruction of nuclear, chemical, and biological weapons and related infrastructure. The major CTR projects can be divided into three broad categories: (1) strategic offensive arms elimination, including submarine dismantlement; (2) weapons storage security and weapons transportation security (commonly known as *weapons protection, control, and accounting,* or WPC&A); and (3) projects to secure or dismantle chemical and biological weapons facilities, as well as to destroy stockpiles of chemical weapons.

Strategic Offensive Arms Elimination

The primary role of the CTR program is to assist Russia and the other states of the former Soviet Union with the elimination of nuclear weapon launchers and strategic delivery vehicles, including heavy bombers, intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and nuclear-powered ballistic missile submarines (SSBNs). This mission also extends to the elimination or conversion of toxic missile fuel. Elimination projects have been conducted in Belarus, Kazakhstan, Russia, and Ukraine but are currently active in Russia and Ukraine only.

In FY 2000, Strategic Offensive Arms Elimination (SOAE) projects received $182.3 million for work in Russia and $35 million for work in Ukraine.[1]

The Russian Federation

- 258 ICBMs eliminated
- 42 heavy bombers eliminated
- 50 ICBM silos eliminated
- 17 nuclear-powered ballistic missile submarines (SSBNs) with 256 SLBM-launchers and 30 SLBMs eliminated
- 153,000 metric tons of rocket fuel and 916 solid rocket motors to be eliminated

United States CTR program efforts in Russian have been a dramatic, if not unqualified, success. The means of delivery for thousands of nuclear weapons have been eliminated through this unique and cost-effective program. Much of

1. Thomas Kuenning, "Cooperative Threat Reduction Program: Overview and Lessons Learned," presentation at the CNS Assessing U.S. Dismantlement and Nonproliferation Assistance Programs in the Newly Independent States conference, Monterey, California, December 11–13, 1999, p. 6.

this program has involved providing Russia with basic equipment and machinery, as well as U.S. assistance in managing dismantlement efforts at Russian facilities in accordance with arms control agreements. Several of these programs have run into schedule and cost overruns, in many cases caused by the Russian economic situation. These developments have slowed the expected pace of weapons elimination. In general, the project has had a remarkable record of accomplishment, one that has effectively improved the security of the United States.

ICBM AND SLBM ELIMINATION

In Russia, the CTR program has assisted in the destruction of 258 ICBMs (119 SS–11s, 10 SS–17s, 116 SS–18s, and 13 SS–19s) and the elimination of 30 SLBMs. United States assistance has also included the removal and storage of missile fuel from these systems.[2] The pace of missile elimination has been slowed by delays in the disposal of missile fuel (see below). As a result, liquid-fuel storage facilities are literally overflowing. Equipment provided by CTR for missile elimination includes cranes, earth-moving equipment, cutting and industrial tools, and scrap-metal-handling equipment. The initial delivery of equipment began in September 1994 and was completed by October 1995. Additional deliveries of equipment were completed in late 1999.[3]

Equipment provided by CTR is in use at Pibanshur, Uzhur, Yedrovo, Sergiyev Posad, Surovatikha, Bershet, and Krasnoyarsk. Project plans call for the eventual elimination of more than 700 SS–18, SS–19, SS–N–6, SS–N–8, and SS–N–18 missiles, at a cost of $203.4 million.[4]

MISSILE-FUEL ELIMINATION: LIQUID- AND SOLID-FUEL DISPOSAL

The Cooperative Threat Reduction program is providing Russia with three liquid-propellant disposal systems, which will break down liquid rocket fuel into commercial chemicals. In late 1999, the elimination of an estimated 153,000 metric tons of liquid fuel began at two commissioned elimination facilities in Krasnoyarsk. A third disposal facility is being built at Nizhnaya Salda, which should begin operation in the summer of 2001. CTR support has also included equipment for the transportation and storage of liquid missile fuel, including 125 flatbed railcars, 670 tank containers, and seven cranes.

The elimination of up to 916 solid-fuel rocket motors (with 17,494 metric tons of propellant) from SS–24, SS–25, and SS–N–20 missiles has not yet begun owing to the Russian decision to relocate a planned elimination facility from the city of Perm to the city of Votkinsk. Although the construction contract for this facility was awarded to Lockheed-Martin in 1997, the change in facility location, as well as local opposition in Votkinsk, has caused substantial project delays. In March 2000, the CTR program estimated that the facility might begin operation in December 2000 and complete disposition by December 2004.[5]

HEAVY-BOMBER ELIMINATION

With U.S. assistance, 42 Russian heavy bombers have been eliminated in accordance with START elimination procedures at the Engels air base.[6] The equipment provided by CTR includes cranes, metal cutting tools, and scrap-metal-handling equipment, all of which were delivered from September 1994 to November 1995. The CTR program also provides logistical support for the bomber elimination program, which is expected to continue through September 2006. Total funding of this project is expected to reach as much as $10.3 million.[7]

ELIMINATION OF MISSILE SILOS, MOBILE ICBM LAUNCHERS, AND SLBM LAUNCHERS

The CTR program is providing equipment and services for the elimination of a total of 152 ICBM silos in Russia (44 SS–11s and 13s,

2. Cooperative Threat Reduction Multi-Year Program Plan Fiscal Year 2000 [CTR Program Plan], U.S. Department of Defense, March 2000.
3. Ibid.
4. Ibid.
5. Ibid.
6. Cooperative Threat Reduction program web site: <www.dtra.mil/ctr/ctr_index.html>.
7. CTR Program Plan, p. IV–21.

12 SS–17s, and 96 SS–18s). It is difficult to provide an accurate count of the number of Russian silos destroyed to date with CTR program–provided equipment, since the United States provides equipment for destruction but does not carry out such missions directly. Thus far, CTR equipment has helped Russia to eliminate at least 50 silos.[8]

The United States plans to provide Russia with the equipment needed to eliminate a total of 36 SS–24 rail-mobile launchers and up to 253 SS–25 road-mobile launchers by 2004. A site selection process for missile elimination is under way, and the CTR program expects to begin delivering needed equipment for this mission by the middle of 2002. This project is currently estimated to cost $11.8 million.[9]

The SOAE project also includes projects to eliminate SLBM launchers and the SSBNs on which they are located. As of October 2000, CTR program assistance has resulted in the dismantlement of 256 SLBM launchers on 17 SSBNs (see table 3.1).[10] The United States initially planned to assist only with SLBM launcher dismantlement, but this mission expanded to dismantling the submarines themselves when it became clear that Russia lacked the necessary dry-dock space for the timely dismantlement of SLBM launchers.

In the mid-1990s, the CTR program provided launcher elimination and dismantlement equipment to three START I–designated dismantlement shipyards: Nerpa Shipyard (located in Snezhnogorsk), Zvezdochka State Machine Building Enterprise (located in Severodvinsk), and Zvezda Shipyard (located in Bolshoy Kamen).[11] Five SSBNs were dismantled using this assistance. Beginning in 1997, the United States began a pilot program to contract with Russian shipyards for dismantlement work on a "deliverables" basis, whereby CTR would provide funds to local

TABLE 3.1: **U.S. CTR SUBMARINE DISMANTLEMENT PLANS**

Location	Type	FY 1992–1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Total
Zvezdochka/ Sevmash	Delta I		2										2
	Delta II		1										1
	Delta III			2			1			1			4
	Delta IV											1	1
	Typhoon			1			1		1	1	1		5
Nerpa	Delta I	2	1	1									4
	Delta II		1	2									3
Zvezda	Yankee	1	1										2
	Delta I	2	1	4		1	1				1		10
	Delta III					2	2	1	1	1	1	1	9
Totals		**5**	**7**	**10**		**3**	**5**	**1**	**2**	**3**	**3**	**2**	**41**

8. Cooperative Threat Reduction program web site: <www.dtra.mil/ctr/ctr_index.html>.
9. CTR Program Plan, p. IV–26.
10. CTR briefing, CTR Program: SSBN Dismantlement Project, December 2000.
11. For details on these and other naval facilities, see naval facilities section, chapter 5.

companies for work to be verified upon completion. CTR officials signed the first pilot project contract with the Zvezdochka facility on March 10, 1997, to dismantle an already-defueled submarine in dry dock for $4.25 million.[12] By 2007, CTR plans to dismantle a total of 36 SSBNs on a contract basis (18 from the Northern Fleet and 18 from the Pacific Fleet).[13] The Northern Machine Building Enterprise (also known as Sevmash) in Severodvinsk recently joined this work and will help dismantle the Typhoon-class submarines originally built there. The total cost for the SSBN dismantlement project is estimated at $469.4 million.[14]

There are two other projects related to submarine dismantlement being funded by CTR that are not part of the official SOAE program. The first is a small-scale reprocessing program for which the United States is providing funds for the Mayak Production Association in Ozersk (formerly known as Chelyabinsk-65) to reprocess spent naval fuel from six SSBNs at its RT–1 facility. It is possible that the reprocessing of spent fuel from up to 15 SSBNs will be financed under this program, the goal of which is to reduce the spent-fuel backlog at shipyards. A lack of spent-fuel storage facilities at the dismantling sites has threatened to slow the pace of submarine destruction.[15] The second project involves DOD participation in the Arctic Military Environmental Cooperation (AMEC) program.[16] This program was established in 1993 in cooperation with the Russian and Norwegian Ministries of Defense with the aim of reducing the environmental impact of military activities in the far north. Today, the activities under this project include a program to build storage casks to facilitate the defueling of nuclear submarines at selected facilities in the Northern and Pacific Fleets.

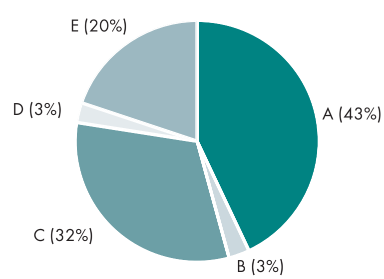
Kazakhstan[17]

- 1,400 strategic nuclear weapons (and 104 SS–18s) returned to Russia
- 147 silos and silo structures eliminated
- 194 nuclear test tunnels sealed
- 7 heavy bombers dismantled (40 returned to Russia)

United States CTR programs in Kazakhstan have resulted in the denuclearization of what would have been the world's third largest nuclear weapons state if its nuclear possession had been consolidated. All SOAE projects have

TABLE 3.2: **U.S. ASSISTANCE PROVIDED TO KAZAKHSTAN, BY CATEGORY**

	Project	Amount (millions)
A	SS–18 Silo Elimination	$42.3
B	Strategic Bomber Elimination	$ 2.7
C	Unified Fill Facility/ Nuclear Warhead Storage Elimination	$31.2
D	Government-to-Government Communications Link	$ 2.6
E	Nuclear Testing Infrastructure Elimination	$19.5
Total		**$98.3**



12. CTR Program Plan, p. IV–26.
13. CTR program briefing, December 2000.
14. Ibid.
15. Center for Nonproliferation Studies (CNS) staff interview with Major Ron Alberto at the Defense Threat Reduction Agency, Dulles, Virginia, January 14, 1999.
16. Information regarding the AMEC program is drawn mainly from press releases and reports appearing on the U.S. Environmental Protection Agency's Office of International Activities web site: <www.epa.gov/oiamount/>.
17. Cooperative Threat Reduction program web site: <www.dtra.mil/ctr/ctr_index.html>.

been successfully completed in Kazakhstan. When the Soviet Union disintegrated, an estimated 1,400 nuclear warheads, 104 SS–18s (the most powerful ICBM in the Soviet nuclear arsenal), and 47 heavy bombers (Bear H-6 and H-16s) were in Kazakhstan. CTR projects have resulted in the return of the nuclear warheads, ICBMs, and bombers to Russia and the destruction of 104 SS–18 silo launchers, 16 launch-control silos, two SS–18 training silos, and 26 other silo structures in Zhangiz-Tobe, Derzhavinsk, Semipalatinsk, and Leninsk. CTR funds were also used to dismantle seven largely obsolete Bear bombers in Kazakhstan and to seal 194 nuclear weapon test tunnels at the Semipalatinsk Nuclear Test Site.[18] The last of 40 heavy bombers were returned to Russia in February 1994.[19] CTR projects spent a total of $98.3 million on these efforts.

Ukraine[20]

- 1,900 strategic nuclear warheads returned to Russia
- 111 SS–19 ICBMs eliminated
- 171 ICBM silos and silo structures eliminated
- 55 SS–24 and 20 SS–24 ICBM silos to be eliminated
- 15 heavy bombers eliminated
- 3,810 metric tons of fuel from 110 SS–19 ICBMs stored

All the approximately 1,900 nuclear warheads deployed in Ukraine were returned to Russia by June 1996. When the Soviet Union ceased to exist, Ukraine was the deployment location for 130 SS–19s, 46 SS–24s,[21] 44 heavy bombers, and associated delivery capabilities.

ICBM AND ICBM SILO ELIMINATION

The CTR program provided Ukraine with rapid assistance in the form of $48.1 million for the housing of deactivated SS–19s and for the early deactivation of SS–24s, as well as for emergency support assistance. The funds resulted in the elimination of 111 SS–19 ICBMs (by February 1999), 130 missile launch silos, 13 SS–19 launch-control silos, and two SS–19 training silos.[22] Forty-six SS–24 missiles have been removed from their silos; 26 had been eliminated by the end of 2000.[23] The missiles (totaling 55 SS–24s, including nine that were never deployed) will be stored at CTR refurbished or built facilities at Pervomaysk and Mykhaylenki, pending rocket motor elimination. The elimination of the SS–24 silos will continue through 2002, although a timetable for final elimination has not been set.[24]

ICBM-FUEL ELIMINATION

Liquid-Fuel Elimination. Ukrainian-based SS–19s contained some 11,700 metric tons of propellant requiring storage and elimination. CTR provided heavy equipment and 58 "intermodal tank" containers to Ukraine for this purpose and for the construction of a fuel storage facility at Shevchenkovo for 60 CTR-provided fuel containers. Currently, fuel is being stored at the missile bases at Khmelnytsky and Pervomaysk. CTR is also providing assistance in the modification and certification of two fuel incinerators.[25]

Solid-Fuel Elimination. CTR assistance has also been provided to remove and safely eliminate solid propellant from the 54 SS–24s in Ukraine at the time of the Soviet breakup. Initial assistance was provided in the temporary storage of the missiles, since a fuel disposal facility will not become operational until the summer of 2002 and the START I Lisbon protocol requires the

18. Ibid.
19. "All Strategic Bombers out of Kazakhstan; Talks on Those in Ukraine," *RFE/RL News Briefs*, vol. 3, no. 9, 2/21–25/94.
20. Cooperative Threat Reduction program web site: <www.dtra.mil/ctr/ctr_index.html>.
21. Nine nondeployed, disassembled SS–24s were located at the Pavlohrad Chemical Plant.
22. CTR Program Plan, p. IV–5, Volodymyr Chumak and Serhey Galaka, "Programma Nann-Lugara V Ukraine" (Nunn-Lugar program in Ukraine), unpublished paper, Kiev, October 1999.
23. Cooperative Threat Reduction program web site: <www.dtra.mil/ctr/ctr_index.html>.
24. CTR Program Plan, p. IV–8.
25. Ibid., p. IV–5.

elimination of SS–24 silos by December 4, 2001. Ukraine is currently evaluating fuel disposal technologies, and CTR estimates that an elimination facility could be operational in the summer of 2002. The Pavlohrad Chemical Plant, the former manufacturing site for these solid rocket motors, has been selected to be the future elimination facility.

BOMBER AND ALCM ELIMINATION

Bomber Elimination. CTR programs aim to eliminate up to 44 heavy bombers (25 Tu–95/Bear and 19 Tu–160/Blackjack bombers) by December 4, 2001. As of June 2000, 15 of these (eight Bear and seven Blackjack bombers) had been eliminated.[26] Eleven (three Bear and eight Blackjacks) were transferred to Russia in February 2000.[27] The remaining 18 bombers are slated for elimination in Ukraine by the end of 2001.[28]

ALCM Elimination. The United States is aiding Ukraine with the elimination of air-launched cruise missiles (ALCMs) controlled under the START I agreement. Ukraine possesses 1,068 Kh–55(AS–15) ALCMs (with a 3,000-km range). Elimination should be completed by September 2002.[29] Almost 600 of these were transferred to Russia along with their associated bombers.

Belarus

- 54 SS–25s returned to Russia
- 81 SS–25 launch sites to be eliminated (work suspended)

The CTR experience in Belarus has been somewhat less productive than in other former Soviet republics. Relations between the United States and Belarus began to deteriorate after the election of President Alexander Lukashenka in the summer of 1994. Despite hints by some officials in Lukashenka's government that Belarus might retain some of the ICBMs on its territory, all 54 SS–25 ICBMs and nuclear warheads in Belarus were removed to Russia by November 1996. Increasing human rights violations, however, led to the suspension of CTR assistance to Belarus in March 1997. The equipment provided by the United States for the destruction of 81 SS–25 ICBM launch positions was withdrawn, and dismantlement work apparently ceased. In addition, 1,000 metric tons of liquid rocket fuel and 9,000 metric tons of oxidizer, which were slated for elimination, remain in Belarus. The current status of this material is unknown.

Weapons Protection, Control, and Accounting

Automated Inventory Control and Management

Soviet-era warhead accounting and management relied upon a hand-written, manual tracking of the nuclear arsenal. United States CTR assistance automated the previously existing system. Under this program, the United States has provided computers (one hundred PCs), software, and training, but is also in the process of identifying additional tasks, including site preparation for the installation of permanent communications equipment. The current program includes plans to install the tracking system at 19 key sites, including field and regional sites. The operation of this system should begin in late spring or early summer 2001, once the hardware and software have been certified by Russian entities.[30]

Storage Site Enhancements

Cooperative Threat Reduction program agreements with Russian authorities authorize the provision of assistance to improve the security of nuclear weapons at as many as 123 storage sites. Initially, 50 sites operated by the 12th Main Directorate (12th MD) were identified for "quick fix" security upgrades. Under this rapid upgrade project, CTR is providing the 12th MD with 50 km of sensor fencing, 350 sensor alarms, and 200 microwave systems. The shipment of this equipment began in October 1997 and continues. Due to a 1998 request from the Russian

26. Center for Nonproliferation Studies staff correspondence with Volodymyr Chumak, June 2000.
27. "Zavershena perebroska iz Ukrainy v Rossiyu gruppirovki strategicheskikh bombardirovshchikov," *Interfax*, February 21, 2000.
28. Kuenning, "Cooperative Threat Reduction Program," p. 21.
29. CTR Program Plan, p. IV–10.
30. CTR Program Plan, p. IV–34.

Ministry of Defense (MOD), CTR is providing similar equipment for 48 air force and navy storage sites and for 25 Strategic Rocket Force sites.

CTR assistance has helped create the Security Assessment and Training Center (SATC) at Sergiyev Posad, a facility built to assist MOD with the design and implementation of security systems throughout the Russian nuclear complex. The site was formally established at a ceremony in February 1998, attended by U.S. Secretary of Defense Cohen and Russian Defense Minister Sergeyev.

The United States is also providing expertise and assistance to assist Russia in assessing site vulnerability (with the use of computer simulation developed by the Department of Energy) and with personnel reliability assessment tools, including drug and alcohol test kits and an analysis center, and polygraph equipment.

Weapons Transport Security

Initial WPC&A projects focused on helping to protect nuclear warheads during transit—especially those in transit from the former Soviet republics to Russia—as well as on support for emergency services in the event of an accident. For this purpose, the United States provided Russia with 4,000 Kevlar blankets, 150 supercontainers (used to carry several warheads at a time) for the physical and ballistic protection of nuclear weapons, and 117 special railcar conversion kits (100 cargo, 15 guard, and two prototypes) to enhance the security of warheads in transit. In addition, CTR has also provided Russia with five mobile emergency response complexes to deal with potential accidents during transport. These include rail-mounted and road-mobile cranes, VHF portable radios, portable command and control computers, chemical and fire-fighting protective clothing, personal dosimetry equipment, Violinist III x-ray and gamma-ray instrument kits, and air-sampling monitors. (An additional 150 supercontainers were provided by Great Britain in May 1997.) The railcars themselves were produced in Russia using U.S. funds and U.S. conversion kits; the rest of the equipment was produced in the United States. This program continues, and on November 1, 1999, DOD and the Russian Ministry of Defense signed a new memorandum for $41.7 million in additional assistance for the purchase of security systems for railcars. The program's aims have now shifted to the replacement of railcars that are nearing the end of their service life.

Former Soviet Biological and Chemical Weapons and Production Capability

Although not as widely discussed, the United States has provided considerable assistance through the CTR program to help dismantle and control the former Soviet Union's chemical and biological weapon (CBW) capabilities. Assistance areas fall into four categories.

- chemical weapons destruction
- the dismantling of former CBW production facilities
- enhancing physical security
- financial support for peaceful research by former Soviet CBW scientists and engineers

History

Following the breakup of the Soviet Union in 1991, the CTR program focused primarily on the threats posed by nuclear weapons safety and security and on the need to eliminate strategic launchers for those weapons. It was quickly recognized, however, that the estimated 40,000 metric tons of chemical weapons (CW) agent in Russia also posed a considerable threat and required attention. In July 1992 $13 million was provided to fund efforts under the chemical weapons destruction agreement.[31] By 1996, however, only 5% of total CTR funds had been allocated to facilitate the destruction of former Soviet chemical stockpiles,[32] and to date little significant progress has been made. Russia has requested and received extensions of destruction deadlines from the Organization for the Prohibition of Chemical Weapons (OPCW) in The

31. U.S. General Accounting Office (GAO), *Weapons of Mass Destruction: Status of the Cooperative Threat Reduction Program* (Washington, D.C.: GAO/NSIAD–96–222, September 1996), p. 19. Forty thousand metric tons is the most often quoted estimate. Some Russian military officers, however (such as General Kuntsevich), have stated that there has yet to be a full accounting.

32. Ibid., p. 2.

Hague, which oversees the implementation of the Chemical Weapons Convention, which requires the elimination of offensive chemical weapons agents.

An additional commitment was made under the CTR program to focus on former Soviet chemical- and biological-weapons-related technology and expertise following a board meeting of the International Science and Technology Center (ISTC) meeting in March 1994.[33] At the same time, meetings were being held between U.S. and Kazakhstani officials on biological weapons conversion, during which the two parties agreed on a $15 million industrial cooperation initiative.

In the chemical weapons sector, delays also occurred during the lengthy (and somewhat contentious) negotiations over a pilot chemical weapons destruction facility in Shchuchye, Russia. In addition to a debate over who should pay for infrastructure costs associated with the destruction facility, Russian military sources were slow to provide information about the chemical weapons that were to be dismantled, further lengthening the negotiation process.[34]

Other Newly Independent States (NIS), such as Uzbekistan, were themselves belatedly made aware of former Soviet research in chemical and biological weapons. The Nukus facility in Uzbekistan, for example, was named as an important chemical weapons test site only after Uzbekistani independence in September 1991.[35] As late as 1995 Russia refused to give the government of Uzbekistan details on previous chemical and biological weaponry work conducted on its territory. The first visit by U.S. DOD officials to the Vozrozhdeniye (Renaissance) Island test site occurred in 1995, when U.S. biologists were allowed to conduct tests on buried anthrax samples both there and at other locations.[36]

Still, total CTR program spending, particularly in the biological weapons (BW) area, remained modest until 1997,[37] when efforts were apparently made by Iran to acquire BW technology from a Russian biological institute. From that point, greatly increased amounts of money have been slated for CTR projects, especially in BW-related institutes within the former Soviet Union.

Chemical Weapons

The former Soviet Union has the largest stockpiles of chemical weapons (CW) in the world. These weapons and related chemicals are to be destroyed in accordance with the Chemical Weapons Convention (CWC), the latter having superseded the bilateral Wyoming Memorandum of Understanding signed in 1989 by the former Soviet Union and the United States.

The U.S. CTR program has supported CW dismantlement in Russia since 1992, and all former Soviet chemical weapons are believed to be in Russia. The CTR program has spent more than $140 million on the development and design of a pilot nerve-agent destruction plant at the Shchuchye CW depot, located in the Kurgan region of southwestern Siberia. The Shchuchye depot houses more than 5,450 metric tons of nerve agents weaponized in nearly two million artillery projectiles, 718 bulk-filled FROG and Scud missile warheads, and 42 bomblet-filled SS–21 missile warheads. The Russian government has designated the State Institute of Organic Chemistry and Technology (GosNIIOKhT) in Moscow as the analytical laboratory for its national chemical demilitarization program, and U.S. assistance has helped to provide nonmilitary jobs for its staff. (As the Russian organization primarily responsible for chemical weapons production and research, GosNIIOKhT had also been receiving ISTC funds since 1994.)

In FY 2000, however, the U.S. Congress canceled $130 million that had been budgeted for the construction of the destruction plant at Shchuchye. The decision to cancel the funding resulted from congressional uncertainty over

33. Amy Smithson, *Toxic Archipelago: Preventing Proliferation from the Former Soviet Chemical and Biological Weapons Complexes,* Henry L. Stimson Center, February 2000, p. 22.

34. U.S. GAO, *Weapons of Mass Destruction: Effort To Reduce Russian Arsenals May Cost More, Achieve Less Than Planned* (Washington, D.C.: GAO/NSIAD–99–76, April 1999) p. 11.

35. Judith Miller, "U.S. and Uzbeks Agree on Chemical Arms Plant Cleanup," *New York Times,* May 25, 1999, p. A3.

36. Judith Miller, "At Bleak Asian Site, Killer Germs Survive," *New York Times,* June 2, 1999, pp. A1, A10.

37. U.S. GAO, *Biological Weapons: Effort To Reduce Former Soviet Threat Offers Benefits, Poses New Risks* (Washington, D.C.: GAO/NSIAD-00-138, April 2000), p. 27.

the cost of the facility; doubts about Russia's ability and willingness to meet its financial obligations to the CW destruction program; limited financial assistance from other countries; and organizational upheavals within the Russian government that have hampered the development of a coordinated federal destruction plan. Part of this money was reallocated for security upgrades at CW depots in Russia; the remainder was transferred to other CTR projects. Schuchye funding has continued, however, with funds budgeted in previous years expended in 2000 with Congressional approval. The Defense Department did request additional money for the Shchuchye project in its FY 2001 budget request.

The CTR program is also helping to destroy equipment and technology from selected former Russian and Uzbek CW production facilities. In 1997 and 1998, a total of $20.2 million in CTR funds was authorized to destroy militarily relevant production equipment and ventilation systems at the former Soviet CW production facilities in Volgograd and the VX nerve agent filling plant in Novocheboksarsk, Russia. To date, however, only $2.2 million has been committed because of the need to secure approval for such efforts from OPCW.[38] In 1999, the United States and Uzbekistan signed a bilateral agreement to provide $6 million in CTR funds to dismantle the Chemical Research Institute in Nukus in southwestern Uzbekistan, which contains CW-relevant equipment and technology. In FY 2000, another $20 million was committed for security upgrades at CW storage depots.[39]

Biological Weapons

The former Soviet Union had a significant, large-scale offensive biological weapons program. The proliferation risks posed by residual biological-weapons-related technology and expertise in an underfunded and insecure complex are similar to those in the nuclear field, although with BW issues there is a greater emphasis on controlling knowledge as opposed to materials. In Russia, efforts are now focused on providing physical protection and material accounting for "libraries" of biological agents as well as on keeping former Soviet-era experts employed in non-weapons-related pursuits. The four major Russian military BW institutes are the Center of Military-Technical Problems of Biological Defense in Yekaterinburg, the Center for Virology in Sergiyev Posad, the Scientific Research Institute of Military Medicine at St. Petersburg, and the Scientific Research Institute in Kirov.[40] While these four institutes have remained closed to foreigners, the United States has provided assistance to the Biopreparat system, the ostensibly civilian part of the Soviet BW effort. In Kazakhstan, U.S. assistance is focused on the destruction of Soviet-era production facilities. The major BW-related facility in Kazakhstan is the Stepnogorsk Scientific Experimental and Production Base (SNOPB).

The Russian Federation: Enhanced Materials Protection Control and Accounting

The United States is providing security assistance for biological materials protection, control, and accounting (BMPC&A) of the pathogen culture collections at the Center for Virology and Biotechnology (Vector) in Koltsovo, near Novosibirsk, and at the Center for Applied Microbiology in Obolensk, near Moscow. In addition to being one of only two known institutes to possess the smallpox virus cultures, Vector also has 15,000 viral strains, including Ebola and Marburg. Obolensk holds approximately two thousand types of microbes, as well as genetically modified anthrax bacteria.[41] Between 1997 and 1999, $3 million in CTR funds was set aside for security improvements at these and other former BW institutes in Russia and Kazakhstan. In FY 2000, $10 million was made available for physical security and accounting measures at BW facilities.[42]

38. CNS staff communication with CTR official, December 22, 1999.
39. House Armed Services Committee, "Summary of Major Provisions, S. 1059: National Defense Authorization Act for Fiscal Year 2000 (Conference Report), August 5, 1999, p. 30.
40. Ibid., pp. 7–8.
41. U.S. GAO, *Biological Weapons,* April 2000, p. 13.
42. Smithson, *Toxic Archipelago,* p. 81.

Kazakhstan

FORMER BIOLOGICAL WEAPON PRODUCTION FACILITY

In addition to testing a variety of BW agents, the Stepnogorsk Scientific Experimental and Production Base was originally given the task of manufacturing weapons-grade anthrax and plague.[43] Estimates vary, but Western estimates are that at full capacity SNOPB could have produced 300 metric tons of anthrax in a ten-month period.[44]

Built by the former Soviet Union at an estimated cost of $1 billion, the massive complex of buildings, tunnels, bunkers, and 20,000-liter fermenters at SNOPB have now been gutted. (To accomplish this, the United States and Kazakhstan had signed a contract worth $1.5 million in September 1998 to dismantle fermenters and other equipment.)[45] Initial plans to convert the large Stepnogorsk facility for civilian manufacturing have been all but scrapped in favor of smaller, scattered factories and institutes around Stepnogorsk city. At least one large fermenter remains and, according to some, is still serviceable. Plans to destroy the buildings are at a standstill, due to the estimated $14 million cost.[46]

Additional funding is either being allocated or considered for institutes possessing agriculturally related pathogens. In Kazakhstan, security measures are being implemented (at a cost of $4 million) for pathogen collections at the Kazakh Institute for Research on Plague Control (Almaty) and at the extensive agricultural pathogen library at the State Research Institute for Agricultural Science (NISKhI), in Otar. Similar approaches may be made at Russian institutes, including the Institute for Animal Health (Vladimir), and the Golitsyno-based Institute of Phytopathology.[47]

BIOLOGICAL WEAPON BRAIN DRAIN INITIATIVES

In addition to Soviet-era biological weapon production capabilities and remaining pathogens, the United States is also providing assistance to keep former Soviet BW experts from selling their services to would-be BW proliferators. These efforts have been undertaken through several other U.S. assistance programs, including programs of the ISTC and Initiatives for Proliferation Prevention (IPP), as well as several DOE programs.

Controlling Nuclear Materials and Expertise

In addition to its large arsenal of nuclear and chemical weapons, Russia has the world's largest stockpile of weapons-usable nuclear materials. Estimates vary, but Russia is believed to have produced as much as 1,350 metric tons of highly enriched uranium (HEU) and plutonium (Pu) during the cold war. Almost half this material exists outside nuclear weapons.

The U.S. Department of Energy (DOE) is responsible for most U.S. nonproliferation assistance programs that focus on nuclear materials and their associated infrastructure, although the Defense Department continues to administer some projects in this area as well.

Material Protection, Control, and Accounting Program

The major program in this sphere has been the effort to improve the security and accounting of the approximately 650 metric tons of weapons-usable nuclear materials at scientific research institutes and production facilities in Belarus, Georgia, Kazakhstan, Latvia, Lithuania, Russia,

43. Tom Mangold and Jeff Goldberg, *Plague Wars: A True Story of Biological Warfare* (Macmillan, 1999), pp. 186–88.

44. Gulbarshyn Bozheyeva, Yerlan Kunakbayev, and Dastan Yeleukenov, *Former Soviet Biological Weapons Facilities in Kazakhstan: Past, Present, and Future,* Occasional Paper 1, June 1999, Monterey Institute, CNS, <www.cns.miis.edu/pubs/opapers/op1/index.htm>

45. "Dismantlement of Biological Weapons Infrastructure at AO Biomedpreparat," DSWA Contract 01–98–C–0165, September 10, 1998.

46. "Former Biological Weapons Facilities in the FSU: Dismantlement and Prospects for Conversion, Stepnogorsk, Republic of Kazakhstan," July 24–26, 2000, Stepnogorsk, Kazakhstan.

47. U.S. GAO, *Biological Weapons,* April 2000, pp. 28–29.

Ukraine, and Uzbekistan. Assistance from the United States for this effort was initiated as part of the CTR program in 1993 and was originally funded through DOD and implemented by DOE. This CTR-funded work was known as the Government-to-Government Program. In 1994, DOE began work under a separate, parallel program, known as the Laboratory-to-Laboratory Program, which used a collaborative approach to meet essentially the same objective: to improve the material protection, control, and accounting (MPC&A) of nuclear material in the NIS. Defense Department–led efforts met resistance from Russian counterparts because of the sensitivity of working with nuclear materials and because of "Buy-American" provisions in the CTR authorizing legislation. In addition, the accounting and audit requirements of the Defense Department programs created additional complexities to implementing programs at these facilities. Particularly important to the progress of Department of Energy–led programs, however, were the working relationships between U.S. and Russian scientists and laboratory employees, which formed a firm technical and cooperative basis for future activities. Although there is some controversy over how much material has become more secure as a result of the program, it is clear that hundreds of tons of Russian nuclear materials are less vulnerable to theft and undetected diversion as a result of U.S. assistance.

In FY 1996, DOE assumed funding responsibility for future MPC&A activities through its own budget authority—meaning that funds were no longer allocated through the CTR program—and in February 1997, DOE consolidated its Government-to-Government and Laboratory-to-Laboratory Programs into the MPC&A program. In spring 1999, responsibility for the non-Russian NIS was transferred from the MPC&A program to DOE's Office of International Safeguards, leaving the MPC&A program to concentrate exclusively on Russia.[48] A few months later, in November 1999, the MPC&A program became the responsibility of a newly created DOE Office of International Materials Protection and Emergency Cooperation.[49]

TABLE 3.3: FUNDING FOR MPC&A, BY YEAR (IN MILLIONS)

FY 1993–1996:	$87.6
FY 1997	$105.1
FY 1998	$149.2
FY 1999	$136.9
FY 2000	$144.6
FY 2001 (request)	$149.9
Total	**$773.3**

The DOE program was originally carried out through the Russian/NIS MPC&A Task Force, which expected to complete its mission in 2002. By 1998, it had become clear to DOE officials that there were many more buildings requiring security upgrades than the program was originally aware of and that additional time would be required to carry out the program. Some program plans reportedly now continue to 2015–2020.[50]

Although initially DOE provided assistance to just a handful of facilities in Russia, by 2000 the number had grown to more than 35 facilities in Russia and more than a dozen facilities in the non-Russian NIS. (For detailed information on the progress of DOE MPC&A projects at particular facilities, please see chapter 4.)[51] DOE has completed MPC&A projects at all NIS sites outside Russia, although related projects will continue at some sites. In

48. Kenneth B. Sheely and Mary Alice Hayward, "New Strategic Directions in the MPC&A Program," paper presented to the 40th Annual Meeting of the Institute of Nuclear Material Management, July 1999, Phoenix, AZ, posted on the DOE MPC&A web site: <www.dp.doe.gov/nn/mpca/pubs>.

49. CNS staff correspondence with DOE official, December 1999.

50. Oleg Bukharin, Matthew Bunn, and Kenneth Luongo, "Renewing the Partnership: Recommendations for Accelerated Action To Secure Nuclear Material in the Former Soviet Union," Russian American Nuclear Security Advisory Council, August 2000, p. 8.

51. Chapter 4 contains entries for all facilities where DOE has conducted or is currently conducting work with the exception of the Norilsk Mining Combine in Russia, the South Ukraine Nuclear Power Plant in Ukraine, the Ignalina Nuclear Power Plant in Lithuania, the Ulba Metallurgical Plant in Kazakhstan, and the Institute of Physics in Georgia. These facilities do not house weapons-usable fissile materials and thus were not included.

Kazakhstan, for example, DOE continues to be involved in projects to decommission the BN–350 fast-breeder reactor at the Mangyshlak Atomic Energy Combine in Aktau and to secure permanent long-term storage of its plutonium (Pu)-laden spent fuel. At two other non-Russian NIS sites—the Ulba Metallurgical Plant in Ust-Kamenogorsk, Kazakhstan,[52] and the Institute of Physics in Tbilisi, Georgia[53]—the United States decided to remove the HEU from the countries altogether rather than spend money to secure material on site for which these facilities no longer had any use. Project Sapphire in 1995 resulted in 600 kg of Kazakh HEU being shipped to the United States for downblending, which was completed in November 1999. The Georgian material was moved in April 1998 to the United Kingdom through the project known as Auburn Endeavor.

In Russia, DOE has signed MPC&A agreements with the Ministry of Atomic Energy (Minatom), which controls most of these facilities, and the Federal Inspectorate for Nuclear and Radiation Safety, which represents the small number of facilities under the administrative auspices of the Ministry of Education, the Ministry of Economics, and others. In addition, DOE has signed agreements for MPC&A cooperation with the Russian navy and independent facilities under the umbrella of its cooperation agreement with Minatom. DOE has completed MPC&A work at 11 small research facilities in Russia, but projects continue at all large research facilities and multi-function production facilities. In addition, the MPC&A program office announced two new initiatives in 1999: the Site Operations and Sustainability Program and the Material Conversion and Consolidation Program.[54] The goal of the Site Operations and Sustainability Program is to make sure that the new MPC&A systems will be sustainable over the long term; the Material Conversion and Consolidation Program is designed to reduce the number of sites, buildings, and NIS states where weapons-usable material is located and to convert that material from HEU to low-enriched uranium (LEU).[55]

DOE also has an agreement with the Russian navy for MPC&A-related projects at naval facilities, where there are many metric tons of fresh and low-irradiated HEU fuel. The MPC&A projects at naval facilities are some of the most sensitive in the DOE program, and the Kurchatov Institute has played a key role in facilitating the relationship between DOE and the Russian navy. Projects in the naval sector pursue three aims: (1) the consolidation of fissile material, especially fresh naval fuel; (2) physical protection at consolidated sites; and (3) the physical protection of spent fuel sites. For the first two years of the naval fuel program, from 1996 to 1998, DOE focused its efforts on sites in the Northern Fleet, upgrading security both at land-based storage sites and on a number of ships that serve as floating refueling and storage facilities. In 1998, DOE work at Russian naval facilities was expanded

52. On November 22, 1994, the U.S. government disclosed that 581 kg of HEU, including several hundred kilograms of weapons-grade material, had been stored at the Ulba Metallurgical Plant under inadequate security arrangements. The material was originally destined for use as fuel in Soviet naval reactors. U.S. spokespersons announced that, in an effort to eliminate the risk of diversion, this material had been transported to Oak Ridge, Tennessee, pursuant to arrangements made with the government of Kazakhstan and in consultation with the government of Russia. It was to be blended with non-weapons-grade uranium to produce fuel for nuclear power plants. Kazakhstan reportedly was to receive several tens of million dollars in U.S. economic assistance in return for relinquishing the material. (William C. Potter, "The 'Sapphire' File: Lessons for International Nonproliferation Cooperation," *Transition,* November 17, 1995, pp. 14–19; R. Jeffrey Smith, "U.S. Takes Nuclear Fuel," *Washington Post,* November 23, 1994; and Steven Erlanger, "Kazakhstan Thanks U.S. on Uranium," *New York Times,* November 25, 1994.)

53. On April 23, 1998, the United States successfully completed the transfer of 4.3 kg of fresh HEU fuel and 800 g of spent fuel from the Institute of Physics in Tbilisi (Mskheta), Georgia, to the Dounreay nuclear complex in Scotland, United Kingdom, where it will be stored permanently. The material had been destined for use in the institute's nuclear research reactor, but the reactor was shut down in 1990. The United States reportedly paid Georgia $125,000 for the material. (Michael Gordon, "U.S., Britain Relocate Nuclear Material from Volatile Georgia," *New York Times,* April 21, 1998; and Steven Kinzer, ""U.S. Agents Whisk Atom Bomb Material from an Ex-Soviet Land," *New York Times,* April 24, 1998.)

54. Kenneth B. Sheely, "New Strategic Directions in the MPC&A Program," U.S. Department of Energy briefing, June 1999.

55. Rose Gottemoeller, "The Importance of Sustainability in Securing Nuclear Material in the Former Soviet Union," U.S. Department of Energy briefing, 2000.

to the Pacific Fleet, where the physical protection of spent fuel as well as fresh fuel storage sites has been upgraded.

Although it is possible that there are some Russian facilities outside the DOE program, almost all the major sites with weapons-usable fissile material in the former Soviet Union are thought to be participating in the program. The four notable exceptions are the nuclear warhead assembly and dismantlement plants: Avangard in Sarov, the Elektrokhimpribor Combine in Lesnoy, the Instrument Making Plant in Trekhgornyy, and the Start Production Association in Zarechnyy. Plans to include these facilities in the DOE program have been suspended until the department can obtain greater access to these sites.

In addition to specific projects to upgrade physical protection and enhance nuclear material control and accounting at individual facilities, the MPC&A program includes projects to assist with the development of a legal and regulatory framework in the nuclear sphere and to support critical training and education in the MPC&A sphere. Training consists of workshops for scientists, engineers, and operators at individual sites, as well as support for a master's degree program in MPC&A at the Moscow Engineering and Physics Institute and for MPC&A training at the Russian Methodological Training Center, which was established at the Institute of Physics and Power Engineering in 1995.

Mayak Fissile-Material Storage Facility

The U.S. CTR program is helping Russia build a large-scale fissile-material storage facility (FMSF) in Mayak to securely store plutonium and highly enriched uranium from dismantled nuclear weapons. The project was initiated in 1992, after Russian Minister of Atomic Energy Viktor Mikhailov told U.S. counterparts that a lack of secure weapons-material storage space might constrain Russia's ability to dismantle nuclear weapons under pending arms control agreements.[56] Original plans called for the construction of a two-wing facility in Seversk, each wing capable of holding 25,000 fissile-material containers and together 66 metric tons of nuclear materials,[57] with the United States and Russia splitting the facility's cost equally.

The Mayak FMSF Project has undergone a series of modifications, however, owing to Russian financial constraints and other issues. The site of the facility was switched from Seversk to Mayak in 1994, and current plans call for completing only the initial wing of the project. One wing of the 50,000-container-capacity facility should be completed by mid-2002 at a total cost of $413 million. The CTR office has indicated an interest in building the second wing of the facility for another 25,000 containers, in 2002, if "appropriate transparency measures can be developed." The cost of this facility is estimated at $229 million.[58]

Funding, Scope, and Schedule

The U.S. Department of Defense and Minatom signed an agreement on October 5, 1992, to cooperate on the design and construction of a FMSF. On this basis, Congress appropriated $15 million for the design of the facility. After completion of the initial designs in 1993 and signature of a FMSF Implementing Agreement on September 2, 1993, the U.S. Congress appropriated $75 million to the Department of Defense for the construction at Mayak. Construction began in August 1994 with site preparation. Congress agreed to fund the U.S. half of the project on the basis of several conditions (discussed under "Transparency" below).

After several years of construction delays, caused in part by unilateral Russian decisions to modify the project's design, Russia announced in April 1998 that it would be unable to make any substantial financial contribution to the construction project. On this basis, the United States agreed to fund the completion of the first wing of the facility but has deferred any decision on completing the second wing of the project. In January 1999, the two countries agreed to an upper limit of $412.6 million for the total costs for the first wing of the facility.[59]

56. Warhead and Fissile Material Transparency Program: Strategic Plan, U.S. Department of Energy, May 1999.

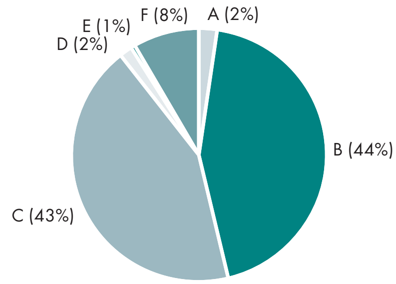
57. CTR Program Plan, p. IV–37.

58. Ibid.

59. CTR program Plan, p.IV–37.

TABLE 3.4: MAYAK FUNDING PROVIDED BY THE UNITED STATES, TO 1999[60]

A	Design	$9.1 million
B	Construction	$175.0 million
C	Equipment Purchases and Installation	$171.5 million
D	Transportation	$6.5 million
E	CLS	$2.1 million
F	Project Support	$33.3 million
Total		**$397.5 million**



Transparency

The U.S. Congress attached certain conditions to its decision to fund the Mayak FMSF. These included a requirement that the United States and Russia negotiate measures so that the United States could confirm that the facility would:

- safely and securely store nuclear materials
- not allow the removal of nuclear materials for military or defense purposes, and
- accept materials only from dismantled nuclear weapons.

U.S.-Russian negotiations have made significant progress on the first two of these monitoring conditions. Up to six U.S. inspections will be permitted at the Mayak FMSF per year. In addition to accessing Mayak's computer-based accounting logs, U.S. inspectors will be able to pick up to 120 storage tubes at random per year for verification.[61]

The issue of verifying the weapons origin of material to be stored at Mayak has been more complicated. When the fissile-material storage agreement was initially signed in 1993, Russia planned to store easily identifiable plutonium "pits" and HEU weapons components at the Mayak site. In 1996, however, Minatom announced that all material to be stored at Mayak would first be converted into nonclassified forms, greatly complicating efforts to confirm their weapons origin. Minatom claimed that this step, which would turn weapons components into basic, 2-kg spheres, was necessary to ensure that International Atomic Energy Agency (IAEA) officials were not given access to classified weapons-related information. The IAEA has been asked, as part of the Trilateral Initiative, to help to verify that material declared to be "excess" is not used for weapons purposes (see full discussion under "Trilateral Initiative").

TABLE 3.5: FUNDING FOR MAYAK FMSF, BY YEAR

FY 1994	$55 million
FY 1995	-
FY 1996	$29 million
FY 1997	$66 million
FY 1998	$57.7 million
FY 1999	$60.9 million
FY 2000	$64.5 million

In response, the United States has asked for Russia to permit verification measures "upstream" from the Mayak plant to help to confirm the weapons origin of the material before the material is converted to nonweapons shape, and then to establish a chain of custody to ensure that the same material is delivered for storage at Mayak. Russia has refused U.S. proposals to monitor materials before their arrival at Mayak, stating that such measures are not

60. CNS Database.

61. GAO, *Weapons of Mass Destruction,* April 1999.

authorized in the U.S.-Russian agreements and that they could potentially allow classified weapons information to be revealed.

Trilateral Initiative

Although the United States and Russia continue to pursue formal negotiations on Mayak facility transparency, they are also pursuing a broader second track of negotiations referred to as the Trilateral Initiative, with the cooperation of the International Atomic Energy Agency. The Trilateral Initiative seeks new methods to verify the presence and accounting of warheads and fissile materials without revealing classified information. In an April 10, 1996, address to the Russian Security Council, President Boris Yeltsin proposed placing the Mayak storage facility under IAEA safeguards, thereby creating the possibility of adding international Trilateral Initiative monitoring to the planned bilateral, U.S.-Russian, monitoring provisions.

Officially launched on September 19, 1996, the Trilateral Initiative talks progressed in fits and starts. The latest potential breakthrough came after consultations at the September 1999 IAEA General Conference between Russian Minister of Atomic Energy Yevgeny Adamov, U.S. Secretary of Energy Bill Richardson, and IAEA Director General Mohamed ElBaradei. The leaders announced progress in developing new verification equipment, including a prototype for plutonium verification that incorporated "information barriers" that would allow inspectors to gain the data necessary for verification without compromising classified information. The ministers also agreed that preparations for talks on applying these initiatives at the Mayak storage facility were also complete. The two sides hoped to announce a more complete agreement at the September 2000 IAEA General Conference, but no announcement on a final agreement was issued following that meeting.

HEU Purchase Agreement

On February 18, 1993, the United States agreed to purchase 500 metric tons of Russian highly enriched uranium from dismantled nuclear weapons. Although this amount represents less than half of the 1,400 metric tons of highly enriched uranium that the Soviet Union is thought to have produced during the cold war,[62] the program is designed to reduce the risk of theft of Russian nuclear material and to speed the dismantlement of Russian nuclear weapons. Under the program, Russia dilutes or downblends weapons-grade material to low-enriched uranium under monitoring arrangements, and then it ships the material to the United States for fabrication into nuclear reactor fuel. The entire program is to take place over a 20-year period and was originally expected to yield the revenue to pay Russia $12 billion for material and services. The agreement has since been renegotiated, making the amount paid to Russia contingent on market forces. This means that Russia will make less than the original amount envisioned.[63]

The pact is carried out by executive agents appointed by the two governments. The U.S. executive agent is the privatized United States Enrichment Corporation (USEC), and the Russian executive agent is Tekhsnabeksport (Tenex), the commercial arm of Minatom. Tenex agreed with USEC in January 1994 to provide the LEU equivalent of 10 metric tons of HEU per year for five years, and the LEU equivalent of 30 tons of HEU per year for a remaining 15 years.[64]

As of June 2000, despite numerous setbacks in realizing the HEU purchase agreement, Russia had transferred to USEC 84 metric tons of HEU in the form of 2,484 metric tons of LEU. This is equivalent to approximately 3,360 nuclear warheads. In return, Russia had received almost $1.5 billion in compensation.

62. U.S. GAO, *Nuclear Nonproliferation: Status of Transparency Measures for U.S. Purchase of Russian Highly Enriched Uranium,* GAO/RCED–99–194, September 1999, p. 3.

63. Thomas Neff, "Privatizing U.S. National Security: The U.S.-Russian HEU Deal Risk," *Arms Control Today,* August/September 1998.

64. This does not include Russia's private sales of natural uranium acquired through the deal. Testimony of Rose Gottemoeller before the Senate Armed Services Committee, March 6, 2000; USEC Status Report for the Megatons to Megawatts Program, June 15, 2000.

The program has faced a number of problems, including lingering disputes between the Russian and U.S. executive agents over payments. One long-standing issue has been the process for paying Russia for the uranium component of the material supplied (the bulk of value being paid to Russia comes from the enrichment services, not from the value of the uranium being delivered). In January 1994, USEC agreed to pay Tenex immediately for the enrichment services, and to defer payments for the uranium component. In early 1995, Minatom requested that USEC pay for the uranium component on a current basis. In June 1995, the two agents agreed that USEC would ensure the "full and simultaneous payment for natural uranium and enrichment services."[65] This understanding was included in a more comprehensive settlement in the USEC Privatization Act signed by President Bill Clinton on April 26, 1996, which ceded Russia ownership of the natural uranium component of materials received under the deal and allowed Russia to sell small amounts of uranium in the United States.[66] The legislation also reimbursed Russia for its 1995–1996 natural uranium shipments.

After shipping only 350 metric tons (11.6 metric tons of HEU) of the contracted 723 metric tons of LEU (24 metric tons of HEU), Russia suspended LEU shipments in August 1998 over another dispute regarding payment for the natural uranium component. At the September 1998 summit, President Clinton promised Russian President Yeltsin that the United States would find a way to solve the uranium component problem. The U.S. and Russian energy ministers signed an agreement on September 20, 1998, at the IAEA General Conference in Vienna whereby, in return for Russia's promise to continue LEU deliveries, the United States agreed to: (1) defer, for the duration of the agreement, sales of USEC's uranium obtained from DOE; (2) oversee USEC's uranium sales; (3) grant Russia cash advances on future shipments; and (4) pay Russia $325 million for its 1997 and 1998 uranium shipments.[67] The consortium agreement was officially signed on March 25, 1999, in conjunction with a Richardson-Adamov joint statement. Russia resumed LEU shipments in March 1999.[68]

Transparency Agreements

An important component of the HEU–LEU arrangement is a transparency regime that seeks to verify that uranium purchased by USEC is derived from dismantled Russian nuclear weapons. The arrangements under the HEU purchase are among the most intrusive of U.S. cooperative programs, given Russia's clear financial interest in cooperating with U.S. agents. DOE has spent roughly $74 million on HEU transparency measures between FY 1994 and FY 2000 and received $15 million for FY 2001.

The HEU purchase verification regime, established through a Transparency Review Committee, which was established in March 1994, is codified in a series of documents known as facility annexes.[69] Under these annexes, six monitoring visits to each site are permitted. Initially, these annexes covered two conversion plants in Russia: the Seversk facility and the Novouralsk facility. Monitoring at the conversion facilities includes: observing the transformation of HEU metal chips into gaseous HEU for blending purposes; applying tamper-indicating tags and seals to HEU and LEU containers; reviewing copies of Russian material control and accounting documents; and, at the Novouralsk facility, random sampling of uranium at the point where the HEU was blended into LEU.[70]

65. Chronology of the Megatons to Megawatts Contract, USEC web site: < www.usec.com/content/thirdtier/newreleases/08-31-09.htm>

66. "Spot Prices Down Again," *Nuclear Fuel,* June 30, 1997, p. 15; "HEU Feed Talks Continue; DOE Sale Notice Appears," *Nuclear Fuel,* August 11, 1997, p. 2; "Little Progress Reported in HEU Talks," *Nuclear Fuel,* July 28, 1997, p. 15.

67. Kent A. B. Jamison, "Overview of the U.S.-Russian HEU Agreement," CNS database, June 1999.

68. Chronology of the Megatons to Megawatts Contract, USEC web site: <www.usec.com/Content/ThirdTier/ newreleases/08-31-09.htm>.

69. For additional information, see *Arms Control Reporter* (1996) (Cambridge, Mass.: Institute for Defense and Disarmament Studies, 1996), p. 612.B–1.17.

70. U.S. GAO, *Nuclear Nonproliferation: HEU,* September 1999, p. 11.

An October 1996 agreement expanded transparency measures in exchange for a $100 million advance to Minatom for its uranium shipments. The agreement extended monitoring to two more facilities—Zelenogorsk in 1996 and Mayak in 1998—where Russia had expanded its blending activities in response to the increased delivery requirements of the November 1996 USEC-Minatom contract. In addition, the agreement strengthened monitoring capabilities by allowing the following: measurement of the enrichment levels of uranium using U.S.-manufactured portable uranium detection equipment; observation of storage areas for HEU received from dismantlement facilities; at the Zelenogorsk and Novouralsk facilities, installation of continuous monitoring equipment to measure enrichment levels and material flow rates during blending; and expansion of U.S. access at Seversk to conduct experiments on Russian nuclear weapons components arriving from Russian dismantling facilities.[71]

The U.S. Department of Energy reported in February 1998 that 95% of transparency measures linked to this additional agreement had been implemented.[72] However, because uranium shipments began before all the relevant facility annexes were signed, U.S. officials estimated in late 1999 that approximately one-third of the uranium shipped to date had not been subject to verification.[73] Even so, U.S. officials have rejected only one canister, which they believed did not contain former weapons uranium.

HEU Downblending

The process of downblending involves diluting highly enriched uranium with a mixture of nonfissionable uranium isotopes containing only 1.5% U–235, which is made from natural uranium. Although uranium containing 20% U–235 or greater is considered highly enriched, an enrichment level of over 90% is preferred for use in a nuclear weapon. The U.S.-Russian HEU purchase agreement provides that Russia's HEU be diluted into commercial-reactor-grade fuel, containing between 3% and 5% U–235.

The uranium blending process entails at least five independent steps. First, Russian nuclear weapons are dismantled at four facilities: Lesnoy (Sverdlovsk-45), Trekhgornyy (Zlatoust-36), Avangard in Sarov (Arzamas-16), and Zarechnyy (Penza-19). Second, the uranium is shipped to the Siberian Chemical Combine (in Seversk) and the Mayak Production Association (in Ozersk), where HEU is ground into metal chips, converted to oxide, and chemically treated to remove impurities. Third, the Seversk facility and the Krasnoyarsk Electrochemical Plant (in Zelenogorsk) combine the purified uranium with fluorine to produce uranium hexafluoride (UF_6). Fourth, the Seversk and Zelenogorsk facilities and the Ural Electrochemical Integrated Plant (in Novouralsk) blend the HEU with uranium enriched to only 1.5% U–235 to produce LEU. Fifth, these facilities load the LEU into cylinders and transport them by rail to St. Petersburg, where they are then shipped to the United States.

In the United States, the Portsmouth uranium enrichment facility in Piketon, Ohio, receives the LEU cylinders. This facility may alter the LEU enrichment level according to the requirements of USEC customers, or it may send the LEU unchanged to one of the five U.S. commercial nuclear-fuel fabricators: the Siemens Power Corporation (Richland, Washington), ABB/Combustion Engineering (Hematite, Missouri), Westinghouse Nuclear (Columbia, South Carolina), Framatome Cogema Fuels (Lynchburg, Virginia), and GE Nuclear Energy (Wilmington, North Carolina).

71. *Arms Control Reporter* (Cambridge, Mass.: Institute for Defense and Disarmament Studies, 1996), 612.B–1.17. and 612B–1.33.

72. U.S. GAO, *Nuclear Nonproliferation: HEU,* September 1999, pp. 10–13.

73. Ibid., p. 8.

The transparency agreements also established reciprocal monitoring measures at U.S. facilities so that Russia can verify that the uranium sold to the United States is not being reenriched and used for weapons. Russia has reciprocal monitoring rights at USEC's Portsmouth Gaseous Diffusion Plant—where Russian LEU is processed upon arrival in the United States—and at the non-government-owned facilities where the material is subsequently fabricated into reactor fuel.

Plutonium Disposition

The United States and Russia have both declared large amounts of former defense-purpose plutonium to be excess to defense needs. President Clinton announced that he had designated 50 metric tons of plutonium to be excess on March 1, 1995,[74] and Boris Yeltsin declared that "up to" 50 metric tons of plutonium would be made excess through the nuclear disarmament process in 1997.[75] Collectively, this material is enough to produce tens of thousands of nuclear weapons, and both countries have pledged to take steps so that the material is never again used for weapons.

These amounts represent significant portions of the plutonium produced in both countries, although both will possess large stocks of weapons-usable materials even after these amounts are dispositioned. The United States has produced more than 111 metric tons of plutonium,[76] and Russia is believed to have produced an even larger amount, although the actual amount produced by Russia has never been made public.[77]

Plutonium, unlike highly enriched uranium, is not easily rendered non-weapons-usable. The goal applied to the disposal of plutonium, originally put forward by the National Academy of Sciences and subsequently adopted by the United States and Russia,[78] is to place excess weapons plutonium into a form that meets the *spent-fuel standard.* This term is defined as a form in which excess plutonium is no more attractive for use in nuclear weapons than is the plutonium contained in commercial spent-nuclear fuel.[79] Such a standard would not completely eliminate the weapons utility of the material, but it would make the material no more dangerous than the vast amounts of plutonium produced by conventional nuclear power reactors and embedded in radioactive spent fuel.

The United States and Russia have officially approved two methods to achieve the spent-fuel standard: irradiation of plutonium as mixed-oxide fuel (MOX),[80] and immobilization of plutonium with high-level radioactive waste (in either glass or ceramic form). The United States has declared its intent to immobilize approximately 17.5 metric tons of plutonium and to irradiate up to 33 metric tons as MOX fuel, while the Russian government has stated its intention to rely almost exclusively on the irradiation of MOX fuel in reactors.[81] Russia may immobilize that minor portion of its excess plutonium that does not meet fuel acceptance standards (amounting to perhaps 1 metric ton).

Negotiated Agreement

After a prolonged period of negotiation, which was supported and influenced by several official and unofficial scientific studies and multilateral reports, the United States and Russia completed a formal plutonium disposition agreement at a

74. President Clinton, "American Leadership and Engagement: Reducing the Nuclear Threat," speech at the Nixon Center, March 1, 1995.
75. Statement delivered by Minatom Minister Mikhailov at 41st IAEA General Conference, September 26, 1997.
76. *Plutonium: The First 50 Years,* U.S. Department of Energy, 1994.
77. The actual number may not even be known in Russia. The U.S. Congress appropriated $500,000 for Russia to conduct an internal plutonium inventory. Moreover, U.S. production amounts were subject to a margin of error, which amounts to approximately 1 metric ton of plutonium.
78. *Management and Disposition of Excess Weapons Plutonium,* National Academy of Sciences (National Academy Press, 1994).
79. *Nonproliferation and Arms Control Assessment of Weapons-usable Fissile Material Storage and Excess Weapons Plutonium Disposition Alternatives,* U.S. Department of Energy, January 1997.
80. Mixed-oxide fuel is produced by combining plutonium oxide and uranium oxide to form reactor fuel.
81. White House Fact Sheet, "United States–Russian Federation Plutonium Disposition Agreement," June 4, 2000.

June 2000 summit in Moscow. The agreement lays out the framework for each country to eliminate 34 metric tons each of excess weapons-grade plutonium. The original goal that each country would dispose of 50 metric tons of plutonium was scaled back at Russia's insistence that 16 of the 50 metric tons the United States had declared excess was not "weapons-grade" and could not be used directly in nuclear weapons without further refinement. The United States eventually accepted this position but intends to dispose of the additional material as part of its plutonium disposition program.

The bilateral political agreement calls for both countries to "seek to" begin operation of "industrial-scale" facilities no later than December 2007, at a disposal rate of 2 metric tons of plutonium per year.[82] The amount of material to be disposed of per year under this agreement is constrained, in part, by the limited number of Russian reactors potentially able to use MOX fuel.[83] Russia has indicated its intent to certify and use all seven of its VVER–1000 reactors to irradiate MOX fuel containing excess plutonium. In addition, it hopes to convert its one BN–600 plutonium reactor into a plutonium "burning" reactor as part of the disposition effort.[84] In order to increase the plutonium irradiation rate, the agreement states that the parties will work with other states to double, potentially, the rate of irradiation, and Moscow is reportedly considering the eventual use of reactors in other countries, including Ukraine.

The main roadblock to disposing of the Russian material is the question of financing. Russia has stated that it does not possess the funds required to carry out the disposition alone, and would simply store the material if international support were unavailable. The United States has already agreed to provide Russia with $200 million to support Russian plutonium disposition efforts.[85] The Clinton administration requested another $200 million in funding for FY 2001.[86] A review of the expense involved, however, suggests that the entire Russian disposition effort, including the construction and operation of facilities, will be $1.7 billion.[87] The U.S.-Russian agreement completed at the June 2000 Moscow summit "recognizes the need for international financing and assistance" in order for Russia to implement its plutonium disposition plans.[88] The July 2000 G–8 summit in Okinawa called upon the G–8 to develop an international financing plan by the 2001 G–8 meeting, to be held in Genoa, Italy. The primary focus of efforts to obtain outside funding is on France and the United Kingdom, whose companies are likely to be involved in the construction and operation of Russian facilities.

Left unanswered by the U.S.-Russian plutonium disposition agreement—which recognizes the possibility of additional materials being declared excess in the future—is the asymmetry between the plutonium stockpiles in both countries. Although no official numbers have ever been released by the Russian government, Russia is widely believed to have produced considerably more separated plutonium than the United States has. The United States and Russia had previously agreed that the goal of plutonium disposition efforts should be "reductions to equal levels of military plutonium stockpiles."[89] It is not clear whether this reflects current Russian or U.S. goals for plutonium disposition efforts.

Conditions

Throughout negotiations with Russia, the United States has struggled to maintain its

82. Office of Fissile Materials Disposition, Strategic Plan, Department of Energy, June 2000.
83. Presentation by Laura Holgate, ISIS Conference, "Civil Separated Plutonium Stocks: Planning for the Future," March 14, 2000, Washington, D.C.
84. This facility was built as a plutonium "breeder," producing more plutonium than it consumes, but may be modified to be a net "consumer" of plutonium.
85. FY 1999 Energy and Water Appropriations Act.
86. White House Fact Sheet, "July 2000 G–8 Summit on Plutonium Disposition."
87. Preliminary Cost Assessment for the Disposition of Weapon-grade Plutonium Withdrawn from Russia's Military Programs, Department of Energy, Office of Fissile Materials Disposition, April 2000.
88. White House Fact Sheet, June 4, 2000.
89. Joint U.S.-Russian Plutonium Disposition Report, September 1996.

TABLE 3.6: **RUSSIAN REACTORS POTENTIALLY AVAILABLE FOR PLUTONIUM DISPOSITION**	
Balakovo	4 VVER-1000
Beloyarsk	1 BN-600
Kalinin	2 VVER-1000
Novovoronezh	1 VVER-1000

policy not to "encourage the civil use of plutonium." Russia's Atomic Energy Ministry, on the other hand, sees the plutonium disposition program as a way to further its internal plans to develop a "closed fuel cycle," using plutonium for the large-scale production of electricity. To balance these conflicting goals, the United States and Russia have agreed that neither side will reprocess any of the MOX fuel containing excess plutonium until all 34 metric tons covered by

TABLE 3.7: **U.S.-RUSSIAN TECHNICAL COOPERATION ON PLUTONIUM DISPOSITION**[90]	
Plutonium Metal-to-Oxide Conversion: Assist Russia to design and build a demonstration facility to convert plutonium metal from warheads into oxide for use in nuclear fuel.	• Bochvar Institute • Research Institute of Atomic Reactors • All-Russian State Design Institute • Mayak Production Association • Scientific and Engineering Center
MOX Fuel Fabrication and Reactor Analysis/ Conversion: Developing a MOX fuel production method compatible with weapons-grade plutonium, testing the fuel and certifying its use in Russian VVER and BN-600 reactors.	• Bochvar Institute • Research Institute of Atomic Reactors • Novosibirsk Chemical Concentrates Plant • St. Petersburg Atomenergoproyekt • Kurchatov Institute • Balakovo Nuclear Power Plant • All-Russian Research Institute for Nuclear Power Plant Operation
BN-600 MOX Fuel Development and Reactor Conversion: Assess the feasibility of converting the Russian BN-600 reactor for the plutonium disposition mission.	• Research Institute of Atomic Reactors • Mayak Production Association • Institute for Physics and Power Engineering • Experimental Machine Building Bureau • Beloyarsk Nuclear Power Plant
CANDU/Parallex Analysis: Examine the technical feasibility of using Canadian "CANDU" reactors for the third-party irradiation of MOX fuel containing excess weapons plutonium.	• Bochvar Institute
High-Temperature Gas Reactor Research and Development: Help Russian institutes and private industry to develop HTGR technology in order to supplement Russia's plutonium irradiation capacity.	• Bochvar Institute • Kurchatov Institute • Experimental Machine Building Bureau • Luch Scientific Production Association • Siberian Chemical Combine • All-Russian Scientific Research and Design Institute of Engineering Technology
Immobilization: Assist Russia in developing glass and ceramic technology for immobilization of plutonium at Russian facilities.	• Bochvar Institute • All-Russian State Design Institute • Mayak Production Association • Zheleznogorsk (Krasnoyarsk-26) • All-Russian Scientific Research and Design Institute of Engineering Technology • All-Russian Scientific Research and Exploratory Planning Institute of Industrial Technology • Khlopin Radium Institute

90. Fissile Materials Disposition Strategic Plan, June 2000.

the initial agreement has been "disposed." The pact does not specify whether this means the point at which plutonium becomes MOX fuel, is inserted into a reactor, or a specific irradiation level.

U.S. Assistance for Russian Plutonium Disposition

The United States Department of Energy is working with several Russian government agencies and scientific institutes to facilitate Russia's disposition efforts. Cooperative efforts are taking place in the areas and facilities listed in table 3.7.

Brain Drain and Export Controls

Both the U.S. Department of State and the Department of Energy are involved in efforts to help prevent the brain drain of talented former Soviet weapons scientists to countries of proliferation concern. These efforts, which are coordinated and supported by other U.S. and international agencies and organizations, consist of projects designed to provide grants for civilian research to scientists and institutions formerly involved in the development of weapons of mass destruction, as well as to help with the conversion and commercialization of former defense industries. The three principal programs in this area are the Science Centers program, the Initiatives for Proliferation Prevention, and the Nuclear Cities Initiative (NCI). Both agencies also fund programs that help NIS countries to develop export control systems designed to prevent the unlawful export of WMD-related goods and technologies.

Science Centers

The State Department manages U.S. participation in both the International Science and Technology Center and the Science and Technology Center of Ukraine (STCU). These centers are multilateral organizations designed to prevent the spread of weapons of mass destruction and missile technology expertise by providing civilian employment opportunities to former weapons scientists and engineers in the NIS.

The ISTC was founded in Moscow in 1992. Current member states are the European Union (EU), Japan, Norway, the Republic of Korea, and the United States as donor countries, and Armenia, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, and Russia as recipient countries.[91] In July 1995, the STCU, a separate but parallel organization, commenced operations in Kiev. Currently, under the STCU auspices, Canada, the EU, Japan, and the United States fund projects in Georgia, Ukraine, and Uzbekistan. In order to ensure the full participation of all NIS member states, branch offices of the ISTC have been established in Almaty, Kazakhstan; Minsk, Belarus; and Yerevan, Armenia.[92] The two centers have agreed to establish a joint branch office in Tbilisi, Georgia, since Georgia is a party to both centers. The STCU also has field offices in the Ukrainian cities of Dnipropetrovsk, Kharkiv, and Lviv and has approved plans to open an information office in Tashkent, Uzbekistan.[93]

Interested facilities and scientists from NIS member states can submit project proposals to the ISTC and STCU secretariats, where they are reviewed and submitted to the governing boards of each center, which meet periodically to decide what proposals will be funded. As of the 23rd meeting of the ISTC governing board in November 2000, the ISTC had approved 1,156 projects with a value of $316 million, engaging more than 30,000 NIS scientists and engineers at more than 400 institutions.[94] As of the 10th meeting of the STCU governing board in mid-2000, the STCU had approved more than 290 projects with a total value of

91. "ISTC Fact Sheet," October 28, 1999, available at the ISTC web site: <www.istc.ru>.

92. In accordance with U.S. policy, the United States has not funded any new projects in Belarus since 1997, although Belarus is still party to the ISTC.

93. Information about the STCU field offices is available at the STCU web site: <www.stcu.kiev.ua>. The decision to open the joint office in Tbilisi is contained in "Joint Statement: STCU Governing Board Meeting, December 15, 1999," available at the STCU web site.

94. "Statement of the 23rd ISTC Governing Board, Moscow, Russian Federation, November 3, 2000, available at the ISTC web site: <www.istc.ru>.

$41.7 million,[95] engaging more than 6,700 NIS scientists and engineers.[96] Initially, the emphasis of both centers was on the nuclear sector, and nuclear weapons laboratories in the Russian closed cities continue to be among the leading recipients of ISTC grants. In recent years, however, a more concerted effort has been made to reach out to biological weapon scientists. From 1994 to 1998, a little more than 13% of ISTC grants went to biology projects.[97] In 1999, in an attempt to bring more BW scientists into the program, the U.S. increased ISTC funding for civilian research at former BW research institutes by $10 million,[98] bringing the total funding for projects in the field of biotechnology and life sciences to approximately $40 million.[99] The

TABLE 3.8: **INTERNATIONAL SUPPORT FOR SCIENCE CENTERS, BY DONOR AND AMOUNT***

Science Center	Funding Parties	Total Contributions ($US Millions)	Comments
ISTC *Headquarters:* Moscow *Current Branch Offices:* Almaty, Minsk, Yerevan	European Union	$86.9	Russia supports ISTC by providing a headquarters facility and related expenses.
	Japan	$31.5	
	Norway[100]	$1.8	
	Republic of Korea[101]	$0.8	
	United States[102]	$92.8	
	Other Sources	$17.5	
	Subtotal	**$231.3**	
STCU *Headquarters:* Kiev	Canada	$1.8	Ukraine supports STCU by providing a headquarters facility and related expenses.
	European Union	$2.1	
	Japan	$0.7	
	Sweden	$1.7	
	United States[103]	$21.4	
	Subtotal	**$32.1**[104]	
	Total	**$263.4**	

* Funding through FY 1999

95. STCU web site: <www.stcu.kiev.ua>.
96. Ibid.
97. Smithson, *Toxic Archipelago,* p. 50.
98. Ibid., p. 55.
99. "ISTC Projects by Technology Area," ISTC web site: <www.istc.ru>.
100. Contribution made since acceding to the ISTC in spring 1997.
101. Contribution made since acceding to the ISTC in 1998.
102. The figures for the U.S. contribution represent funds committed to the science centers during fiscal years 1994–1999. In FY 1994 and FY 1995, U.S. support for the science centers came from the DOD CTR program. Since FY 1996, funding has been authorized under the Freedom Support Act administered by the Department of State.
103. Ibid.
104. This number includes $4.4 million in funding for 30 STCU projects that were approved at the ninth meeting of the STCU governing board on December 15, 1999. These funds are not included in the funding party breakdown above, as the breakdown data were not yet available at the time of publication.

funding for former chemical weapons scientists has remained static at around 3% of the ISTC budget.[105]

Since 1997, both centers have begun partner programs that offer opportunities for private industry from around the world to acquire research and development partnerships in the NIS. Private industrial partners benefit from the established infrastructure of the science centers and their tax-exempt diplomatic status as international organizations. Both centers are making the development of partner projects a top priority, as such projects contribute to the long-term conversion of former NIS weapons technologies, assist with the integration of NIS science and technology centers into international civilian markets, and help to reduce science center dependence on government funding. The ISTC has approved more than 50 partner projects, the STCU more than 25 projects.[106]

Initiatives for Proliferation Prevention and Nuclear Cities Initiative

The Department of Energy manages and funds two programs designed to prevent brain drain: the Initiatives for Proliferation Prevention (formerly the Industrial Partnering Program) and the Nuclear Cities Initiative. Like the Science Centers program, the IPP program aims to provide productive nonmilitary projects for former NIS weapons scientists and engineers. The projects funded by IPP, however, must also have the potential for commercialization since, over the longer term, IPP seeks to promote converting NIS defense industries for civilian production through the commercialization of NIS technologies and the development of links between NIS institutes and U.S. industrial partners. Unlike the ISTC and the STCU, IPP is exclusively a U.S.–NIS program and does not involve additional international partners.

INITIATIVES FOR PROLIFERATION PREVENTION

Initiatives for Proliferation Prevention projects are divided into three phases: Thrust I, Thrust II, and Thrust III. The projects of Thrust I are fully funded by DOE. They involve laboratory-to-laboratory contacts between U.S. national laboratories and NIS institutes and are intended to identify commercially feasible technologies. In the second phase, or Thrust II, a U.S. industrial partner agrees to share the cost of developing potential technologies. In the final stage, or Thrust III, projects are expected to become self-sustaining business ventures. The program has funded projects in Russia (84%), Ukraine (9%), Kazakhstan (4%) and Belarus (3%).[107] As of June 2000 the program had approved 511 projects. These projects have engaged more than 8,000 NIS scientists, engineers, and other staff at more than 170 institutes. Seventy percent of the projects have been in the nuclear sector, and 30% in the chemical and biological sectors.[108]

A U.S. Government Accounting Office report released in February 1999 criticized IPP for excessive spending on overhead expenses at U.S. national laboratories, expressed concern about inadequate program oversight, and argued that the program was not achieving its long-term nonproliferation goal of commercializing NIS weapons technologies.[109] Partly in response to these comments, IPP has adopted new guidelines that require that at least 50% of project funds be spent in the NIS. In the past two years, it has placed increasing emphasis on Thrust II and Thrust III projects. As of June 2000, eight IPP projects had reached the point of commercialization, and DOE officials expect another nine projects to do so by the end of 2001. By the end of FY 2000, all program funds were being spent on Thrust II and Thrust III projects.[110]

105. "ISTC Projects by Technology Area," ISTC web site: <www.istc.ru>.

106. Detailed information on the partner programs of both centers is available at their respective web sites: <www.istc.ru> and <www.stcu.kiev.ua>. See also the annual reports issued by both centers.

107. In accordance with U.S. policy, IPP has approved no new projects in Belarus since 1997.

108. Conversation with U.S. Department of Energy officials, January 2001.

109. U.S. GAO, *Concerns with DOE's Efforts To Reduce the Risks Posed by Russia's Unemployed Weapons Scientists,* GAO/RECD–99–54, February 1999.

110. Correspondence with Peter Green, deputy director of the IPP program, U.S. Department of Energy, January 2000.

TABLE 3.9: **INITIATIVES FOR PROLIFERATION PREVENTION PROJECTS, BY YEAR**						
Fiscal Year		**Amount Obligated ($US Millions)**	**Thrust I: Technology Identification**	**Thrust II: Cost-sharing Partnerships**	**Academic Support Element**	**Additional Projects**
FY 1995 (Funding originated in FY 1994.)	Amount Obligated		$20	$12	$3	-
	Projects Approved		159	34	-	-
FY 1996	Amount Obligated		$6	$12	-	$2
	Projects Approved		40	24	-	-
FY 1997	Amount Obligated		$29.6	-	-	-
	Projects Approved		68	10	-	-
FY 1998	Amount Obligated		$29.6	-	-	-
	Projects Approved		60	40	-	-
FY 1999	Amount Obligated		$22.5	-	-	-
	Projects Approved		35	41	-	-
FY 2000	Amount Obligated		$24.5 for Thrust II and Thrust III (100% of funding planned)		-	-
	Projects Approved				-	-

NUCLEAR CITIES INITIATIVE

In 1998, the United States Department of Energy launched the Nuclear Cities Initiative, designed to assist Russia in the development of non-defense-related jobs in Russia's ten "closed" nuclear cities. These cities, which are geographically isolated, are home to hundreds of thousands of skilled scientists, engineers, and technicians and hundreds of metric tons of weapons-usable nuclear materials. The desperate financial situation of the former Soviet Union's nuclear complex—built around ten remote and restricted cities—has sparked fears that highly skilled nuclear scientists and technicians with access to nuclear materials and technology might be forced to sell their wares to would-be nuclear-weapon states. In addition, many supporters of the NCI program hope that the effort will lead to a downsizing of the Russian nuclear complex, which would reduce Russia's ability to reconstitute its cold war nuclear arsenal rapidly, thereby strengthening strategic stability.

The U.S.-Russian Government-to-Government agreement on the Nuclear Cities Initiative was signed by U.S. Secretary of Energy Bill Richardson and Russian Atomic Energy Minister Yevgeny Adamov on September 22, 1998. The original concept was developed by the U.S. government in cooperation with an initiative from several nongovernmental organizations. According to the agreement, the initiative aims to "create a framework . . . that will provide new jobs for workers displaced from enterprises of the nuclear complex."[111] Since the signing of this agreement, the U.S. Department of Energy and Minatom have agreed to focus initial activities at three of the ten Russian nuclear cities: Sarov (Arzamas-16), Snezhinsk (Chelyabinsk-70), and Zheleznogorsk (Krasnoyarsk-26). In addition, Minatom has stated its intention to cease weapons-related activities at Zarechnyy (Penza-19) and Sarov by the year 2003, and the NCI office of the Department of Energy, which serves as executive agent for the NCI program, has

111. Agreement between the government of the United States of America and the government of the Russian Federation on the Nuclear Cities Initiative, September 22, 1998.

TABLE 3.10: **NUCLEAR CITIES INITIATIVE FUNDING PROFILE**

Year	Request	Amount Appropriated
1999	N/A	$15 million[112]
2000	$30 million	$7.5 million
2001	$27.5 million	$27.5 million[113]

stepped up operations at Avangard to facilitate its conversion to nondefense work; Russia has stated that operations at Zarechnyy can begin after success has been demonstrated at Avangard.

The goal of the NCI project is similar in nature to other U.S. government and international activities designed to prevent a Russian brain drain, including the International Science and Technology Centers and the Initiatives for Proliferation Prevention. The focus of the NCI, however, is on the development of long-term or permanent jobs and on the creation of industry in the nuclear cities as a means of keeping Russian weapons experts from aiding would-be proliferators and simultaneously accelerating the down-sizing of the Russian nuclear weapons complex. These efforts have come under some criticism from the U.S. Congress and the GAO, and Congress has failed to provide the NCI program with the funding requested during its initial years of implementation. Members of Congress and the investigative body have raised questions about what effect NCI funding is having in the nuclear cities and are concerned over the possibility that NCI money is being used to subsidize scientists still engaged in weapons-related work.[114]

The initial activities at each of the three target cities have initially focused on two areas: the creation of a strategic business development plan and the creation of an adequate infrastructure and "environment" to promote interest from outside industries and investors. The challenge of luring outside investment to the closed cities is complicated by several factors. The remote location of many of the cities is only the first challenge to be overcome. Another is the tight access controls that exist in these cities. People who want to visit one of the cities must apply for access 45 days in advance, a requirement that has worked against attracting Western investment. Moreover, specialists in these cities have little experience with Western business models or access to modern communication and business development tools. This means that additional effort will be needed to develop workable business plans and expectations.

The initial steps in the three first-tier cities, therefore, have included the creation of business development centers and the upgrading of Internet and e-mail access from these cities. Examples of business concepts and programs for each of the three cities are given in table 3.11.

Export Control Assistance

The U.S. State Department coordinates and funds most U.S. export control assistance to the NIS, although the Department of Energy also funds an export-control assistance program. Projects in this sphere focus primarily on training and have also included practical assistance in the development of a legal and regulatory framework.

The Department of State provides funds from the Nonproliferation, Anti-Terrorism, De-Mining, and Related Programs (NADR) and the Nonproliferation and Disarmament Fund (NDF) to the U.S. Department of Commerce (DOC), which implements a portion of U.S. export control assistance in the NIS. The Department of Commerce has held several large

112. Permission given by Congress to spend this amount from available funds and prior year balances.

113. "Defense Nuclear Nonproliferation Executive Budget Summary FY 2001," U.S. DOE Office of Chief Financial Officer web site: <www.cfo.doe.gov/budget/01budget/othernuc/nucnonpr/nnprolif.pdf>.

114. U.S. GAO, "Concerns, Russia's Weapons Scientists," February 1999.

TABLE 3.11: **PLANNED NCI PROJECTS, BY NUCLEAR CITY, 1999**	
City	**Activity**
Sarov	• Open Computing Center • Nonproliferation Center • High-level Waste System Model • Pharmaceutical Packaging Project • Sarov Services to Commercial U.S. Industry • Ophthalmologic Scalpels • Expand Titanium Company • Canola Production and Processing • Mercury Lamp Project • Expand Kidney Dialysis Technology • Marketing Assistance for Avangard Commercial Products • Detection Technologies Center • MPC&A Equipment Production
Snezhinsk	• Open Computing Center • International Development Center • Nonproliferation Center • Pharmaceutical Repackaging • Oil Well Perforators • Fiber Optic Production • Water Jet Technologies • Super Bright Light Emitting Diodes • Argus Optics and Eyewear • Bottle Manufacturing
Zheleznogorsk	• International Development Center • Tank Retrieval and Closure Demonstration Center • Silicon of Siberia • Canola Production and Processing • Mercury Lamp Recycling • Medical Bandages • Radioisotope Production • Rare Earth Metals • Internet Service Provider Business

export-control training forums in Armenia, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. It has also worked intensively with some of these countries in the development of a legal basis for export controls. In Russia and Ukraine, DOC is currently working with indigenous nongovernmental organizations to conduct training seminars for and provide specialized software to internal export-control compliance programs at firms that trade in sensitive and dual-use technologies.

Department of Energy export-control assistance programs focus exclusively on the nuclear sector, and have targeted Kazakhstan, Russia, and Ukraine. These programs emphasize the development of a cadre of specialists who combine technical expertise in the nuclear field with a strong knowledge of export controls. Such specialists are important, as they can play a critical role in their countries' export license review processes—much as experts from the U.S. national laboratories assist in the U.S. export-control process. Department of Energy projects also seek to help in the development of licensing procedures, the enhancement of the legal framework for export controls, and the increase in awareness of export control among industry and government officials. It has funded training seminars for representatives from the Kazakhstani, Russian, and Ukrainian nuclear industry on the development of internal compliance programs, just as DOC has funded such seminars for firms dealing in dual-use equipment and technologies. The Department of Energy has also provided specialized English-language training to Kazakhstani, Russian, and Ukrainian export-control officials in the United States in order to improve their ability to interact with U.S. and international colleagues at international conferences and meetings.[115]

115. For more details on U.S. export control assistance to the NIS, see Scott Parrish and Tamara Robinson, "Efforts to Strengthen Export Controls and Combat Illicit Trafficking and Brain Drain," *Nonproliferation Review,* vol. 7, spring 2000, pp. 112–124.