NUCLEAR STATUS REPORT

NUCLEAR WEAPONS, FISSILE MATERIAL, AND EXPORT CONTROLS IN THE FORMER SOVIET UNION

NUMBER 6
JUNE 2001

JON BROOK WOLFSTHAL, CRISTINA-ASTRID CHUEN, EMILY EWELL DAUGHTRY

EDITORS

MONTEREY INSTITUTE OF INTERNATIONAL STUDIES

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DESIGN: CUTTING EDGE GRAPHICS

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Introduction

THE PROLIFERATION of weapons of mass destruction remains the single greatest threat to the security of the United States and other countries around the world. Of the many aspects of this threat, one of the most acute is the tenuous state of the nuclear complex in Russia and the other Newly Independent States (NIS). After almost ten years of cooperative effort with the United States and other countries—efforts that have brought significant progress—the situation in the NIS continues to pose serious proliferation challenges. These challenges pertain both to the enormous amount of nuclear weapons, material, and expertise present in the NIS nuclear archipelago and to the policies pursued by the post-Soviet states with respect to nuclear exports and nonproliferation.

This sixth issue of the *Status Report* provides a detailed picture of the sprawling nuclear complex in Russia and in the other post-Soviet states. It is a landscape marked by dozens of nuclear weapons bases, many thousands of strategic and substrategic nuclear weapons, more than five dozen major nuclear facilities, and hundreds of metric tons of fissile material. It is also the home of thousands of nuclear scientists and technicians with access to nuclear material and know-how.

A great deal of cooperative work has been done over the past decade to reduce and secure nuclear weapons in the Soviet nuclear successor states. International programs of nonproliferation assistance also have contributed to the strengthening of nuclear material control and accounting practices, physical protection, and export controls. These accomplishments are chronicled in this report, as are many of the major proliferation problems that remain owing to the economic disarray of the NIS nuclear complex, the relatively low priority attached to nonproliferation by senior political leaders, and the inadequacies of safeguards currently in place at many nuclear facilities.

The first chapters of this report detail the composition of the Russian nuclear weapons arsenal, the status of U.S.-Russian strategic arms control reduction negotiations, the implementation of U.S. nonproliferation assistance programs, and the structure of nuclear facilities in the former Soviet Union. As in earlier editions, the report also includes a detailed description of the export control systems that have been established to regulate nuclear exports and prevent unauthorized transfers. It also includes information on the membership of the 15 successor states to the Soviet Union in different international export control regimes.

The new features of this *Status Report* include:

- Extensive data on the current Russian nuclear arsenal and projections for future force developments
- Easy-to-read layout for NIS facilities known to possess nuclear materials
- Site descriptions of Russian naval facilities where nuclear materials might be at risk of theft or diversion
- An updated map of nuclear facilities in the NIS

This report has been prepared jointly by the Monterey Institute of International Studies and the Carnegie Endowment for International Peace as a resource to assist in monitoring the rapidly evolving events related to nuclear weapons and weapons-usable materials in the former Soviet Union. The report is published in English and is distributed free of charge to officials and analysts in both the United States and the Newly Independent States. The Carnegie Moscow Center will translate the report into Russian for distribution in Russia and the states of the former Soviet Union. The entire report is available on the web sites of the Carnegie Non-Proliferation Project at www.ceip.org/npp and the Monterey Institute's Center for Nonproliferation Studies at www.cns.miis.edu.

We wish to thank the individuals whose contributions have made this report possible, including the editors, Jon Wolfsthal of the Carnegie Endowment and Cristina-Astrid Chuen and Emily Ewell Daughtry of the Monterey Institute. These three individuals shared primary responsibility for gathering, assembling, and preparing for print the information in this report. Justin Anderson, Josh Hanson, Todd Sescher, and Adrienne Weiner of the Carnegie Endowment, and Kenley Butler, Michael Jasinski, John Lepingwell, Clay Moltz, Lauren Nolen, Scott Parrish, Elena Sokova, Nikolai Sokov, and Ray Zilinskas of the Monterey Institute also provided invaluable research, editorial, and technical assistance.

Outside reviewers whose comments have enhanced this volume but who may not necessarily agree with all its contents include: Oleg Bukharin, Matthew Bunn, Vladimir Orlov, Dmitriy Kovchegin, Elina Kirichenko, Maria Drohobycky, Phil Robinson, Greg Sheppard, Dastan Eleukenov, and officials from the U. S. Department of Energy.

The authors also wish to thank the Carnegie Corporation of New York, the Ford Foundation, the John D. and Catherine T. MacArthur Foundation, the John Merck Fund, the Ploughshares Fund, the Prospect Hill Foundation, the Scherman Foundation, the Smith Richardson Foundation, and the W. Alton Jones Foundation for their support of our respective organizations' NIS nonproliferation activities.

All the information in this report has been derived from open sources. Although every attempt has been made to achieve accuracy, timeliness, and comprehensiveness, the rapidly changing and sometimes classified nature of this topic creates the possibility that the report contains some inaccuracies or incomplete entries. The editors have made the final judgments as to the contents of this report, using Fall 2000 as their cutoff date, and bear full responsibility for it.

We hope that you will find this sixth edition of the *Status Report* a useful resource, and we encourage you to send your comments to either the Monterey Institute of International Studies or the Carnegie Non-Proliferation Project.

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June 2001

CHAPTER 1

Russian Nuclear Weapons

RUSSIA MAINTAINS its strategic nuclear forces in a triad of land-based missiles, submarine-based missiles, and bombers. Within each leg of the triad are several different weapon systems, deployed at different times. This chapter provides a short description of all the former Soviet Union's strategic launchers, focusing on production details and service lives.[1] In sum, Russia's strategic nuclear arsenal is aging and shrinking. Strategic delivery vehicles have limited operational lives. Routine maintenance and replacement parts may prolong the operational life of subsystems such as guidance systems and aircraft engines, but replacing major components, such as intercontinental ballistic missile (ICBM) rocket motors, is both difficult and expensive. It is possible to prolong the operational life of deployed forces through careful maintenance and by lowering operational effectiveness requirements. Each instance of maintenance may extend the life of a weapon by several years, but this process cannot continue indefinitely.[2] These factors, in addition to START II limits, are particularly important in determining the future composition of Russia's nuclear forces.

Inventory levels for strategic nuclear forces are provided for 1990, at the end of the cold war; 1994, a midway point; July 2000, the latest official data on the number of START I "accountable" systems; and May 2000 estimates of the number of operationally deployed strategic nuclear weapons.[3] Projections for future levels are given for 2007, the START II reduction completion date; and for 2010 (except for those systems retired before 2007).

1. Data on the specifications and production of Russia's strategic nuclear forces are from START I Memorandum of Understanding (MOU), July 31, 2000; *Nuclear Weapons Database: Russian Federation Arsenal* (Center for Defense Information; online at <www.cdi.org/issues/nukef&f/database/rusnukes.html>); *Soviet/Russian Nuclear Forces Guide* (Federation of American Scientists; online at <www.fas.org/nuke/guide/ russia/index.html>); Pavel Podvig, ed., *Strategicheskoye yadernoye vooruzheniye Rossii* (Moscow, 1998); Dean Wilkening, "The Evolution of Russia's Strategic Nuclear Forces" (Center for International Security and Cooperation, Stanford University, July 1998; online at <cisac.stanford.edu/docs/russianforces.pdf>).

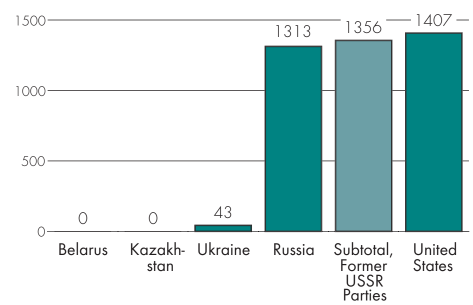
2. Wilkening, "Russia's Strategic Nuclear Forces," p. 3; Nikolai Sokov, *Russian Strategic Modernization* (Rowman and Littlefield: Maryland, 2000).

3. Data for September 1990, December 1994, and July 2000 are from the official START I Memorandum of Understanding (MOU), provided by the U.S. Department of State. In the charts, weapons systems for 1990 and 1994 include all accountable weapons controlled by the Soviet/Russian National Command Authority, even if deployed outside Russia. Data for May 2000 estimates of actual weapon deployments are from the Natural Resources Defense Council's (NRDC) reports, as published in the *Bulletin of the Atomic Scientists,* Nuclear Notebook, July/August 2000, no. 4, p. 70. Data for projected 2007 and 2010 forces are derived from Wilkening, "Russia's Strategic Nuclear Forces"; Joshua Handler, "Russia's Nuclear Strategic Forces in 2008–2013," *New Challenges in the Spread of Weapons of Mass Destruction* (conference, September 23–26, 1999), and from various other reports and current news stories.

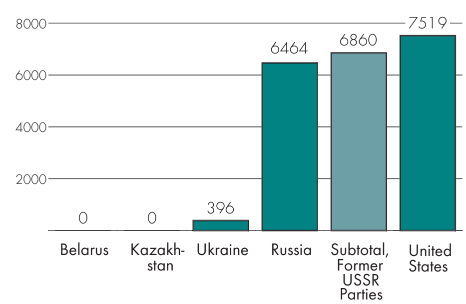
TABLE 1.1: START I PARTIES, STRATEGIC NUCLEAR WEAPONS, JULY 31, 2000

Category of Data	Belarus	Kazakh-stan	Ukraine[4]	Russia	Subtotal, Former USSR Parties	United States	Total, START I Parties
Deployed ICBM Launchers, SLBM Launchers, and Nuclear-capable Heavy Bombers	0	0	43	1,313	1,356	1,407	2,763
Deployed Warheads on ICBMs, SLBMs, and Heavy Bombers	0	0	396	6,464	6,860	7,519	14,379
Warheads attributed to Deployed Ballistic Missiles	0	0	260	5,812	6,072	5,941	12,013
Throw-weight of Deployed Ballistic Missiles (MT)	0	0	105.3	3,796.0	3,901.3	1,889.5	5,790.8

DEPLOYED LAUNCHERS



DEPLOYED WARHEADS



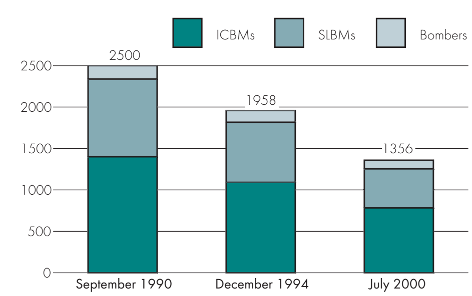
SOURCE: START I MOU Data

4. Although Ukraine has returned all its nuclear warheads to Russia, START I counting rules continue to include Ukraine's launchers (ICBMs and bombers) as deployed until they are destroyed or returned to Russia. Under START I counting rules, warheads are attributed to deployed launchers even when the warheads have been removed from the launchers. Thus, Ukraine has "attributed warheads" even though there are no warheads in the country.

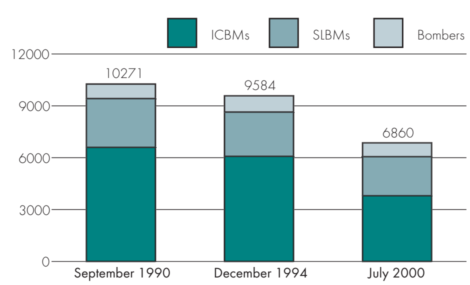
TABLE 1.2: SOVIET/NIS START-ACCOUNTABLE STRATEGIC NUCLEAR FORCES, 1990–2000

Type		September 1990	December 1994	July 2000
ICBMs	Launchers	1,398	1,089	782
	Warheads	6,612	6,078	3,800
SLBMs	Launchers	940	728	472
	Warheads	2,804	2,560	2,272
Bombers	Launchers	162	141	102
	Warheads	855	946	788
Total, Strategic Nuclear Forces	Launchers	2,500	1,958	1,356
	Warheads	10,271	9,584	6,860

LAUNCHERS



WARHEADS

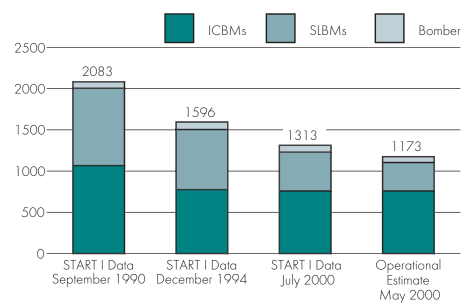


SOURCE: START I MOU Data

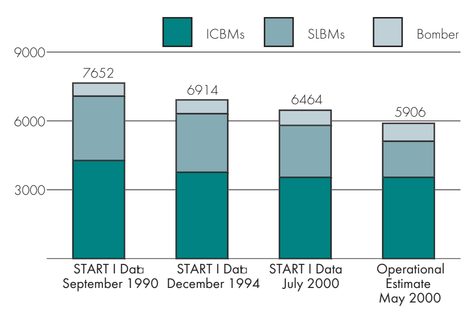
TABLE 1.3: START-ACCOUNTABLE AND OPERATIONAL STRATEGIC NUCLEAR FORCES IN RUSSIA, 1990–2000

Type		START I Data September 1990	START I Data December 1994	START I Data July 2000	Operational Estimate May 2000
ICBMs	Launchers	1,064	773	756	756
	Warheads	4,278	3,762	3,540	3,540
SLBMs	Launchers	940	728	472	348
	Warheads	2,804	2,560	2,272	1,576
Bombers*	Launchers	79	95	85	69
	Warheads	570	592	652	790
Total	Launchers	2,083	1,596	1,313	1,173
	Warheads	7,652	6,914	6,464	5,906

LAUNCHERS



WARHEADS



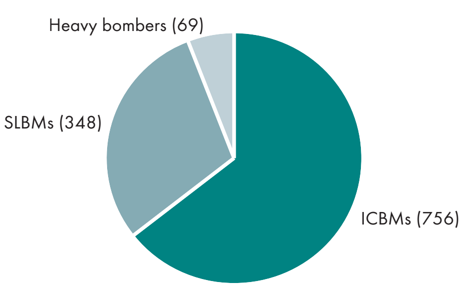
SOURCE: START I MOU Data and NRDC

* Under START I counting rules, Soviet/Russian cruise-missile-equipped bombers are counted as carrying a maximum of eight warheads, even if they are capable of carrying more. Bombers equipped to carry bombs are counted as carrying one warhead. The May 2000 operational estimates reflect the actual warhead-carrying capability of the bomber.

TABLE 1.4: ESTIMATE OF OPERATIONAL RUSSIAN STRATEGIC NUCLEAR FORCES, MAY 2000

Type (Russian/U.S. name)	Delivery Vehicles		Warheads
R-36M/RS-20/SS-18 Satan		180	1,800
UR-100N/RS-18/SS-19 Stiletto		150	900
RT-23/RS-22/SS-24 Scalpel, Silo-based		10	100
RT-23/RS-22/SS-24 Scalpel, Rail-based		36	360
RT-2PM/RS-12M/SS-25 Sickle		360	360
RT-2-PM2/RS-12M/Topol-M		20	20
Subtotal, ICBMs		**756**	**3,540**
Delta III/Project 667 BDR R-29R/RSM-50/SS-N-18	SSBNs: SLBMs:	11[5] 176	528
Typhoon/Project 941 R-39/RSM-52/SS-N-20	SSBNs: SLBMs:	3 60	600
Delta IV/Project 667 BDRM R-29M/RSM-54/SS-N-23	SSBNs: SLBMs:	7 112	448
Subtotal, SSBNs/SLBMs	**SSBNs: SLBMs:**	**21 348**	**1,576**
Subtotal, Ballistic Missiles		**1,104**	**5,116**
Bear H16/Tu-95MS		34	544
Bear H6/Tu-95MS		29	174
Blackjack/Tu-160		6	72
Subtotal, Heavy Bombers		**69**	**790**
Total		**1,173**	**5,906**

DELIVERY VEHICLES



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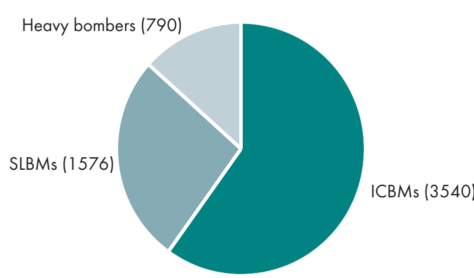


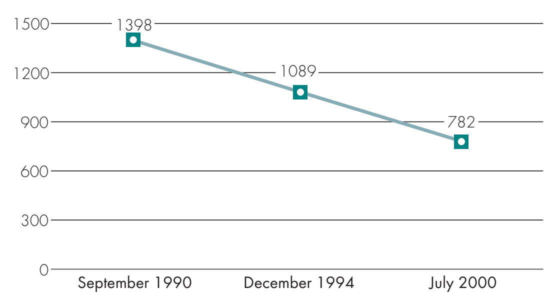
SOURCE: NRDC, "Nuclear Notebook," *Bulletin of the Atomic Scientists*, July/August 2000.

5. Alternative estimates from the Center for Nonproliferation Studies for operational Delta IIIs put this figure at five, lowering the SLBM total to 80 and the number of Delta III warheads to 240.

TABLE 1.5: SOVIET/NIS START-ACCOUNTABLE ICBMS, 1990–2000

Type (Russian/U.S. name)		September 1990	December 1994	July 2000
UR-100/RS-10/ SS-11 Sego	Launchers	326	20	0
	Warheads	326	20	0
RT-2/RS-12/ SS-13 Savage	Launchers	40	20	0
	Warheads	40	20	0
MR UR-100/RS-16/ SS-17 Spanker	Launchers	47	11	0
	Warheads	188	44	0
R-36M/RS-20/ SS-18 Satan	Launchers	308	292	180
	Warheads	3,080	2,920	1,800
UR-100N/RS-18/ SS-19 Stiletto	Launchers	300	300	150
	Warheads	1,800	1,800	900
RT-23/RS-22/ SS-24 Scalpel	Launchers	89	92	72
	Warheads	890	920	720
RT-2PM/RS-12M/ SS-25 Sickle	Launchers	288	354	360
	Warheads	288	354	360
RT-2-PM2/RS-12M/ SS-27 Topol-M	Launchers	Not in production	Not in production	20
	Warheads	N/A	N/A	20
Subtotal, ICBMs	Launchers	1,398	1,089	782
	Warheads	6,612	6,078	3,800

LAUNCHERS



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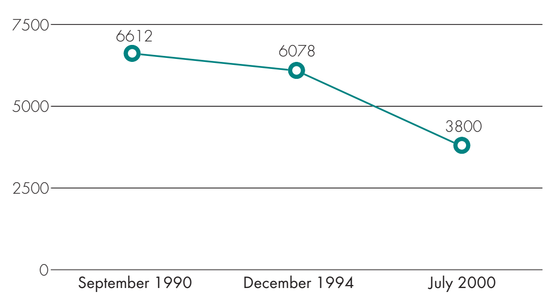
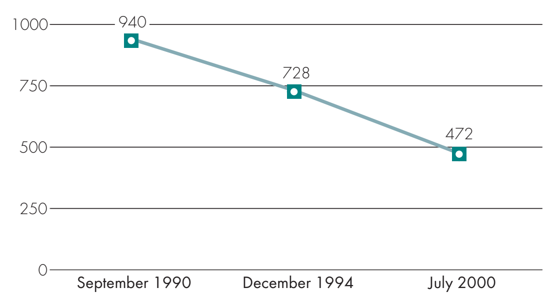


SOURCE: START I MOU Data

TABLE 1.6: SOVIET/RUSSIAN SEA-LAUNCHED BALLISTIC MISSILE (SLBM) LAUNCHERS AND WARHEADS, 1990–2000

Type (Russian/U.S. name)		September 1990	December 1994	July 2000
R-27/RSM-25/ SS-N-6 Serb	Launchers	192	32	0
	Warheads	192	32	0
R-29/RSM-40/ SS-N-8 Sawfly[6]	Launchers	280	256	48
	Warheads	280	256	48
R-31/RSM-45/ SS-N-17 Snipe	Launchers	12	0	0
	Warheads	12	0	0
R-29R/RSM-50/ SS-N-18 Stingray[7]	Launchers	224	208	192
	Warheads	672	624	576
R-39/RSM-52/ SS-N-20 Sturgeon[8]	Launchers	120	120	120
	Warheads	1,200	1,200	1,200
R-29M/RSM-54/ SS-N-23 Skiff[9]	Launchers	112	112	112
	Warheads	448	448	448
Subtotal SLBMs	Launchers	940	728	472
	Warheads	2,804	2,560	2,272

LAUNCHERS



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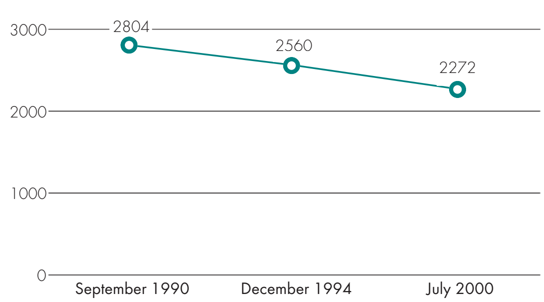


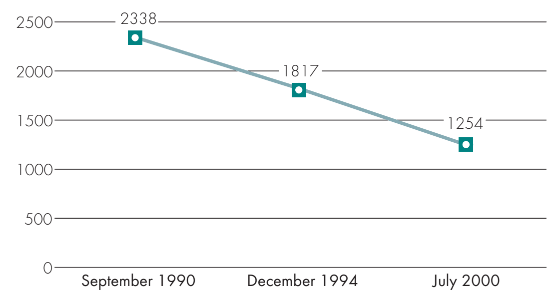
SOURCE: START I MOU Data

6. The SS–N–8 is carried on two classes of Russian SSBNs. The Delta I SSBN carries up to 12 SS–N–8 launchers, and the Delta II SSBN carries up to 16 SS–N–8 launchers.
7. The SS–N–18 is carried on Delta III SSBNs. Each Delta III carries up to 16 SS–N–18 launchers (48 warheads per submarine).
8. The SS–N–20 is carried on Typhoon SSBNs. Each Typhoon carries up to 20 SS–N–20s launchers (200 warheads per submarine).
9. The SS–N–23 is carried on Delta IV SSBNs. Each Delta IV carries up to 16 SS–N–23s launchers (64 warheads per submarine).

TABLE 1.7: SOVIET/NIS START-ACCOUNTABLE BALLISTIC MISSILE (ICBM AND SLBM) LAUNCHERS AND WARHEADS, 1990–2000

	September 1990	December 1994	July 2000
Launchers	2,338	1,817	1,254
Warheads	9,416	8,638	6,072

LAUNCHERS



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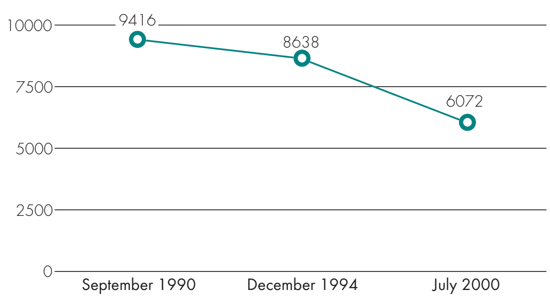
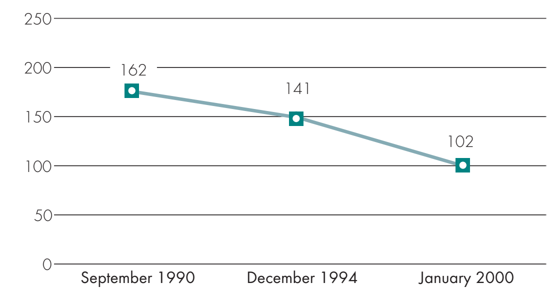


SOURCE: START I MOU Data

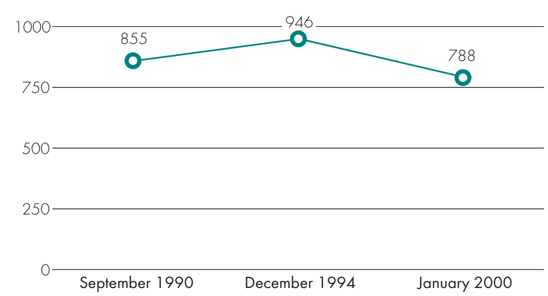
TABLE 1.8: SOVIET/NIS START-ACCOUNTABLE STRATEGIC BOMBERS, 1990–2000

Type		September 1990	December 1994	July 2000
Tu-95/Bear A, B	Launchers	17	2	0
	Warheads	17	2	0
Tu-95MS/Bear H	Launchers	84	90	79
	Warheads	672	720	632
Tu-95 Bear G	Launchers	46	24	4
	Warheads	46	24	4
Tu-160	Launchers	15	25	19
	Warheads	120	200	152
Subtotal Bombers	Launchers	162	141	102
	Warheads	855	946	788

LAUNCHERS



WARHEADS



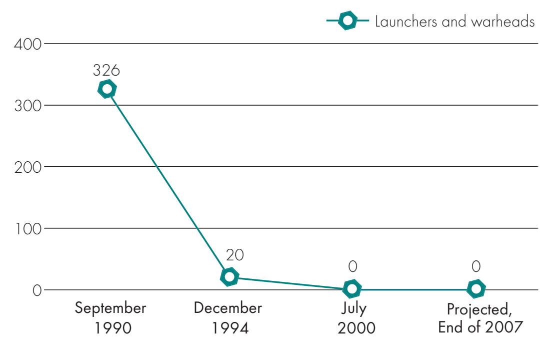
SOURCE: START I MOU Data

Intercontinental Ballistic Missiles (ICBMs)

Retired Systems

TABLE 1.9: UR–100/RS–10/SS–11 SEGO[10]				
	September 1990	December 1994	July 2000	Projected, End of 2007
Launchers	326	20	0	0
Warheads	326	20	0	0

LAUNCHERS AND WARHEADS



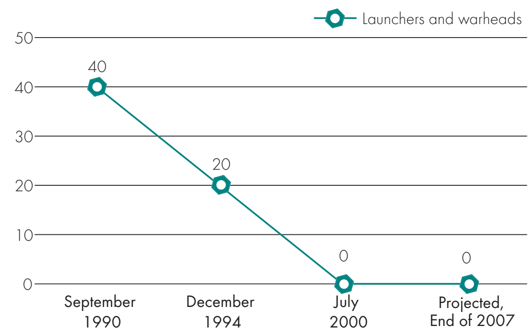
The SS–11 ICBM was a two-stage, storable-liquid-propellant missile with a maximum throw-weight of 1,500 kg and a maximum range of 12,000 km. Early variants carried a single 1-MT warhead, while a later variant carried three warheads. It was manufactured at the Khrunichev Plant in Moscow and the Omsk Aviation Factory.[11] The most recent variant was 19.5 m long and 2.0 m in diameter.[12] The first flight-test occurred on April 19, 1965, and the initial operational capability of variants 2 and 3 was reached in 1973 and 1975, respectively. The SS–11 is no longer a part of the Russian nuclear arsenal.

10. For each of Russia's strategic delivery systems, this report provides the three most common designations for that system. The first is the Russian military designation, the second the bilateral (START I) designation, and the third the NATO designation.
11. Podvig, *Strategicheskoye yadernoye vooruzheniye Rossii,* p. 178.
12. START I MOU, January 2000, p. 88.

TABLE 1.10: **RT–2/RS–12/SS–13 SAVAGE**

	September 1990	December 1994	July 2000	Projected, End of 2007
Launchers	40	20	0	0
Warheads	40	20	0	0

LAUNCHERS AND WARHEADS



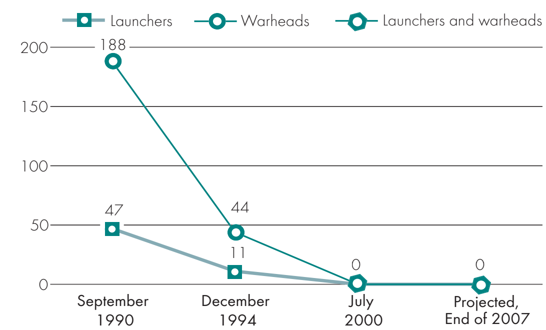
The SS–13 ICBM was a three-stage, solid-propellant missile with a maximum throw-weight of 600 kg and a maximum range of 9,500 km. It was deployed with a single 750-kT warhead.[13] It was 19.7 m long and 1.8 m in diameter.[14] Initial operational capability was achieved in 1969, and deployment was completed in 1972.[15] The SS–13 is no longer a part of the Russian nuclear arsenal.

13. Podvig, *Strategicheskoye yadernoye vooruzheniye Rossii,* p. 181.
14. START I MOU, January 2000, p. 88.
15. Federation of American Scientists web site: <www.fas.org/nuke/guide/russia/icbm>.

TABLE 1.11: **MR UR–100/RS–16/SS–17 SPANKER**

	September 1990	December 1994	July 2000	Projected, End of 2007
Launchers	47	11	0	0
Warheads	188	44	0	0

LAUNCHERS AND WARHEADS



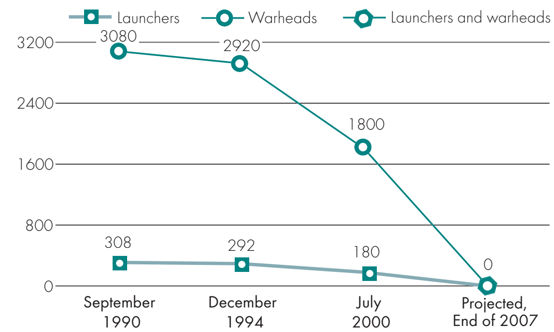
The SS–17 ICBM was a two-stage, storable-liquid-propellant missile with a maximum throw-weight of 2,550 kg and a maximum range of 10,300 km. It was manufactured at the Yuzhmash Machine-Building Plant in Dnipropetrovsk, Ukraine.[16] It was 21.6 m long and 2.25 m in diameter.[17] The missile carried four 550–750 kT warheads. Initial operational capability was reached between 1976 and 1982, depending on the particular modification of the ICBM.[18] The SS–17 is no longer a part of the Russian nuclear arsenal.

16. Podvig, *Strategicheskoye yadernoye vooruzhiniye Rossii,* p. 187.
17. START I MOU, January 2000, p. 90.
18. Wilkening, "Russia's Strategic Nuclear Forces," p. 6.

Current Systems

TABLE 1.12: **R–36M/RS–20/SS–18 SATAN**				
	September 1990	**December 1994**	**July 2000**	**Projected, End of 2007**
Launchers	308	292	180	0
Warheads	3,080	2,920	1,800	0

LAUNCHERS AND WARHEADS



The SS–18 ICBM is a large, two-stage, storable-liquid-propellant missile. It is 35.7–38.9 m long (depending on modification type) and 3.0 m in diameter.[19] The currently deployed modification of this heavy Russian ICBM carries ten 500–750 kT multiple independently targeted reentry vehicles (MIRVs), has a throw-weight of 8,800 kg, and a range of 10,000–16,000 km, depending on the number of warheads.[20] The SS–18 has six modifications, the first of which reached initial operational capability in 1975, and the latest reached initial operational capability in 1988. The last SS–18s were deployed in 1991.[21] SS–18 ICBMs are deployed at four locations in Russia: 52 missiles at Dombarovskiy, 46 missiles at Kartaly, 30 missiles at Aleysk, and 52 missiles at Uzhur.[22]

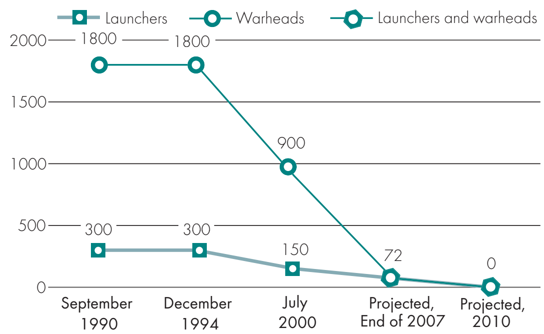
The SS–18 was designed at the Yuzhnoye Design Bureau and manufactured at the Yuzhmash Machine-Building Plant, both located in Ukraine, although Russian enterprises provide maintenance for SS–18s that are currently in the inventory.[23] Under START II, all SS–18s would be eliminated by 2007. Without START II, however, Russia might be able to extend the life of the SS–18 from the original 15 years to 20 years, leaving approximately 90 SS–18s by the end of 2007. Furthermore, all would be able to carry their maximum payload of ten warheads.[24] Few if any SS–18s would remain by the end of 2010.

19. START I MOU, January 2000, p. 90.
20. Podvig, *Strategicheskoye yadernoye vooruzheniye Rossii,* p. 190.
21. Wilkening, "Russia's Strategic Nuclear Forces," p. 6.
22. START I MOU, July 1, 2000, pp. 14–29.
23. Federation of American Scientists web site: <www.fas.org/nuke/guide/russia/icbm>.
24. Wilkening, "Russia's Strategic Nuclear Forces," p. 9.

TABLE 1.13: UR–100N/RS–18/SS–19 STILETTO

	September 1990	December 1994	July 2000	Projected, End of 2007	Projected, 2010
Launchers	300	300	150	72	0
Warheads	1,800	1,800	900	72	0

LAUNCHERS AND WARHEADS



The SS–19 ICBM is a two-stage, storable-liquid-propellant MIRVed missile carrying six warheads. The SS–19 is 24.3 m long, 2.5 m in diameter, has a throw-weight of 3,600 kg, and a range of 10,000 km.[25] There are three modifications of the SS–19, the first of which reached initial operational capability in 1975, and the latest reached initial operational capability in 1980. The last SS–19s were deployed in 1984. SS–19 ICBMs are currently deployed at two locations in Russia: 60 missiles at Kozelsk, and 90 missiles at Tatishchevo.[26]

The SS–19 was designed at the TsKBM Design Bureau located near Moscow and manufactured at the Khrunichev Plant in Moscow. Russia has already successfully extended the life of the ICBM to 21 years. It might be able to extend the life further, to 25 years, by using parts from undeployed SS–19s received from Ukraine in 1995. Under the START II treaty, Russia is allowed to download 105 SS–19s to one warhead by December 2007. However, if the maximum life of 25 years holds, it is probable that only the 72 SS–19s deployed in 1984 would still remain operational by the end of 2007. After 2007, all SS–19s would rapidly reach the end of their operational lives. Few if any would remain in service by 2010.[27] Without START II, Russia would be able to maintain the same number of SS–19s and could continue to deploy them with six warheads each.[28]

25. START I MOU, January 2000, p. 90.

26. START I MOU, July 2000, pp. 29–39.

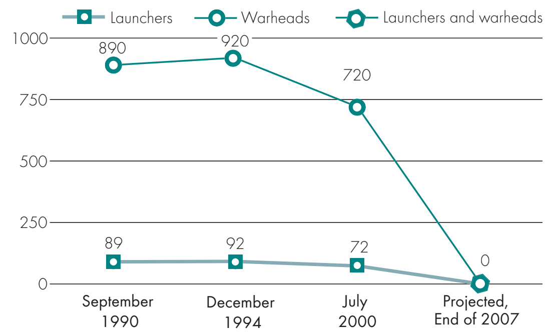
27. Russia received 30 “unfueled” SS–19s from Ukraine in 1995 whose operational lifetime had not yet started. If Russia were to extend the operational life of other more recently deployed SS–19s, it is possible that the SS–19 force could be maintained until 2009–2012. Handler, “Russia’s Nuclear and Strategic Forces.”

28. Wilkening, “Russia’s Strategic Nuclear Forces,” p. 11.

TABLE 1.14: **RT–23/RS–22/SS–24 SCALPEL**

	September 1990	December 1994	July 2000	Projected, End of 2007
Launchers	89	92	72	0
Warheads	890	920	720	0

LAUNCHERS AND WARHEADS



The SS–24 ICBM is a three-stage, solid-propellant missile carrying 10 MIRVed warheads. It is 22.4 m long and 2.4 m in diameter. It has a throw-weight of 4,050 kg and a range of 10,000 km.[29] The SS–24 reached initial operational capability in 1988, and the last SS–24s were deployed in 1990. It has both rail-mobile and silo-based variants, although only the rail-based versions are operational.[30] SS–24 rail-mobile ICBMs are deployed at three locations in Russia: 12 missiles at Kostroma, 12 missiles at Bershet, and 12 missiles at Krasnoyarsk.[31] In addition to the rail-based systems, there are 10 SS–24 silo launchers at Tatishchevo that remain START I–accountable and 26 SS–24 silo launchers in Ukraine at Pervomaysk.[32]

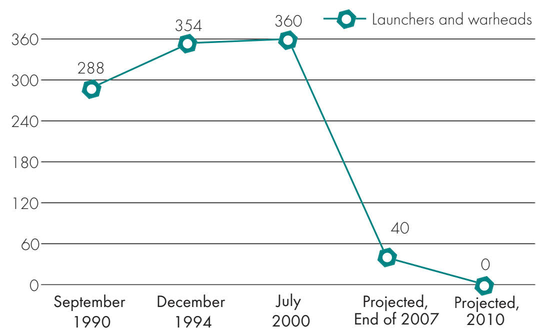
Production of the SS–24 ceased in 1991, and Russia would have difficulty restarting production of the SS–24 even if it wanted to, since the missile was designed at the Yuzhmash Design Bureau and manufactured at the Pavlohrad Mechanical Plant, both in Ukraine.[33] This ICBM has a short, ten-year life, although Russia has successfully extended the life by five years. It is generally assumed that the SS–24 will be phased out by 2007 regardless of START II.[34]

29. START I MOU, January 2000, p. 91; Podvig, *Strategicheskoye yadernoye vooruzheniye Rossii,* p. 197.
30. Federation of American Scientists web site: <www.fas.org/nuke/guide/russia/icbm>.
31. Operational numbers vary slightly from START I MOU data. The July 31, 2000, MOU lists 46 deployed SS–24 launchers but only 36 deployed SS–24 ICBMs; the 10 silo-based SS–24s are not considered operational. START I MOU, July 2000, pp. 61–64.
32. Start I MOU, July 2000, p. 37 (Russia) and p. 11 (Ukraine).
33. Center for Defense Information web site: <www.cdi.org/issues/nukef&f/database>.
34. Wilkening, "Russia's Strategic Nuclear Forces," p. 12.

TABLE 1.15: RT–2PM/RS–12M TOPOL/SS–25 SICKLE

	September 1990	December 1994	July 2000	Projected, End of 2007	Projected, 2010
Launchers	288	354	360	40	0
Warheads	288	354	360	40	0

LAUNCHERS AND WARHEADS



The SS–25 ICBM is a three-stage, solid-propellant missile that carries one warhead. It is 22.3 m long and 1.8 m in diameter.[35] It has a throw-weight of 1,000 kg and a range of 10,500 km. Initial operational capability was reached in 1988.[36] The SS–25 is deployed on road-mobile launchers. SS–25 ICBMs are deployed at ten sites in Russia: 36 at Teykovo, 36 at Yoshkar-Ola, 45 at Yurya, 45 at Nizhniy Tagil, 45 at Novosibirsk, 45 at Kansk, 36 at Irkutsk, 36 at Barnaul, 18 at Drovyanaya, and 18 at Vypolzovo.[37]

Although the SS–25 was designed at the Moscow Institute of Thermal Technology and manufactured at the Votkinsk Machine-Building Plant in Russia, the breakup of the Soviet Union had a significant impact on the program. Belarus manufactured the missiles' transporter-erector-launchers, and some 90% of the components of the guidance system were manufactured in Ukraine. Nevertheless, Russia might be able to extend the current life of 10 years by five years, leaving at the most 40 SS–25s deployed by the end of 2007.[38] Even with the extended life of 15 years, few, if any, SS–25s will remain in service by 2010.

35. START I MOU, January 2000, p. 88.

36. Podvig, *Strategicheskoye yadernoye vooruzheniye Rossii,* p. 200.

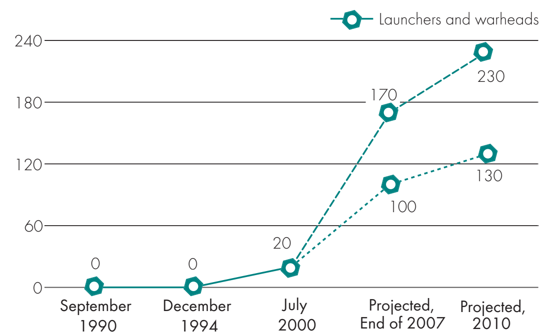
37. START I MOU, July 2000, pp. 40–61.

38. Wilkening, "Russia's Strategic Nuclear Forces," p. 13.

TABLE 1.16: RT–2PM2/RS–12M, VARIANT 2/SS–27 TOPOL-M

	September 1990	December 1994	July 2000	Projected, End of 2007[39]	Projected, 2010[40]
Launchers	0	0	20	100-170	130-230
Warheads	0	0	20	100-170	130-230

LAUNCHERS AND WARHEADS



The SS–27 ICBM was developed on the basis of the SS–25. It is a three-stage, solid-propellant missile carrying a single warhead. The SS–27 is 22.7 m long, is 1.86 m in diameter, has a throw-weight of 1,200 kg, and a range of 11,000 km.[41] Initial operational capability was reached in 1999. All 20 SS–27 ICBMs are currently deployed at Tatishchevo in Russia.[42]

The SS–27 was designed at the Moscow Institute of Thermal Technology and is produced at the Votkinsk Machine Building Plant, both of which are in Russia.[43] Although all currently deployed SS–27s are silo-based, Russia plans to accommodate the system on road-mobile launchers as well. The estimated service life is 20 years for silo-based missiles, and 15 years for road-mobile missiles. Although the SS–27 represents the backbone of the future Russian ICBM force, production is greatly lagging behind projections (fewer than 10 missiles per year instead of the planned 30–40). The future of Russia's strategic rocket forces largely depends on the production rate of the SS–27. If current levels of production continue, Russia will have 100 SS–27s by the end of 2007. Russia could substantially increase funding for the program and produce 20 missiles a year to reach a total of 170 by the end of 2007, or 230 by the end of 2010.

Given the lack of funding for Russia's strategic forces, low-to-medium SS–27 production rates are likely.[44] If START II does not enter into effect, Russia could easily modify the SS–27 to carry three or four warheads. In that case, Russia could field 600–800 warheads on 200 land-based ICBMs. In any case, by 2010, the SS–27 will likely be the only ICBM Russia deploys in significant numbers.

39. The first number is based on current production levels, while the second assumes production of 20 missiles per year, beginning in 2001.

40. The first number is based on current production levels, while the second assumes production of 20 missiles per year, beginning in 2001.

41. START I MOU, July 2000, p. 88.

42. Ibid., p. 33.

43. William Arkin and Robert Norris, "Nuclear Notebook: Russian Strategic Nuclear Forces, End of 1998," *Bulletin of the Atomic Scientists,* March/April 1999. Online at <www.bullatomsci.org/issues/nukenotes/ma99nukenote. html>

44. Wilkening, "Russia's Strategic Nuclear Forces," p. 13.

Nuclear Ballistic Missile Submarines and Sea-launched Ballistic Missiles (SSBNs/SLBMs)

Sea-launched ballistic missiles are usually developed specifically for a particular class of ballistic missile–carrying nuclear submarine. It is therefore easier to understand Russia's sea-based nuclear forces if one examines together the SSBN and its corresponding SLBM. Currently, Russia has only three classes of operational SSBN: the Delta III, the Typhoon, and the Delta IV.[45] These boats carry, respectively, SS–N–18, SS–N–20, and SS–N–23 ballistic missiles. The number of SLBMs shown in Table 1.3 is lower than the number given by the START I MOU, which includes SSBNs and SLBMs that are no longer deployed and are awaiting dismantlement. The number of operational SLBMs may drop precipitously over the next decade as Russian SSBNs reach the end of their service lives.

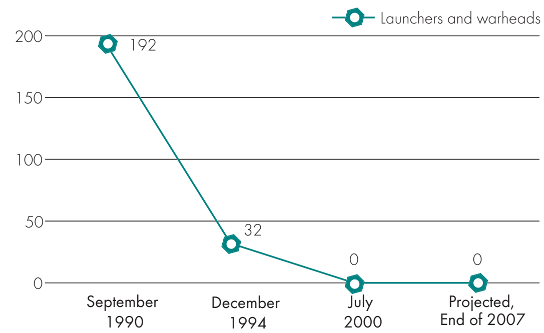
45. Ibid., p. 20.

Retired Systems

TABLE 1.17: **R–27/RSM–25/SS–N–6 SERB**

	September 1990	December 1994	July 2000	Projected, End of 2007
Launchers	192	32	0	0
Warheads	192	32	0	0

LAUNCHERS AND WARHEADS

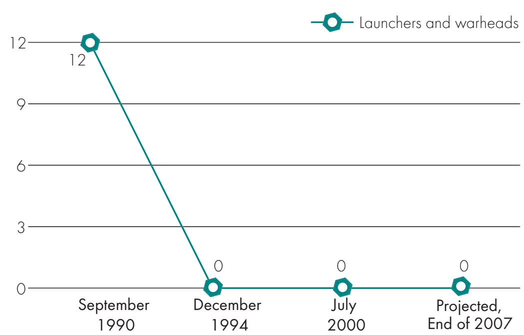


The SS–N–6 SLBM was a single-stage, storable-liquid-propellant missile with a throw-weight of 650 kg and a maximum operational range of 3,000 km. Early variants carried a single 1-MT warhead, while a later variant carried three warheads. The SS–N–6 was manufactured at the Zlatoust Machine Construction Factory and the Krasnoyarsk Machine Building Plant,[46] and it is 7.1 m long and 1.5 m in diameter.[47] The SS–N–6 was deployed on Yankee-class nuclear submarines, which carried 16 of these missiles each. All three variants of this missile reached operational capability in 1975.[48] The SS–N–6 is no longer a part of the Russian nuclear arsenal.

46. Podvig, *Strategicheskoye yadernoye vooruzheniye Rossii,* p. 277.
47. START I MOU, January 2000, p. 95.
48. Federation of American Scientists web site <www.fas.org/nukes/guide/russia/slbm>.

TABLE 1.18: **R–31/RSM–45/SS–N–17 SNIPE**				
	September 1990	**December 1994**	**July 2000**	**Projected, End of 2007**
Launchers	12	0	0	0
Warheads	12	0	0	0

LAUNCHERS AND WARHEADS



The SS–N–17 was a single-warhead SLBM with a maximum throw-weight of 450 kg and a maximum range of 3,900 km. It carried a single 500-kT warhead and was 11 m long and 1.5 m in diameter.[49] It was deployed on Yankee II–class submarines. Each submarine carried up to 12 SS–N–17 SLBMs. The Yankee II submarines reached initial operational capability in 1977.[50] The SS–N–17 is no longer a part of the Russian nuclear arsenal.

49. Podvig, *Strategicheskoye yadernoye vooruzheniye Rossii,* p. 283.

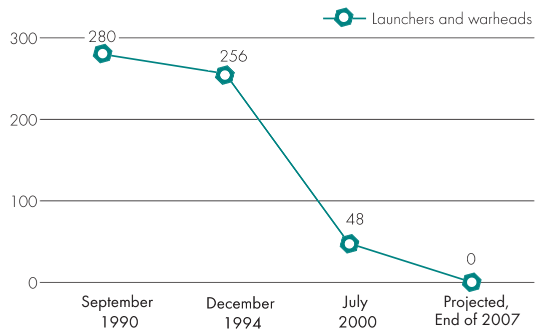
50. Wilkening, "Russia's Strategic Nuclear Forces," p. 43.

Current Systems

TABLE 1.19: R–29/RSM–40/SS–N–8 SAWFLY

	September 1990	December 1994	July 2000	Projected, End of 2007
Launchers	280	256	48	0
Warheads	280	256	48	0

LAUNCHERS AND WARHEADS



The SS–N–8 SLBM is a two-stage, storable-liquid-propellant missile with a maximum throw-weight of 1,110 kg and a maximum range of 9,100 km. It carries a single 500 kT–1 MT warhead.[51] It is 12.1 m long and 1.8 m in diameter.[52] Initial operational capability was reached in 1973.[53] Delta I–class nuclear submarines can each carry 12 SS–N–8 SLBMs, and Delta II–class submarines can each carry up to 16 SS–N–8s.

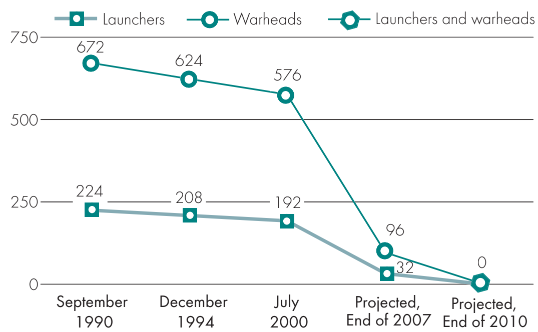
As of July 2000, SS–N–8 SLBMs were deployed on four boats at three locations in Russia: two Delta Is at Gadzhiyevo, one Delta I at Rybachiy, and one Delta I at Pavlovskoye. In addition, there were 16 SS–N–8 START I–accountable SLBM launchers awaiting elimination at a facility in Murmansk.[54] These four Delta Is are still listed under START I counting rules, even though they are awaiting retirement and are not thought to be operational.

51. Podvig, *Strategicheskoye yadernoye vooruzhiniye Rossii,* p. 281.
52. START I MOU, January 2000, p. 95.
53. Federation of American Scientists web site <www.fas.org/nukes/guide/russia/slbm>.
54. START I MOU, July 2000, pp. 73–74, 78.

TABLE 1.20: **R–29R/RSM–50/SS–N–18 STINGRAY**

	September 1990	December 1994	July 2000	Projected, End of 2007	Projected, 2010
Delta III SSBNs	14	13	11	2	0
Launchers	224	208	192	32	0
Warheads	672	624	576	96	0

LAUNCHERS AND WARHEADS



The SS–N–18 SLBM is a two-stage, liquid-propellant missile with a throw-weight of 1,650 kg. The SS–N–18 is 14.1 m long and 1.8 m in diameter.[55] It was the first MIRVed Soviet SLBM and can carry three warheads to a maximum operational range of 6,500 km or a single warhead up to 8,000 km.[56] The SS–N–18 was first deployed in 1979.[57]

It was manufactured in Krasnoyarsk, Russia. As of July 2000, SS–N–18 SLBMs were deployed on 11 Delta III SSBNs at two locations in Russia: two Delta IIIs at Gadzhiyevo, and nine Delta IIIs at Rybachiy. In addition, there were 16 SS–N–18 launchers awaiting elimination at a facility in Severodvinsk.[58]

55. Ibid., p. 95.

56. Federation of American Scientists web site <www.fas.org/nukes/guide/russia/slbm>.

57. Ibid.

58. START I MOU, July 2000, p. 78.

Delta III Kalmar SSBN

The Project 667 BDR/Delta III–class SSBN reached initial operational capability in 1977. The last boat was deployed in 1982.[59] Each Delta III is capable of carrying 16 SS–N–18 SLBMs for a total of 48 warheads per boat. In April 1999, the Russian navy decided to overhaul a number of Delta III SSBNs, thereby extending the service lives of those boats.[60] It is unclear how many years that maintenance will add to the Delta III's current service life of roughly 21 years, particularly because, in the absence of such maintenance, all Delta III SSBNs would have to be retired in the next few years.[61] Even a five-year-life extension, however, would allow Russia to keep some Delta IIIs in service through 2007.

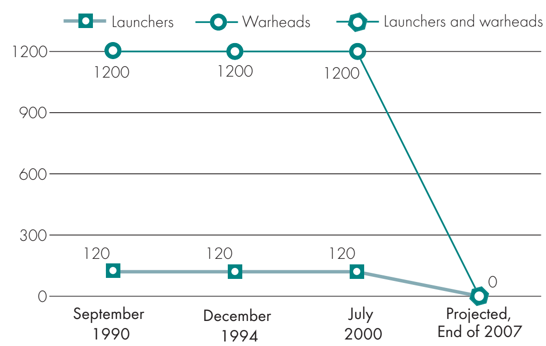
59. Wilkening, "Russia's Strategic Nuclear Forces," p. 6.

60. Sokov, *Russian Strategic Modernization,* p. 135.

61. Wilkening, "Russia's Strategic Nuclear Forces," p. 20.

TABLE 1.21: **R–39/RSM–52/SS–N–20 STURGEON**	September 1990	December 1994	July 2000	Projected, End of 2007
Typhoon SSBNs	6	6	5	0
Launchers	120	120	120	0
Warheads	1,200	1,200	1,200	0

LAUNCHERS AND WARHEADS



The SS–N–20 SLBM is a three-stage, solid-fuel missile with a throw-weight of 2,500 kg. The SS–N–20 is 16.1 m long and 2.4 m in diameter.[62] It is capable of carrying ten warheads to a maximum operational range of 8,300 km. The SS–N–20 was first deployed in 1981 on Typhoon-class SSBNs. One hundred SS–N–20 SLBM launchers are currently deployed on five Typhoon SSBNs at Nerpichya in Russia, although not all these boats are operational. Twenty SS–N–20 launchers are also awaiting elimination at a facility in Severodvinsk.[63]

Production of the SS–N–20 ceased during the Soviet era amid plans to deploy an updated version (R–39U), but the fall of the Soviet Union in 1991 led to the cancellation of the upgrade. In the early 1990s, Russia began developing another upgraded SLBM, the Bark, but in 1997, after three successive test failures, the navy canceled the program.[64] It is not clear if Russia is developing a replacement SLBM for its aging SS–N–20s, which are reaching the end of their service lives. Most SS–N–20s will be retired by 2003 barring extensive—and very expensive—efforts to prolong their operational lives. This suggests that even if there are operational Typhoons by the end of 2007, there may not be any operational ballistic missiles on board.

62. START I MOU, July 2000, p. 95.

63. Ibid., pp. 72, 78.

64. Sokov, *Russian Strategic Modernization,* p. 137.

Typhoon Akula SSBN

The Project 941/Typhoon-class SSBN reached initial operational capability in 1981. The last boat was deployed in 1989.[65] It is capable of carrying 20 SS–N–20 MIRVed SLBMs, for a total of 200 warheads per boat. As of July 2000, only three Typhoons were both deployed and operational in Russia. In addition to difficulties with their SLBMs, the submarines themselves have had numerous maintenance problems, which suggests that the boat's lifetime is probably shorter than for other SSBNs. Assuming a 16-year life, the remainder of the Typhoon SSBNs will likely be retired by the end of 2007.[66]

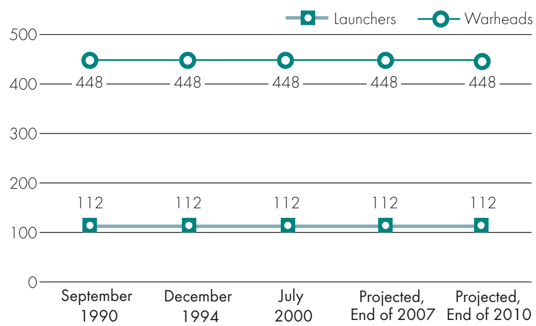
65. Wilkening, "Russia's Strategic Nuclear Forces," p. 6.

66. Ibid., p. 22.

TABLE 1.22: R–29RM/RSM–54/SS–N–23 SKIFF

	September 1990	December 1994	July 2000	Projected, End of 2007	Projected, End of 2010
Delta IV SSBNs	7	7	7	7	7
Launchers	112	112	112	112	112
Warheads	448	448	448	448	448

LAUNCHERS AND WARHEADS



The SS–N–23 SLBM is a three-stage, liquid-propellant missile. It is capable of carrying ten warheads to a maximum operational range of 8,300 km. It is 14.8 m long, 1.9 m in diameter, and was first deployed in 1985.[67] All deployed SS–N–23s carry four warheads. As of July 2000, all 112 SS–N–23 SLBMs were deployed on seven Delta IV SSBNs at Gadzhiyevo in Russia.[68]

Although Russia has resumed manufacturing the SS–N–23 at the Krasnoyarsk Machine Building Plant, it also has at least two SLBM development programs under way, either of which could eventually replace the SS–N–23.

67. START I MOU, July 2000, p. 96.

68. Ibid., p. 73.

Delta IV Delfin SSBN

The Project 667 BDRM/Delta IV–class SSBN reached initial operational capability in 1986. The last boat was deployed in 1991.[69] It is capable of carrying 16 SS–N–23 SLBMs, or a total of 64 warheads per boat. Given the aging Delta III class and the problem-ridden Typhoon class, Russia's Delta IV fleet may represent the mainstay of the country's sea-based strategic forces until the newest class of nuclear submarines—the Borey class (Project 955)—is deployed. As of May 2000, Russia had seven operational Delta IVs. The standard life of a Delta IV SSBN is approximately 21 years, but Russia has already upgraded one Delta IV and will likely do the same for the rest of them. Assuming that all seven receive service lifetime extensions, Russia may be able to maintain its Delta IV fleet through 2010.[70]

Borey SSBN

The Project 955/Borey-class submarine is a nuclear, ballistic-missile submarine currently under development in Russia. The initial model appears to have 12 SLBM tubes, but experts suggest that later modifications may hold up to 16 SLBM launchers. Although construction of the first boat, the *Yuriy Dolgorukiy,* began in November 1996, it was halted two years later because of a lack of funding and difficulties in developing a new SLBM. Specifically, Borey-class SSBNs were initially designed to carry the Bark SLBM, but that program was canceled in 1997. After cancellation of the Bark project, Russia resumed production of an updated version of the liquid-fueled SS–N–23 code-named *Sineva.* Simultaneously, the Moscow Institute of Thermal Technology was given a contract for a more long-term project to design a solid-fuel missile—code-named *Bulava*—suitable for both land and sea-based deployment.

The type of SLBM deployed on these boats will determine the number of warheads that a Borey-class SSBN can carry. A sea-based solid-fuel SLBM will probably have at most three to four MIRVed warheads (36–48 warheads per boat), but an SLBM based on the SS–N–23 would likely have six warheads (72 warheads per boat). In addition, future Borey-class SSBNs may have 16 missile tubes, further increasing the number of warheads per boat.

Nevertheless, unless production resumes immediately on both the Borey-class SSBN and its accompanying SLBM, Russia will not have any new SSBNs deployed by the end of 2007. Even under the best-case scenario, Russia will have no more than one to two Borey-class SSBNs deployed by that time. By 2010, Russia could have two to three Borey SSBNs.

69. Federation of American Scientists web site: <www.fas.org/nukes/guide/russia/slbm>.

70. Wilkening, "Russia's Strategic Nuclear Forces," p. 22.

Strategic Bombers

TABLE 1.23: TU–95MS BEAR H

	September 1990	December 1994	July 2000	Projected, End of 2007	Projected, End of 2010
Launchers	84	90	79	10–50	10
START Warheads	672	720	632	80–400	80

LAUNCHERS AND WARHEADS

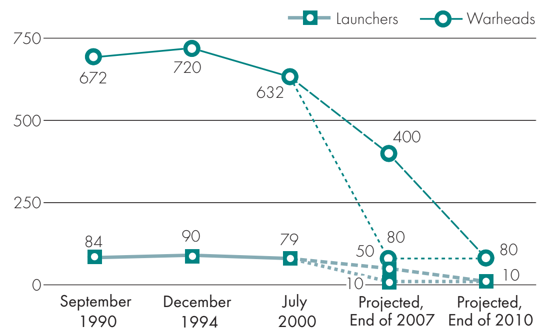
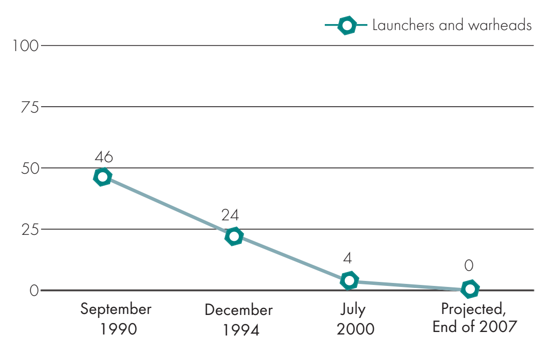


TABLE 1.24: TU–95 BEAR G

	September 1990	December 1994	July 2000	Projected, End of 2007
Launchers	46	24	4	0
START Warheads	46	24	4	0

LAUNCHERS AND WARHEADS



The Tu–95 Bear is a turboprop-driven strategic bomber with a range of 8,300 km (greater with midair refueling), capable of carrying air-launched cruise missiles (ALCMs) or short-range attack missiles (SRAMs). First deployed in 1956, two variants of the more modern Tu–95MS are still deployed (with the exception of some aging Bear Gs that are disabled beyond repair). One deployed variant of the Bear carries six AS–15A Kent ALCMs or six AS–16 Kickback SRAMs and reached initial operational capability in 1987. The other variant carries 16 AS–15 Kent

ALCMs or 16 AS–16 Kickback SRAMs and reached initial operational capability in 1983.[71] Tu–95MS bombers are currently deployed at two locations in Russia: 48 at Ukrainka, and 18 at Engels.[72]

Production of the Tu–95MS ceased in 1991, and if one assumes a 30-year service life, then the newer Bear bombers will not be retired by the end of 2007.[73] Of the legs of the Russian nuclear triad, however, the bomber force has received the least attention and funding, which may severely affect the lives of these aircraft. Some experts even suggest that by the end of 2007, almost all Bear bombers will face early retirement.[74] In late 1999, Ukraine transferred three Tu–95MS bombers to Russia in partial payment of gas debts to Russia. The deal also provided for the transfer of 575 ALCMs (presumably AS–15A Kent ALCMs) to Russia.[75]

71. Federation of American Scientists web site: <www.fas.org/nukes/russia/bomber>.

72. START I MOU, July 2000, p. 80.

73. Wilkening, "Russia's Strategic Nuclear Forces," p. 26.

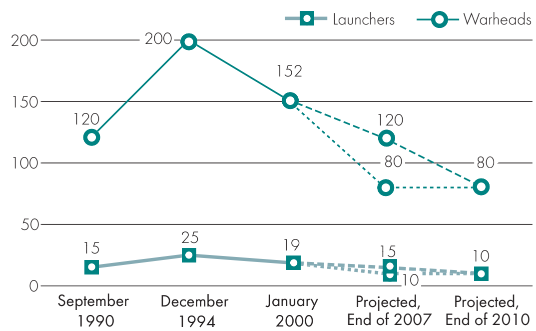
74. William Arkin, Robert Norris, and Joshua Handler, *Taking Stock: Worldwide Nuclear Deployments, 1998,* online at <www.igc.apc.org/nrdc/nrdcpro/fpprog.html>.

75. Ilya Kedrov, "Oruzhiye natsii vernulos na rodinu," *Nezavisimoye voennoye obozreniye,* no. 44, November 12–18, 1999.

TABLE 1.25: TU–160 BLACKJACK

	September 1990	December 1994	July 2000	Projected, End of 2007	Projected, End of 2010
Launchers	15	25	19	10–15	10
START Warheads	120	200	152	80–120	80

LAUNCHERS AND WARHEADS



The Tu–160 Blackjack is a jet-propelled strategic bomber with a range of 7,300 km, capable of carrying ALCMs or SRAMs.[76] Initial operational capability was reached in 1987. It can carry 12 AS–15A Kent ALCMs or 24 AS–16 Kickback SRAMs and has a service life of approximately 30 years.[77] Tu–160 bombers are deployed only at Engels air base in Russia.[78]

Russia's Tu–160 force more than doubled owing to a bomber-for-debt deal between Russia and Ukraine in late 1999 and early 2000. Russia acquired eight Tu–160 bombers and three Tu–95MS bombers.[79] In early May 2000, the Kazan Manufacturing Plant delivered to the air force a completed Tu–160. This aircraft was one of seven Tu–160 bombers that had been sitting partially completed on the production line for almost twelve years.[80] It is still unclear whether or not Russia will complete the construction of the remaining bombers. With proper maintenance, Russia's Tu–160 bomber force should remain in service through 2007.

76. Federation of American Scientists web site: <www.fas.org/nukes/russia/bomber>.
77. Wilkening, "Russia's Strategic Nuclear Forces," p. 27.
78. START I MOU, July 2000, p. 80.
79. "Ukraine Transfers Bombers to Russia as Pay for Gas," *ITAR–TASS,* January 19, 2000.
80. "Russia Adds Strategic Bomber to Fleet," *RFE/RL,* May 4, 2000.

Russian Substrategic Nuclear Weapons

Nuclear weapons associated with delivery vehicles without intercontinental ranges are often referred to as tactical nuclear weapons. This class of weapons incorporates everything from nuclear land mines to nuclear-tipped torpedoes to bombs carried by tactical aircraft. Given that these weapons may have ranges of up to several thousand kilometers, and that yields may be equal to those of strategic weapons, the term *tactical* is a misnomer and so has been gradually replaced by *substrategic*. While strategic nuclear weapons may garner more attention, the Soviet Union may have possessed approximately 22,000 substrategic nuclear warheads in 1991, a far larger number than those deployed on strategic weapons.

The only arms control treaty that currently limits substrategic nuclear forces is the Intermediate-Range Nuclear Forces (INF) Treaty, signed in December 1987 by Soviet President Mikhail Gorbachev and U.S. President Ronald Reagan. The INF Treaty banned ground-launched cruise missiles (GLCMs) and ballistic missiles with ranges of between 500 and 5,500 kilometers, making it the first arms control treaty to eliminate an entire class of nuclear forces. In addition, it broke new ground by incorporating extensive on-site inspection and monitoring provisions, setting an important precedent for similar provisions in the START treaties. The INF Treaty entered into force in June 1988, and by May 1991 the Soviet Union completed the dismantling of all forces covered by the treaty, a total of 1,846 SS–20, SS–4, SS–5, and SS–21 ballistic missiles. The United States dismantled 846 missiles, including all Pershing IA and Pershing II ballistic missiles, and all land-based Tomahawk GLCMs. The treaty provided for the on-site inspection of missile deployment and storage areas, as well as the continuous monitoring of missile production facilities in Russia and the United States.[81] While the INF Treaty is of unlimited duration, the inspection and monitoring regime was to end by May 31, 2001, ten years after the completion of missile elimination.[82]

The success of the INF Treaty paved the way for the START I treaty. Implementation of the INF Treaty also created a new relationship between the United States and the Soviet Union that facilitated subsequent initiatives to reduce substrategic weapons. After the attempted coup in Moscow in August 1991, Western analysts raised concerns about the security of substrategic nuclear weapons, which were numerous and widely dispersed throughout the Soviet Union. On September 27, 1991, prompted by fears that the crumbling Soviet regime might lose control of its nuclear weapons, U.S. President George Bush announced a series of unilateral reductions and redeployments of U.S. substrategic nuclear weapons and invited the Soviet Union to follow suit.

Nine days later, President Gorbachev announced a similar set of unilateral measures on reducing substrategic nuclear weapons. These initiatives were confirmed and expanded by Russian President Boris Yeltsin in January 1992. Combined, the Soviet/Russian measures provide for the following:

- The complete elimination of warheads for tactical land-based missiles, artillery shells, and mines
- The elimination of one-half of the warheads for anti-ballistic and anti-aircraft missiles, the remaining warheads to be stored at central warhead storage facilities
- The removal of all substrategic nuclear weapons from naval vessels and elimination of one-third of the warheads, the remaining warheads to be stored at central warhead storage facilities
- The partial elimination of warheads for naval aircraft, the remaining warheads to be stored at central warhead storage facilities
- The elimination of half of the warheads for tactical aircraft

81. "Intermediate-Range Nuclear Forces (INF) Treaty," Defense Threat Reduction Agency Fact Sheet, <www.dtra.mil/news/fact/nw_infosi.html>.

82. *Reuters*, December 14, 2000.

The process of disassembling the nuclear warheads slated for elimination was to be completed by the end of 2000.[83]

The process of removing substrategic nuclear weapons from ships and bases may have begun in 1991, but it was not completed before the Soviet Union collapsed in late December 1991. As a result, in early 1992 there were an estimated 4,000 substrategic nuclear weapons still in Belarus, Kazakhstan, and Ukraine. Under the terms of the Almaty agreement of December 1991, these weapons were rapidly withdrawn to Russia, with the pullout completed by May 1992.[84] These weapons were included in the warheads to be reduced under the terms of the Russian unilateral statement.

Substrategic nuclear weapons remain the area of greatest uncertainty in the Russian nuclear stockpile. Apart from the INF Treaty, there are no arms control treaties requiring an exchange of information on substrategic nuclear weapons. (The Conventional Forces in Europe Treaty does cover some dual-use launchers, but not their nuclear components.) Furthermore, in contrast to strategic weapons, there is no direct correlation between the number of launchers and the number of nuclear warheads. Thus, one cannot simply count launchers, multiply by warhead loadings, and produce an approximate total number of warheads. The problem is compounded by the difficulty of estimating how many warheads are actually deployed, how many are in central storage facilities, and how many have been dismantled. This has led to widely varying estimates of the number of deployed or stockpiled nuclear warheads.

The calculation of the total number of substrategic warheads in the Russian stockpile depends upon the types and numbers of warheads existing in 1991 and the progress made in eliminating warheads. Alexei Arbatov, a leading Russian international security expert and State Duma member, has estimated that there were approximately 21,700 substrategic nuclear warheads in the Soviet stockpile in 1991. In 1998, at a meeting of the Russia-NATO Permanent Joint Council, Russian officials reported that the number of substrategic nuclear weapons had been cut in half, but NATO officials continued to express concern at the pace of dismantlement and its lack of transparency.[85] At the April 2000 Non-Proliferation Treaty Review Conference, Russian Foreign Minister Igor Ivanov stated that Russia had eliminated one-third of its naval substrategic nuclear warheads, one-half of its warheads for anti-aircraft missiles and gravity bombs, and was "about to complete" the elimination of warheads from its tactical missiles, artillery shells, and nuclear mines.[86] Based on this statement, and using Arbatov's estimate for the number and types of warheads extant in 1991, this would leave approximately 8,400 warheads in the Russian arsenal as of early 2000. When the reduction process is completed, the stockpile total will be reduced to approximately 8,000 warheads. The number of deployed nuclear warheads, which would include only nuclear bombs deployed near tactical air bases, would be smaller—no more than 3,500. Although the reductions were to be finished by the end of 2000, as of mid-January 2001 the Russian government had made no statement indicating that the reduction process had been completed.

Other estimates suggest that Russia has roughly 4,000 substrategic nuclear warheads on active duty. In 1998, analysts William Arkin, Robert Norris, and Joshua Handler estimated that Russia had approximately 4,000 deployed warheads.[87] Their estimate, however, included delivery vehicles whose warheads should have

83. "Gorbachev Pledges Wide-ranging Nuclear Cuts," *Washington Post,* October 5, 1991, p. A1.

84. Mitchell Reiss, *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Baltimore: Johns Hopkins University Press, 1995), pp. 89–97.

85. Linda D. Kozaryn, "Russians Say Yeltsin's Nuclear Pledge Fulfilled," *American Forces Press Service*, May 8, 1998, <www.defenselink.mil/news/May1998/n05081998_9805086.html>.

86. Statement by Russian Minister for Foreign Affairs Igor Ivanov before the Non-Proliferation Treaty Review Conference, New York, April 25, 2000.

87. They do note, however, that there might be as many as 12,000 weapons in reserve or awaiting dismantlement (William Arkin, Robert S. Norris, and Joshua Handler, *Taking Stock: Worldwide Nuclear Deployments, 1998* [Natural Resources Defense Council; Washington, D.C., 1998], p. 27).

either been eliminated or stored at central storage sites. Similarly, in 1998 Alexei Arbatov estimated that Russia had 3,800 substrategic nuclear weapons, all of which are stored in weapon depots of the armed forces or in central storage facilities of the Ministry of Defense.[88] Table 1.26 summarizes the status of Russia's substrategic nuclear weapons.

Much higher estimates of the total Russian tactical stockpile are sometimes given by U.S. government officials. In response to a question at a Senate hearing, for example, Gen. Eugene Habiger, former commander-in-chief of the U.S. Strategic Command, estimated that "the gross number of tactical nuclear weapons in Russia today . . . [is] between 17,000 [and] 22,000."[89] Habiger's comment, which was not part of his formal briefing, was not a formal U.S. government estimate of Russia's stockpile size. Official U.S. government estimates from 1997 suggest a total Russian strategic and substrategic nuclear stockpile of up to 23,000 warheads, with a substrategic stockpile of perhaps 14,000 to 15,000 warheads.[90] This wide variation in estimates of stockpile size suggests that the United States believes that the pace of warhead reductions is slower than Russian reports indicate.

TABLE 1.26: **RUSSIAN SUBSTRATEGIC NUCLEAR WEAPONS, 1991 AND 2000**

Substrategic Weapon Type	Totals in 1991[91]	Total To Remain under 1991 Bush-Gorbachev Agreements	Total Substrategic Nuclear Weapons Stockpile, 2000[92]
Land-based Missiles	4,000	0	0
Artillery	2,000	0	0
Mines	700	0	0
Air Defense	3,000	1,500	1,500
Air Force	7,000	3,500	3,500
Navy	5,000	3,000	3,400
Total	**21,700**	**8,000**	**8,400**

88. Alexei Arbatov, "Deep Cuts and De-alerting: A Russian Perspective," *The Nuclear Turning Point* (Brookings Institution Press: Washington, D.C., 1999), p. 320; also, Assistant Secretary of Defense Ashton Carter's testimony before the Senate Armed Service Committee in which he said that Russia had removed all tactical nuclear weapons from naval vessels (April 28, 1994).

89. Testimony by General Eugene Habiger before the Senate Armed Services Committee, March 31, 1998.

90. For a contemporaneous estimate, see William S. Cohen, *Annual Report to the President and Congress,* chap. 20, at <www.dtic.mil/execsec/adr97/chap20.html>.

91. Alexei Arbatov, ed., *Yadernye Vooruzheniya Rossii* (Moscow: IMEMO, 1997), p. 56.

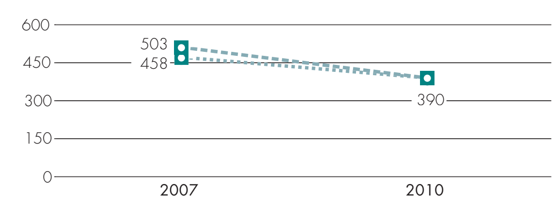
92. Statement by Russian Minister for Foreign Affairs Igor Ivanov before the Non-Proliferation Treaty Review Conference. New York, April 25, 2000. Text of statement is on the Carnegie Non-Proliferation Project's web site: <www.ceip.org/programs/npp/npt2000.htm>.

Future Russian Nuclear Forces

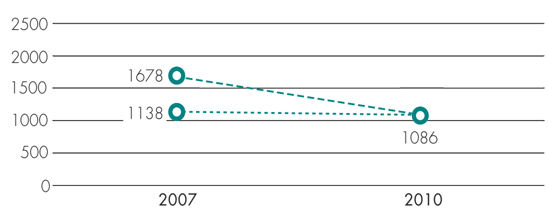
TABLE 1.27: PROJECTED RUSSIAN STRATEGIC NUCLEAR FORCES, 2007 AND 2010

	Type	2007 Launchers/Warheads	2010 Launchers/Warheads
ICBMs	SS-19	72/72 (432*)	0
	SS-25	40/40	0
	SS-27	170/170 (510*)	230/230 (690*)
SSBNs/SLBMs	Delta III/SS-N-18	~32/~96[94]	0
	Delta IV/SS-N-23	112/448[95]	112/448
	Borey/??	12/72[96]	28/168[97]
Bombers	Tu-95MS Bear	10-50/120-600	~10/~120
	Tu-160 Blackjack	10-15/120-180	~10/~120
	Total, Strategic Nuclear Forces	458-503/1138-2378	390/1086-1546

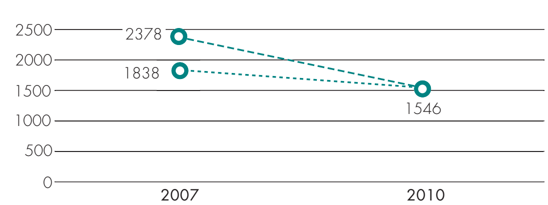
LAUNCHERS



WARHEADS WITH START II PROVISIONS



WARHEADS WITHOUT START II PROVISIONS



* Without a START II ban on MIRVed ICBMs

94. Deployed on two Delta III SSBNs.
95. Deployed on seven Delta IV SSBNs.
96. Deployed on one Borey SSBN.
97. Deployed on two Borey SSBNs. This table projects that the second Borey will have 16 launch tubes rather than 12.

CHAPTER 2

U.S.-Russian Strategic Nuclear Negotiations and Agreements

START I

THE FIRST ROUND of Strategic Arms Reduction Talks (START) between the United States and the Soviet Union opened in Geneva in June 1982 and focused for the first time on reductions in the numbers of nuclear warheads. The Strategic Arms Limitation Treaty (SALT) had placed limits on the numbers of launchers but did not directly address the numbers of deployed warheads. Progress on START was almost immediately stalled by Soviet concerns about President Ronald Reagan's Strategic Defense Initiative, announced in March 1983. The Soviet Union then "discontinued" negotiations in the fall of 1983, in response to the American deployment of intermediate-range ballistic missiles in Europe. Negotiations did not resume until 1985, under what became known as the "umbrella" Nuclear and Space Talks, which combined three independent but interrelated groups of talks: on strategic, intermediate-range, and defensive weapons. In December 1987, Presidents Reagan and Mikhail Gorbachev signed the Intermediate-Range Nuclear Forces (INF) Treaty, eliminating all land-based missiles with ranges between 500 and 5,500 km. The Soviet Union agreed in 1989 to drop the link between START and missile defenses, clearing the way for negotiations toward a final agreement, which was signed at the July 1991 Moscow summit by Presidents George Bush and Gorbachev. The first START treaty limits each country to no more than 1,600 strategic nuclear delivery vehicles, with 6,000 accountable warheads.[1] Of these, no more than 4,900 can be deployed on ICBMs (intercontinental ballistic missiles) and SLBMs (sea-launched ballistic missiles), no more than 1,540 on heavy ICBMs (a 50% reduction from pre-START levels), and no more than 1,100 on mobile ICBMs.

When the Soviet Union ceased to exist, Belarus, Kazakhstan, Russia, and Ukraine all had former Soviet strategic nuclear weapons deployed on their territories. In May 1992, all four former Soviet states became parties to the START I treaty by signing the Lisbon Protocol. START I entered into force on December 5, 1994, when the United States and the other four parties exchanged instruments of ratification in Budapest, Hungary. By the end of 1996, Belarus, Kazakhstan, and Ukraine had all returned the nuclear weapons on their territories to Russia and joined the Non-Proliferation Treaty as non-nuclear-weapon states. Since START I mandates a seven-year period of reductions, the agreed levels should be reached by Russia and the United States by the end of 2001. (See chapter 3 on U.S.-Russian assistance.)

START I contains extensive verification and data exchange provisions that surpass those of

1. Each limited weapon system under START I is attributed with a certain number of nuclear warheads under agreed "counting rules." In fact, many more than 6,000 warheads could be deployed under the START I limits. In particular, heavy bombers are allowed to carry twice as many long-range air-launched cruise missiles (ALCMs) as they are counted with.

any other arms control treaty in force today. It provides for 12 types of on-site inspections and continuous monitoring of mobile ICBM production facilities. Data relevant for treaty limitations and compliance are exchanged continuously and summarized twice a year in a Memorandum of Understanding. The Joint Compliance and Inspection Commission (JCIC) established by the treaty meets regularly to discuss verification and compliance issues.

START II

At the June 1990 Washington summit, Presidents Bush and Gorbachev agreed that following the signing of START the two sides would begin new talks on further reductions at the earliest practical date. This statement included, among other elements, an agreement to seek a significantly reduced concentration of warheads on ballistic missiles, paving the way for the elimination of MIRVed ICBMs (land-based missiles with multiple independently targetable warheads). Consultations on START II began in the fall of 1991 with the Soviet Union and resumed with the government of Russia in January 1992. At a summit meeting in June 1992, Presidents Bush and Boris Yeltsin agreed on the basic principles of START II, including a ban on MIRVed ICBMs. This was a significant development since MIRVed ICBMs had been considered by nuclear strategists as "destabilizing" weapons, posing an attractive target for a disarming first strike. This ban placed a disproportionately heavy burden on the Russian Federation, since the vast majority of their strategic nuclear weapons were deployed on MIRVed ICBMs. Bush and Yeltsin signed START II in Moscow on January 3, 1993. START II caps the number of deployed strategic warheads in both countries at no more than 3,500, eliminates all land-based ICBMs with MIRVs, and limits the number of warheads on SLBMs to 1,750. Reductions under START II were to be completed by January 1, 2003. Ratification of START II, however, was initially delayed because it could not be ratified until after START I entered into force on December 5, 1994, and since then a series of other factors have intervened to delay START II's entry into force.

The U.S. Senate ratified START II on January 26, 1996. Among other conditions, the Senate resolution prohibited the unilateral reduction of the U.S. strategic weapons before START II entered into force without the consent of the Senate. The resolution further stated that ratification of START II should not be interpreted as an obligation by the United States "to accept any modification, change in scope, or extension" of the ABM treaty and that "an offense-only form of deterrence cannot address by itself the emerging strategic environment," which was characterized by the proliferation of long-range ballistic missiles and efforts by the United States and Russia "to put aside their past adversarial relationship and instead build a relationship based upon trust rather than fear."[2]

Boris Yeltsin submitted START II to the Duma for ratification in the summer of 1995. The draft law on ratification that the president proposed to the legislature was straightforward and did not contain any interpretations, limitations, or conditions for the executive. Yeltsin's letter, however, noted that START II "can only be implemented under conditions of preservation and strict implementation by the United States of the bilateral Treaty on the Limitation of Anti-Ballistic Missile Systems (ABM) of 1972."[3]

Delays in Russian ratification resulted from strong opposition to START II by Duma members, which grew as more time passed. Aside from domestic political factors, including the struggle between President Yeltsin and Communists in the Duma, many Duma members expressed concern over Russia's need to build new single-warhead ICBMs to reach the START II limit of 3,500. These systems might then have to be quickly eliminated to meet the envisioned 2,000–2,500 warhead limit of the still-to-be negotiated START III treaty. Another major cause of concern was the significant U.S. "upload" capability, that is, the ability to return warheads placed in storage back to delivery vehicles. For the United States a

2. *Congressional Record,* January 26, 1996, S461.
3. Letter from Boris Yeltsin to Ivan Rybkin on June 20, 1995, no. Pr-819.

large part of the reductions could be achieved by the simple removal of warheads from delivery vehicles ("downloading"), whereas the majority of Russian missiles were subject to physical elimination. Finally, Duma members viewed the implementation date of 2003 as increasingly unrealistic.[4]

Growing among the Duma's concerns, and reflected in the eventual conditions the Russian parliament attached to the rectification of the agreement, was the future direction of the U.S. national missile defense (NMD) program. Russian officials opposed any significant modifications to the Anti-Ballistic Missile (ABM) Treaty and viewed continued limits on national missile defenses as a precondition for reducing the number of deployed nuclear weapons in Russia's arsenal.

In an effort to speed START II's entry into force, at the March 20–21, 1997, summit meeting in Helsinki, Bill Clinton and Boris Yeltsin signed the "Joint Statement on Parameters of Future Reductions in Nuclear Forces," which addressed a number of these concerns. In the documents, they agreed:

- to adopt a protocol to the START II treaty (subject to approval by the appropriate legislative bodies in both countries) that would extend the treaty's implementation deadlines to December 31, 2007
- to begin negotiations on a START III treaty immediately after START II's entry into force that would limit deployed strategic forces on both sides to 2,000–2,500 warheads, also by December 31, 2007, and
- to deactivate all systems scheduled for elimination under START II by removing their nuclear warheads or by taking other jointly agreed steps by December 31, 2003, in order to avoid significantly extending the period during which deployed nuclear forces would remain above START II levels.[5]

Russia and the United States signed the START II extension protocol in New York on September 26, 1997. In addition, Secretary of State Madeleine Albright and Foreign Minister Yevgeniy Primakov also exchanged letters and signed a joint statement in New York that codified the Helsinki commitment to "deactivate" ICBMs scheduled to be eliminated under START II (Russian SS–18s and SS–24s, and the American MX) by December 31, 2003. Deactivation will either entail the removal of warheads or be carried out by other jointly agreed steps, yet to be negotiated. Primakov also provided the U.S. side with a letter expressing Russia's understanding that the START III treaty would be negotiated and would enter into force well before the deactivation deadline. In addition, the two ministers signed several documents on the ABM treaty (see below) that addressed a number of Russian concerns and paved the way for a renewed effort to ratify START II the following year.

In April 1998, Yeltsin submitted the September 26, 1997, protocols on ratification for part of the START II package. In May 1998, START II came very close to ratification only to be derailed by the Communist Party, which used it as revenge against Boris Yeltsin for having been forced to approve the appointment of young reformer Sergey Kiriyenko as prime minister. According to some reports, the last-minute failure led to the cancellation of the expected summer 1998 visit to Moscow by President Clinton.[6] During that period, Foreign Minister, and later Prime Minister, Primakov emerged as an influential proponent of early ratification.

At the end of 1998, after a series of hearings in the Duma, START II again came close to ratification. The 1997 New York agreements, together with a more determined push by the Primakov government in favor of ratification, helped to improve the outlook for Duma

4. Normally, arms control treaties set a time limit to carry out reductions, but START II is unique in that it sets the precise date (originally it was expected that it would enter into force in 1993). Every delay with ratification shortened the period of reductions, so even with ratification in 1996, immediately after U.S. Senate action, Russia would probably have been unable to implement the treaty on time.

5. "Joint Statement on Parameters of Future Reductions in Nuclear Forces," Clinton-Yeltsin summit, Helsinki, Finland, March 20–21, 1997, White House press release.

6. *Agence France Presse*, May 20, 1998.

approval. Parliamentarians developed their own version of the ratification law, however, which the government accepted. On December 17, 1998, Boris Yeltsin was supposed to resubmit the treaty to the Duma (according to Russian law, the initiative must be taken by the president). The political price for the agreement was added provisions that included a tight linkage between START II and the ABM treaty.

But START II ratification became hostage to a series of international political crises that elicited strong reactions from both the Duma and the government. In December 1998 and January 1999, the Duma twice postponed a vote on the treaty. The first time was in protest of the U.S. bombing of Iraq, and the second time because of U.S. proposals to amend the ABM treaty in order to allow the deployment of a national missile defense (see below). Finally, the vote was scheduled for early April 1999, but then the NATO bombing of Yugoslavia over Kosovo sealed the treaty's fate for the rest of that year.[7]

START II was finally ratified under Russia's new president, Vladimir Putin. On April 18, 2000, Putin signed the law on ratification after both the Duma and the upper chamber of the parliament, the Federation Council, voted to approve it. Among other provisions, the law defined "extraordinary circumstances" that allowed withdrawal from START II to include U.S. exit from the ABM treaty or the deployment of U.S. nuclear weapons on the territories of new NATO members. Further, the law established that if a new treaty were not signed by December 31, 2003 (the original date for START II implementation and the date when the "deactivation" of weapons subject to elimination should be completed under the 1997 accords), then the president and the parliament would review Russia's overall security situation and decide upon further actions. Finally, the ratification law made the entry of START II into force conditional on U.S. ratification of the 1997 agreements with regard to the ABM treaty. This condition has delayed START II's entry into force and may permanently prevent it, given U.S. Congressional attitudes.

START III

As noted above, Presidents Yeltsin and Clinton signed a joint statement at the Helsinki summit agreeing to begin negotiations on a START III immediately after START II enters into force and identifying certain parameters for the new treaty. In addition to limiting deployed strategic forces on both sides to between 2,000 and 2,500 warheads by the end of 2007, the presidents decided that START III would include measures related to the transparency of strategic nuclear warhead inventories, the destruction of strategic nuclear warheads, and the transparency in nuclear materials.[8] In addition, they agreed to explore possible measures involving long-range nuclear sea-launched cruise missiles and tactical nuclear weapons. These discussions were to take place separately from, but in the context of, START III negotiations. The first post-Helsinki discussion of the future treaty took place in April 1997 during a visit by Deputy Minister of Foreign Affairs Georgiy Mamedov to Washington.[9]

In September 1997 (just before the signing of the START II extension protocol and ABM memorandum in New York), Bill Clinton and Foreign Minister Primakov agreed in Washington to begin informal consultations on START III before the ratification of START II by Russia, but only at the level of experts. These consultations continued intermittently throughout the fall of 1997 and 1998 at various levels, but the main venue was the meetings between Deputy Secretary of State Strobe Talbott and his Russian counterpart, Mamedov. These consultations were interrupted by the crisis in U.S.-Russian relations caused by the NATO military operation in Yugoslavia in the spring of 1999 but were resumed after a Clinton-Yeltsin meeting during the G–8 summit in Cologne in June 1999.

7. For a detailed description of these events, see Petr Romashkin, "Novyye Problemy s Ratifikatsiyey Dogovora SNV-2" (New problems with ratification of the START II treaty) at <www.armscontrol.ru>; PIR Arms Control Letters, January 24, 1999, and March 22, 1999; "START II Ratification Dead in the Duma," *Daily Telegraph* (London), April 3, 1999.

8. "Joint Statement," Clinton-Yeltsin Summit, Helsinki, March 1997.

9. *ITAR–TASS*, April 15, 1997.

TABLE 2.1: **LIMITS UNDER START AGREEMENTS**

Treaty	Limits	Special Conditions
START I	6,000 weapons	Special counting rules resulting in more than 6,000 weapons being deployed
START II	3,000–3,500	Bans land-based missiles with more than 1 warhead
START III	1,500–2,500	Various proposals made by both sides, including possible release from ban of land-based MIRVed missiles

Subsequently, the main venue for START III consultations became meetings between Undersecretary of State John Holum and Chief of the Department on Security and Disarmament Grigoriy Berdennikov, who was, after his promotion, replaced by Yuriy Kapralov. During their meeting in August 1999 Russia proposed a lower aggregate ceiling for START III than was originally agreed upon in Helsinki: 1,000–1,500 warheads.[10] The United States, however, did not accept the proposal for deeper reductions. As the Joint Chiefs of Staff explained in May 2000, the Helsinki target of 2,000–2,500 warheads had been based on a thorough study of its impact on U.S. national security. The acceptance of a lower limit would require a similar study.[11] Instead, the United States tabled a draft text of START III in January 2000, together with detailed proposals on amendments to the ABM treaty (see below). The Russian side tabled its draft of START III, including the lower numbers, at a Holum-Kapralov meeting in June 2000.

Missile Defenses and the ABM Treaty

START III talks have been increasingly intertwined with the controversial issue of the ABM treaty. In July 1999, the U.S. Congress passed legislation requiring the deployment of an NMD system as soon as it became "technologically possible" in order to protect the United States from the emerging threat of ballistic missile programs in states of proliferation concern.[12] In the meantime, the United States tried unsuccessfully to persuade Russia that the deployment of such defenses would not undermine Russian security. The controversy over possible U.S. deployment of an NMD system has become a major obstacle to START II's entry into force and, to an even greater extent, to negotiations on START III.

The defense-related debates can be broken into two distinct periods. Until 1997, Russian concerns centered on the development by the United States of a host of theater defense systems that Russia claimed could conceivably intercept strategic missiles. These disagreements stemmed from the "gray areas" of the 1972 ABM treaty, which does not define the distinction between strategic and tactical defensive systems, the former of which are restricted by the agreement. At the March 1997 Helsinki summit meeting, Bill Clinton and Boris Yeltsin confirmed that each side was free to develop and deploy nonstrategic defensive systems provided they were not used against the other side and subject to certain confidence-building measures. They also instructed their governments to develop criteria to distinguish between strategic and nonstrategic defensive systems. In the meantime, they confirmed that both sides continued to view the ABM treaty as a cornerstone of strategic stability.[13]

In September 1997 Secretary of State Madeleine Albright and Foreign Minister Primakov signed a package of protocols on the ABM treaty that established specific demarcation criteria. They also signed a protocol

10. David Hoffman, "Moscow Proposes Extensive Arms Cuts; U.S., Russia Confer over Stalled Pacts," *Washington Post,* August 20, 1999.

11. *Washington Times*, May 11, 2000; *Philadelphia Inquirer,* May 24, 2000.

12. "National Missile Defense Act of 1999," Public Law 106-38, 106th Congress.

13. Joint Statement concerning the Anti-Ballistic Missile Treaty, Helsinki summit, March 21, 1997, White House press release.

replacing the Soviet Union as a party to the ABM treaty with Russia, Belarus, Kazakhstan, and Ukraine, thus converting it from a bilateral to a five-party document. The Russian parliament ratified these protocols simultaneously with START II and made their ratification by the United States a condition for START II's entry into force. These protocols have not been submitted to the U.S. Senate for ratification, and opposition to them in Congress remains significant.

After 1997, Russian concerns shifted to focus on U.S. efforts to develop and deploy a territorial-wide NMD system that would likely violate the 1972 ABM treaty. The ABM treaty prohibits the United States and Russia from deploying nationwide missile defenses or from laying the basis for their deployment, although the pact does allow each side to build one missile defense site to protect either a national capital or an ICBM base. Russia still maintains one such site near Moscow. The United States built a site to defend an ICBM field in North Dakota but deactivated the facility in 1976 as "militarily ineffective." When the ABM treaty was negotiated, both nations believed that the restrictions on NMD-type systems provided the basis for strategic stability and enabled the reduction of offensive forces. The U.S. position has shifted over the past decade in response to the potential development of long-range missile systems in third countries. Iraq's use of Scud missiles in the Gulf War, specifically, had a major impact on interest in the United States in developing increasingly capable missile defenses.

In January 1999, President Clinton wrote to Russian President Yeltsin informing him of U.S. interest in amending the ABM treaty to permit the deployment of national missile defenses. That month, Secretary of Defense William Cohen announced substantial increases in the five-year NMD budget and stated that the deployments the United States was considering "might require modifications to the ABM treaty."[14] Russian officials maintained, however, that Russia would not approve START II or reduce offensive forces if the United States did not comply with the current terms of the ABM treaty.[15]

In mid-February 1999, Deputy Secretary of State Talbott met with Russian officials in Moscow to begin discussions on ABM treaty modifications. At the time, the United States had not settled on a single plan for deploying missile defenses, and the talks did not include specific U.S. proposals on how to amend the ABM treaty. Instead, Talbott sought to explain to Russian officials that the future system would not interfere with Russia's strategic deterrent and that the United States continued to view the ABM treaty as central to the U.S.-Russian strategic balance.[16]

In June 1999, President Clinton and President Yeltsin met at the G–8 summit in Cologne, Germany, resumed consultations on START III, and launched a discussion of U.S. proposals to amend the ABM treaty. The joint statement adopted at that summit described the ABM treaty as "fundamental" to the further reduction of strategic weapons, but it also affirmed the obligation under Article 13 of the treaty to "consider possible changes in the strategic situation that have a bearing on the ABM treaty and, as appropriate, possible proposals for further increasing the viability of the treaty." The two presidents agreed to begin discussions on START III and the ABM treaty in late summer 1999.[17]

The talks got off to a poor start in Moscow in mid-August. Russian officials argued that any changes to the ABM treaty would upset strategic stability and undermine Russia's national security.[18] The United States refused to discuss START III except as a package deal with an amended ABM treaty.[19]

14. Amy Woolf and Steven Hildreth, "National Missile Defense: Issues for Congress," CRS Brief, Order Code IB10034, October 19, 1999.
15. Andrei Khalip, "Russian Papers Attack U.S. Anti-Missile Proposal," *Reuters*, January 22, 1999.
16. Woolf and Hildreth, "National Missile Defense," p. 12.
17. "Joint Statement between the United States and the Russian Federation concerning Strategic Offensive and Defensive Arms and Further Strengthening of Stability," June 20, 1999.
18. Woolf and Hildreth, "National Missile Defense," p. 12.
19. *Yaderny Kontrol (Nuclear Control) Digest* 5(3): 11 (summer).

In September 1999, the U.S. administration announced that it desired treaty modification in two phases. First, it sought an amendment permitting the United States to deploy its single permitted ABM site in Alaska rather than in North Dakota. In the second phase, the United States would seek amendments to permit the deployment of two or more sites and the use of more advanced radars and space-based sensors.[20]

That month, Talbott returned to Moscow and met with his Russian counterpart, Deputy Foreign Minister Mamedov. Russian officials again rejected any changes to the treaty that would enable the United States to deploy national missile defenses, and the Russian Foreign Ministry released a statement that Moscow would insist on the "strict observance" of previous arms control agreements.[21] The chief of the Russian Foreign Ministry's Security and Disarmament Department, Berdennikov, declared that "the creation of a national ABM system by the USA will not only hamper consultations on the parameters of the START III talks, but, moreover, will also force Russia to tear up the START II treaty."[22]

Subsequently, though, the Russian negotiating position began to display subtle changes. During a meeting on September 12, 1999, President Clinton met briefly with then–Prime Minister Vladimir Putin in Auckland, New Zealand. Clinton expressed his desire to work together to share the benefits of a missile defense system with Russia. Putin conceded that there are threats from nuclear proliferation and nuclear terrorism that must be addressed in a way that takes account of the security concerns of other nations, but that these were matters for negotiation, which he hoped would proceed.[23] This represented an important change in the Russian approach and signaled that Russia was prepared to entertain options that would allow U.S. security concerns to be addressed. On September 13, when Secretary of Defense William Cohen met with Russian Defense Minister Igor Sergeyev in Moscow, the head of the Defense Committee in the State Duma, Roman Popkovich, stated that greater transparency with regard to the projected anti-missile system could improve the prospects for bilateral discussions.[24] Other Russian government and military officials, however, continued to express strong opposition to U.S. missile defense proposals and threatened the Russian withdrawal from arms control agreements in response to U.S. deployment of such systems. Washington had tried to allay Moscow's fears by offering to help Russia complete a missile-tracking radar installation near Irkutsk, Siberia, but Moscow did not respond to the offer.[25]

As negotiations continued, John Holum, the undersecretary of state for arms control and international security, met with Kapralov, the head of the Russian Foreign Ministry's Arms Control Department, in Geneva on January 19–21, 2000. There, U.S. negotiators presented Russian officials with a draft agreement that would revise the ABM treaty and with accompanying documents detailing the reasons for the proposed amendments.

According to talking points used by the United States at this meeting, "The U.S. national missile defense system, which will be limited and intended to defend against several dozen long-range missiles launched by rogue states, will be incapable of threatening Russia's strategic deterrence." A defense that limited, the administration argued, would preserve each side's "ability to carry out an annihilating counterattack," because "[f]orces of this size can easily penetrate a limited system of the type the United States is now developing." In the event of a first strike, Russia would still be able "to send about a thousand warheads, together with

20. Woolf and Hildreth, "National Missile Defense," p. 12.

21. Ibid., p. 12.

22. "Diplomat Criticizes U.S. ABM Plans," RIA news agency, Moscow, September 11, 1999.

23. Washington File Transcript, September 13, 1999.

24. "ABM Treaty Progress Made," *Radio Free Europe,* September 14, 1999.

25. "Russians Firmly Reject U.S. Plan To Reopen ABM Treaty," *New York Times,* October 21, 1999. See also, "Russia Fears ABM Revision Will Ignite New Nuclear Race," *Detroit News,* October 19, 1999.

two to three times more decoys, accompanied by other advanced defense penetration aids" that would easily overwhelm the American system.[26]

The amendments proposed in January 2000 would have allowed the United States to deploy a "limited NMD system as an alternative to the deployment of ABM systems permitted under the current provisions of the ABM treaty" and to move the site allowed under the treaty to a different location. The draft amendments, however, would retain other restrictions, such as the limit of no more than 100 interceptors within a 150-km radius. The proposed changes would also have allowed the use of existing long-range radar for ABM purposes. The United States also proposed that "at the demand of one Party, the Parties shall begin further negotiations no sooner than March 1, 2001, to bring the Treaty into agreement with future changes in the strategic situation" to allow for subsequent expansion or modification of the NMD system.[27]

Russian negotiators repeated their offer to reduce the number of deployed strategic nuclear warheads held by each side from the START II level of 3,000–3,500 to 1,500, but rejected the U.S.-proposed amendments. The United States, in its turn, rejected the Russian offer for deeper reductions.[28]

On January 31, 2000, Secretary of State Albright held talks in Moscow with acting Russian President Putin and Foreign Minister Igor S. Ivanov but failed to make specific progress. Russians and Americans continued to disagree about the nature and extent of the ballistic missile threat and the wisdom of deploying missile defenses.[29] Albright, however, also spoke with acting President Putin during that visit, who did not completely reject the idea of treaty modifications.[30]

Hopes for a possible compromise were reignited during a spring 2000 visit to Washington by Foreign Minister Ivanov and Secretary of the Russian Security Council Sergey Ivanov. Sergey Ivanov, in particular, reportedly discussed the possible transfer of the U.S. ABM deployment area from North Dakota to Alaska.[31] Foreign Minister Ivanov was also given a highly detailed briefing at the Pentagon on the future NMD architecture and capabilities. At a meeting with Bill Clinton, Foreign Minister Ivanov agreed to hold discussions of possible amendments to the ABM treaty but specifically noted that this only entailed consultations with regard to the U.S.-proposed amendments, rather than talks on precisely how the treaty should be amended.[32]

A large group of U.S. legislators, however, voiced opposition to possible official talks on ABM amendments. Twenty-five senators, including Trent Lott and Jesse Helms, sent a letter to Bill Clinton expressing concern that negotiations with Russia on amending the ABM treaty might constrain U.S. ability to deploy an effective NMD.[33] Representatives Curt Weldon and David Vitter, in a separate letter, asked for assurances that the administration would not initiate formal negotiations with Russia to amend the ABM treaty.[34]

The full scope of the Russian "diplomatic offensive" soon became clear when newly elected Russian President Putin succeeded in pushing START II and the Comprehensive Test Ban Treaty (CTBT) through the Duma and, shortly after that, advanced the concept of a joint U.S.-Russian-European theater mis-

26. Steven Lee Myers and Jane Perlez, "Documents Detail U.S. Plan To Alter '72 Missile Treaty," *New York Times,* April 27, 2000.

27. *Bulletin of Atomic Scientists,* May–June 2000.

28. Myers and Perlez, "Documents Detail U.S. Plan," *New York Times,* April 27, 2000.

29. Jane Perlez, "Russians Wary of U.S. Pitch for Missile Defense System," *New York Times,* February 1, 2000.

30. Ibid.

31. Alexander A. Pikayev, "Moscow's Matrix," *Washington Quarterly,* summer 2000, p. 191.

32. BBC News Service, April 26, 2000; *New York Times,* April 29, 2000.

33. *New York Times,* April 22, 2000

34. *Defense Daily,* April 18, 2000. Formal talks, including within the framework of the Standing Consultative Commission, would contradict the fact that the U.S. Senate did not approve the 1997 Memorandum of Understanding, which confers the status of parties to Russia, Ukraine, Kazakhstan, and Belarus as parties to the ABM treaty in the place of the Soviet Union.

sile defense (TMD) system to counter the emerging threat of missile proliferation without changing the ABM treaty. In an interview with *NBC News* on the eve of the June U.S.-Russian summit in Moscow, Putin raised the possibility of a joint U.S.-Russian TMD system,[35] and during later visits to Italy and Germany he promoted the notion of a trilateral defense system.[36] The substance of the new initiative, however, remained unclear. Separately, Russian Deputy Defense Minister Nikolay Mikhaylov told visiting U.S. members of Congress that Russia would be prepared to share its S–500 air defense system (still under development) for such a joint system, but that it lacked the necessary funding to complete work on it.[37]

The United States extended a cautious welcome to the Putin proposal. U.S. Secretary of Defense Cohen called it a "step forward."[38] Pentagon acquisition chief Jacques Gansler stated, however, that joint work with Russia would not stop a separate U.S. NMD system.[39]

The Clinton-Putin summit in June 2000 did not produce the breakthrough that many analysts had expected on strategic nuclear issues. A much-discussed potential compromise might have involved Russia's acceptance of ABM amendments in exchange for U.S. acceptance of the 1,500-warhead limit for START III pushed for by Russia.[40] As noted above, however, the Joint Chiefs of Staff had previously rejected the idea of deeper cuts, pending a comprehensive study of its impact on U.S. national security, a view supported by the U.S. Congress.

Although the summit failed to produce a "grand bargain," the presidents did sign a Joint Statement on Principles of Strategic Stability. This statement reaffirmed the role of the ABM treaty as the "cornerstone of strategic stability," but simultaneously recognized that the international community faces "a dangerous and growing threat of proliferation of weapons of mass destruction and their means of delivery." The presidents noted that the ABM treaty contained provisions for considering new developments in the strategic situation and directed their cabinet members and experts to prepare a report on concrete measures that would address emerging threats while preserving strategic stability. The two sides also noted the importance of the consultative process and expressed their desire to continue consultations in the future as a means of promoting the objectives and implementation of the ABM treaty.[41] The language of the joint statement was carefully written, however, so that it allowed for disagreement on whether the ABM treaty should actually be amended. On October 12, 2000, the Russian Foreign Ministry issued a special statement noting that the June 4 joint statement did not contain agreement by Russia to amend the ABM treaty.[42]

Russian officials continued to warn that a unilateral U.S. withdrawal from the ABM treaty would trigger a wholesale withdrawal from a number of arms control treaties by Russia. Simultaneously with the Clinton-Putin summit in Moscow, Chief of Strategic Rocket Forces General Vladimir Yakovlev declared in an interview that inspection and verification activities could be terminated if the United States were to withdraw from the ABM treaty. He also noted a number of other possible shifts in Russian policy, including equipping the new Topol-M missile with multiple warheads, giving warheads enhanced penetration aids, changing the deployment of tactical

35. Ivan Safranchuk, "The U.S.-Russian Summit: Negotiations on the ABM NMD Issues and START III," letter of June 2000, *Arms Control Letters,* PIR, June 7, 2000.

36. "Putin Goes to Rome To Promote Russian Arms Control Alternative," *New York Times,* June 6, 2000.

37. "Washington Awaits Details on Putin Missile Defense Proposal Says White House," *Russia Today,* June 7, 2000; *Agence France Presse*, June 14, 2000.

38. *Agence France Presse*, June 6, 2000.

39. House Armed Service Committee Transcript, June 28, 2000.

40. Alexander Pikayev, "The Rise and Fall of START II," Carnegie Endowment Working Paper no. 6, September 1999.

41. "Text: Joint Clinton-Putin Statement on Strategic Stability," U.S. Department of State International Information Programs, Washington File web site: <usinfo.state.gov/products/washfile.htm>, June 4, 2000.

42. Official statement of the Ministry of Foreign Affairs, no. 1063-12-10-2000.

nuclear weapons, increasing the number of nuclear-tipped air-launched cruise missiles, and restarting production of intermediate-range ballistic missiles.[43] Earlier, Security Council Secretary Sergey Ivanov had stated that Russia would automatically withdraw from the START II and START I agreements if the United States were to withdraw from the ABM treaty.[44] On June 22, senior Russian government officials yet again publicly expanded the list of measures that Russia might take if Washington were to withdraw from the ABM treaty. These measures included abrogating the Intermediate-Range Nuclear Forces Treaty of 1987 and producing modernized intermediate-range missiles that would be targeted at Europe.[45]

In the meantime, the United States and Russia proved more successful in reaching agreement in the area of early warning and missile launch notification. Discussion of these issues began at the initiative of the United States in 1998, and at the September 1998 summit Bill Clinton and Boris Yeltsin adopted the Joint Statement on the Exchange of Information on Missile Warning. This agreement foresaw the creation of a joint center on Russian territory to prevent miscalculations about missile launches and promised to examine the possibility of a multilateral ballistic missile and space launch vehicle notification regime. During the June 2000 summit, Presidents Clinton and Putin signed a Memorandum of Understanding establishing a Joint Data Exchange Center with the goal of a "near real-time" exchange of data produced by U.S. and Russian space- and land-based missile-launch early-warning systems. This center will feature a built-in expansion capability so that additional countries can eventually join it to create a multilateral launch notification regime.

In mid-summer 2000 Putin visited North Korea immediately before the G–8 meeting in Okinawa, Japan, and announced that North Korea had promised to scrap its military missile program in exchange for access to peaceful satellite launch capability. During their meeting on June 21 on the fringes of the G–8 conference, Putin briefed Clinton on the results of his talks with Kim Jong-Il.[46] This unexpected development subsequently generated a cautious dialogue between the United States and North Korea on Pyongyang's military missile program.

Generally, however, as the second term of the Clinton administration approached its end, disagreements pertaining to START III and the future of the ABM treaty remained unresolved. Both sides exchanged draft texts of START III, but differences remained substantial. The United States continued to press for a Russian amendment of the ABM treaty to allow the deployment of an NMD system, which Russia continued to reject. Meanwhile, many in the U.S. Congress objected to these efforts by the White House on the ground that NMD deployment should be pursued irrespective of Russian views.

43. *Kommersant,* June 3, 2000.

44. "Russia Threatens To Scrap START Accords If U.S. Ditches ABM," *Interfax Diplomatic Panorama,* February 28, 2000.

45. "Russia Could Withdraw from Key Arms Treaty If U.S. Violates ABM," *Russia Today,* June 22, 2000.

46. *New York Times,* July 22, 2000.

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, earthmoving 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.

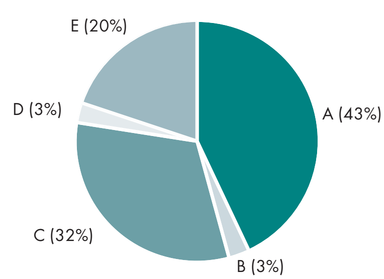
Kazakhstan[17]

- 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.

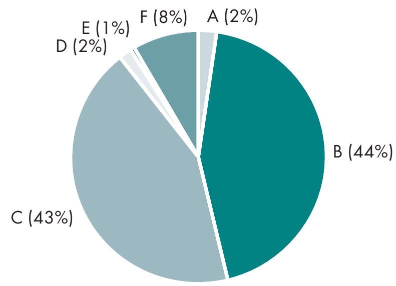
57. CTR Program Plan, p. IV–37.

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.

CHAPTER 4

Nuclear Facilities and Fissile Materials in the Former Soviet Union

THERE ARE APPROXIMATELY 650 metric tons of weapons-usable fissile material in the countries of the former Soviet Union, not including the material currently in nuclear warheads. This chapter attempts to catalogue all the facilities in the Newly Independent States (NIS) where this material is located. The facilities listed in the following tables include nuclear weapons research, design, and production facilities; nuclear fuel production facilities; non-weapons-research facilities; educational and industrial facilities; and naval facilities. Only ten of these facilities are in the non-Russian Newly Independent States (NIS): one in Belarus, three in Kazakhstan, one in Latvia, three in Ukraine, and two in Uzbekistan. (Two facilities listed in previous editions of this publication, in Georgia, however, are no longer included since no weapons-usable uranium remains at those sites.)[1] The remaining 56 facilities are within the Russian Federation. The facilities within the Russian Federation are divided into two categories: civil and military, and naval facilities. Naval facilities have been divided into Northern Fleet sites, Pacific Fleet sites, and other naval facilities, which include research institutes and shipyards.

Each entry contains the name, supervising agency, and location of the facility, a brief description of the facility's mission, a list of its most relevant assets, an approximation of the amount of weapons-usable uranium and separated plutonium present at each facility, and a short overview of the current status of material protection, control, and accounting (MPC&A) there. (For the purposes of this report, we have defined *weapons-usable uranium* as uranium enriched to 20% or higher of the isotope U_{235}. Separated plutonium does not include the plutonium present in spent nuclear reactor fuel.)[2] The exact amount of weapons-usable uranium and separated plutonium at each site is sensitive and generally unavailable for publication. Thus, in many cases the editors have had to estimate the amounts of material present at various facilities from publicly available information. In the case of many facilities, the phrase "more than 1,000 kg" might mean many tons or even many tens of tons. We were not able to confirm a more precise quantity from the open source literature. Where we had

1. The last 5 kg of HEU removed from the Institute of Physics just outside the Georgian capital of Tbilisi in April 1998. The material was airlifted out of Georgia to Scotland in a joint Georgian–United States–United Kingdom operation known as Project Auburn Endeavor. In the early 1990s, there was reportedly a small quantity—probably 1–2 kg—of HEU at a second Georgian facility, the Sukhumi Institute of Physics and Technology. The city of Sukhumi was taken over by Abkhazian separatists in 1993, and Georgian officials currently have no information about the status of the HEU at that institute. At the invitation of the Abkhazian separatists, Russian scientists reportedly gained access to the facility in 1997. The scientists found that the material had disappeared. Its whereabouts is currently unknown.

2. About 15 kg of *weapons-grade* uranium, usually defined as uranium containing more than 90% of the isotope U_{235}, or 6 kg of *weapons-grade* plutonium, usually defined as plutonium containing 6% or less of the isotopes Pu_{240} and Pu_{242} combined, are required to build an implosion-type fission weapon. However, all weapons-usable uranium and separated plutonium can also be used to build nuclear weapons if large enough amounts are used and additional technical hurdles are overcome.

no information on the amount of material at a given site, we have simply stated that it is "unknown."

The vast majority of the information contained in the tables is derived directly from the extensive nuclear facilities database developed and maintained by the Monterey Institute for International Studies (MIIS). Additional resources for each site can be obtained through the MIIS database, which can be accessed by contacting MIIS at <cns.miis.edu>.

Naval Facilities

Tables 4.2 and 4.3 include details on Russian naval facilities—sites not previously included in past editions of the *Nuclear Status Report*. The editors have listed Russian naval facilities with fresh or spent fuel in port or on board active-duty submarines or ships. They do not include facilities that have only radioactive waste, such as Sayda Bay. Unless otherwise noted, all information is drawn from the Naval Nuclear Reactors section of the NIS Nuclear Profiles Database prepared by the MIIS Center for Nonproliferation Studies (CNS).

Tables 4.2 and 4.3 also include descriptions of Russian nuclear submarines. Russia (and the Soviet Union before it) produced three generations of nuclear submarines. The earliest, or first-generation, includes the November-, Hotel-, and Echo-class of submarines, which were fueled with 21% enriched uranium. Fifty-five first-generation submarines were produced. The next, second generation, of submarines includes the Yankee-, Charlie-, and Victor-class submarines, which also had 21% HEU reactor cores. One hundred forty-two second-generation boats were built by the Soviet Union. The current, third-generation, of submarines include the Typhoon, Oscar, Sierra, and Akula submarines, which use fuels of various enrichment between 21% and 45% HEU.[3] To date, 39 third-generation submarines have been produced.[4]

3. Thomas Nilsen, Igor Kudrik, and Aleksandr Nikitin, "Bellona Report 1: The Russian Northern Fleet," The Bellona Foundation, 28 August 1996, pp. 29, 36–37.

4. Bellona web site: <www.bellona.no/imaker?id=4587&sub=1>; CNS staff research.

TABLE 4.1: **RUSSIAN CIVILIAN AND MILITARY NUCLEAR FACILITIES**

ALL-RUSSIAN SCIENTIFIC RESEARCH INSTITUTE OF EXPERIMENTAL PHYSICS (VNIIEF)

	Всероссийский научно-исследовательский институт экспериментальной физики (ВНИИЭФ) Vserossiyskiy nauchno-issledovatelskiy institut eksperimentalnoy fiziki (VNIIEF) <www.vniief.ru>
SUPERVISING AGENCY	Ministry of Atomic Energy
LOCATION	Sarov, Nizhniy Novgorod Oblast, approximately 400 km east of Moscow
SITE ACTIVITIES[5]	1. Nuclear weapons research, design, and development 2. Advanced weapons research 3. Nuclear weapons and component stewardship 4. Material science, nuclear and laser physics, and engineering, and supercomputers research and development 5. High-technology projects in power and mechanical engineering, instrumentation, medicine, and the environment 6. Nonproliferation center[6]
RELEVANT ASSETS	1. Four operational research reactors[7] 2. Two decommissioned research reactors[8] 3. Critical assemblies[9] 4. Three fissile-material central storage facilities[10]
WEAPONS-USABLE URANIUM	Yes. More than 1,000 kg of HEU is located on site.[11]
SEPARATED PLUTONIUM	Yes. More than 1,000 kg of plutonium is located on site.[12]
MPC&A TIMELINE	Work begun: 1994 Work completed: Not yet completed.
MPC&A STATUS	Initial MPC&A cooperation with DOE was limited to a few sites within the VNIIEF complex. In the fall of 1997, VNIIEF management agreed to expand MPC&A cooperation to all sites that process or store HEU or plutonium.

5. Elena Dorofeyeva, presentation on VNIIEF and Arzamas-16, Center for Nonproliferation Studies, Monterey Institute of International Studies, March 20, 1996; *Nuclear Business Directory,* "All-Russian Institute of Experimental Physics" (Moscow: IBR Corporation, 2000), p. 54.
6. Russian-American Nuclear Security Advisory Council (RANSAC) web site: <www.ransac.org>.
7. Gosatomnadzor, "List of Research Reactors, Critical and Subcritical Assemblies under Supervision of Gosatomnadzor," July 1992 (hereafter "GAN Reactor List").
8. Ibid.
9. V. Euferev et al., "Program for Upgrading Nuclear Materials Protection, Control, and Accounting at All Facilities within the All-Russian Institute of Experimental Physics (VNIIEF)," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
10. Ibid.
11. U.S. Department of Energy, "MPC&A Program Strategic Plan," Office of Nonproliferation and National Security, January 1998, p. 16; Carnegie Endowment for International Peace correspondence with DOE officials, July 2000.
12. Ibid.

(MPC&A STATUS) VNIIEF can be divided into two zones: the industrial zone and the scientific zone. Within these two zones, there are 16 individual fenced and guarded areas where weapons-usable material is located. The industrial zone includes the production site and three central storage facilities. The scientific zone includes the reactor site where the research reactors and critical assemblies are located.[13] The reactor site in the scientific zone was the first area where MPC&A systems were completed. Reactor site upgrades include perimeter and facility access control, measured physical inventories, and equipment for better accounting and tracking of nuclear material.[14] As of July 1999, VNIIEF had completed a threat analysis and design for a comprehensive new MPC&A system and is now in the process of implementing MPC&A upgrades at all 16 sites.[15]

In 1999, problems regarding U.S. access to sensitive facilities slowed the pace of work at this site. Existing projects will continue, but no new projects will be initiated until access issues are resolved.[16]

NOTES

- The operational research reactors are the BIGR, VIR–2M, *Neptune,* and *Kvant*. The decommissioned reactors are the VIR–1 and VIR–2.[17]

13. Euferev, "Program for Upgrading Nuclear Materials Protection."
14. Ibid.
15. V. Euferev, "Program for Securing Nuclear Materials Protection, Control, and Accounting at All Facilities within the All-Russian Institute of Experimental Physics," paper presented at the Institute for Nuclear Materials Management's (INMM) 40th annual meeting, Phoenix, AZ, July 26–29, 1999.
16. CNS interviews with DOE officials, fall 1999.
17. GAN Reactor List.

ALL-RUSSIAN SCIENTIFIC RESEARCH INSTITUTE OF TECHNICAL PHYSICS (VNIITF)

Всероссийский научно-исследовательский институт технической физики (ВНИИТФ)
Vserossiyskiy nauchno-issledovatelskiy institut tekhnicheskoy fiziki (VNIITF)

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Snezhinsk, approximately 90 km south of Yekaterinburg

SITE ACTIVITIES
1. Nuclear warhead research and design[18]
2. Assembly, disassembly, and testing of experimental and prototype warheads[19]
3. Tritium target fabrication for inertial confined fusion[20]
4. Development of dosimeters, medical equipment, and irradiation devices[21]

RELEVANT ASSETS
1. Three pulse reactors[22]
2. Fissile-material storage facilities[23]
3. MPC&A training center[24]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[25]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[26]

MPC&A TIMELINE Work begun: 1995
Work completed: Not yet completed.

MPC&A STATUS DOE began providing MPC&A assistance to VNIITF in 1995, two years after Minatom directed the site to rethink its approach to materials protection owing to changes in Russian society. Although Minatom provided some initial funding for this effort, VNIITF has used DOE funding to implement advanced MPC&A improvements.[27]

Cooperative MPC&A work with DOE began at the pulse research reactor (PRR) facility. Upgrades included the installation of hardened doors, access controls, metal detectors, video surveillance,

18. Thomas B. Cochran, Robert S. Norris, and Oleg A. Bukharin, *Making the Russian Bomb: From Stalin to Yeltsin* (Boulder, Colo.: Westview Press, 1995), pp. 42–45.
19. Gennadiy Tsygankov, "U.S./Russian Cooperative Efforts To Enhance Nuclear Material Protection, Control, and Accounting at the All Russian Scientific Research Institute of Technical Physics (VNIITF) Chelyabinsk-70," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
20. CNS staff discussion with Russian scientist, October 1997.
21. VNIITF web site: <www.ch70.chel.su/vniitf/capabilities.html>.
22. Tsygankov, "U.S./Russian Cooperative Efforts."
23. Ibid.
24. CNS staff discussions with Russian scientist, fall 1999; CNS correspondence with Oleg Bukharin, January 2000.
25. U.S. Department of Energy, "MPC&A Program Strategic Plan"; and Carnegie Endowment correspondence with DOE officials, July 2000.
26. Ibid.
27. Gennadiy Tsygankov, presentation to CNS staff, Snezhinsk, January 1999.

(MPC&A STATUS) alarm systems, and a physical protection control center.[28] A new MPC&A system was commissioned at the PRR facility in May 1998.[29]

In addition, a number of areawide MPC&A improvements have been implemented. Vehicle and pedestrian portal monitors and metal detectors have been installed at key points throughout VNIITF. Other complexwide upgrades include the installation of access controls, implementation of a computerized badging system, construction of a centralized MPC&A control station, and development of a tamper-indicating device program.[30]

VNIITF is also completing a measured physical inventory of all its nuclear materials, and plans to develop a complex-wide computerized material control and accounting (MC&A) system. As of July 2000, physical inventories were under way in two of the buildings in the PRR facility (containing hundreds of kilograms of HEU) and were planned for several other sites within the complex.[31]

Last, VNIITF is considering construction of a new fissile-material storage building that would house nuclear material consolidated from three separate buildings within VNIITF.

In 1999, problems regarding U.S. access to sensitive facilities slowed the pace of work at this site. Existing projects will continue, but no new projects will be initiated until access issues are resolved.

NOTES

- The pulse reactors at the pulse research reactor facility are the *BARS,* the *IGRIK,* and the *YaGUAR.*[32] All three reactors are located within Site 20.[33]
- The MPC&A training center will be partially funded by the European Union.[34]

28. Tsygankov, "U.S./Russian Cooperative Efforts."
29. U.S. Department of Energy MPC&A web site: News Archives, "Nuclear Security System Installed at C–70 Research Reactor Facility," May 1998, <www.dp.doe.gov/nn/mpca/oldnews/05-98.htm>.
30. Gennadiy Tsygankov et al., "Progress and Future Plans for MPC&A at Chelyabinsk-70," paper presented at the INMM 40th annual meeting, Phoenix, AZ, July 26–29, 1999.
31. Ibid.
32. "Osnovnyye podrazdeleniya instituta: Tseli i zadachi," *Rossiyskiy Federalnyy yadernyy tsentr: Vserossiyskiy NII tekhnicheskoy fiziki* (Snezhinsk, Russia: RFNTs–VNIITF, 1998), p. 10.
33. Tsygankov, "U.S./Russian Cooperative Efforts."
34. CNS staff discussions with Russian scientists, fall 1999; and CNS correspondence with Oleg Bukharin, January 2000.

AVANGARD ELECTROMECHANICAL PLANT (AMZ)

Электромеханический завод «Авангард»
Elektromekhanicheskiy zavod "Avangard"

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Sarov, Nizhniy Novgorod Oblast, approximately 400 km east of Moscow

SITE ACTIVITIES Nuclear warhead assembly and dismantlement[35]

RELEVANT ASSETS
1. Nuclear warhead production and dismantlement facility
2. Interim fissile-material storage[36]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[37]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[38]

MPC&A TIMELINE Work begun: Not yet begun.
Work completed: Not yet completed.

MPC&A STATUS DOE was scheduled to begin MPC&A upgrades at the Avangard Electromechanical Plant and other nuclear warhead production facilities in 1998. Although some portal monitors and other equipment upgrades have been sent to these facilities, U.S. experts have not been given direct access to any of these sites. In 1999, DOE established a policy that no work would proceed at these sensitive sites until the issue of appropriate access was resolved.[39] DOE officials continue their discussions with Minatom on gaining appropriate access to this site in order to provide adequate oversight for MPC&A cooperation.

NOTES
- The Ministry of Atomic Energy has announced that the assembly of nuclear ammunition at this plant was to end in 2000. Warhead dismantlement will be completed at this site by the end of the year 2003.[40]
- Fissile-material components from dismantled warheads are stored here before being sent to Ozersk (Chelyabinsk-65) or Seversk (Tomsk-7) for storage.[41]

35. U.S. Department of Energy, Office of Intelligence, "Russian Nuclear Facility Map," June 1999.
36. Oleg Bukharin, "Security of Fissile Materials in Russia," *Annual Review: Energy and Environment* 21:467–496, 1996, p. 476.
37. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment correspondence with DOE officials, July 2000.
38. Ibid.
39. Oleg Bukharin, Matthew Bunn, and Ken Luongo, "Renewing the Partnership: Recommendations for Accelerated Action To Support Nuclear Material in the Former Soviet Union," Russian-American Nuclear Security Advisory Council report, August 2000, p. 71.
40. "Nuclear Weapons Plants To Be Wound Down," *ITAR–TASS*, February 9, 1999.
41. Bukharin, "Security of Fissile Materials in Russia," p. 476.

BELOYARSK NUCLEAR POWER PLANT

Белоярская АЭС
Beloyarskaya AES

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Zarechnyy, approximately 60 km east of Yekaterinburg[42]

SITE ACTIVITIES Nuclear power plant[43]

RELEVANT ASSETS[44]
1. BN–600 fast-breeder reactor
2. Fresh-fuel storage
3. Spent-fuel storage

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[45]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: January 1996[46]
Work completed: June 1998[47]

MPC&A STATUS DOE-funded physical protection upgrades include the installation of a central alarm station; upgrades to the fresh- and spent-fuel vault areas, including access controls, video surveillance, and electronic sensors; hardening of the vehicle and personnel portals; and provision of a guard communication system. MC&A upgrades include provision of equipment for nuclear-material measurement; provision of an underwater video camera and recorder for verification of spent-fuel serial numbers; and a computer network for material accounting. VNIITF is working with the Beloyarsk NPP on the development and implementation of a computerized accounting system.[48]

NOTES
- The BN–600 uses uranium dioxide fuel enriched to 21% and 33% in a uranium blanket for plutonium production. The core load is approximately 8,500 kg.[49] Approximately 100 kg of MOX fuel with 3%, 4%, and 5% plutonium is also used in the reactor. Fresh HEU and MOX fuel is likely to be present on site sporadically.[50]
- Plutonium is present in spent-fuel and breeder blankets, which are stored on site in liquid and solid-waste storage facilities.[51]

42. Oleg Saraev et al., "U.S./Russia MPC&A Upgrades at the Beloyarsk Nuclear Power Plant," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
43. Ibid.
44. Ibid.
45. The core-loading of the Beloyarsk NPP is 8.5 tons. Atomenergoexport, "Beloyarskaya Nuclear Power Plant Named After I. V. Kurchatov," prospectus, 1987, p. 6.
46. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.
47. U.S. Department of Energy MPC&A web site: News Archives, "Nuclear Security Systems Commissioned at Three Russian Civilian Sites," June 1998, <www.nn.doe.gov/mpca/frame04.htm>.
48. Saraev et al., "U.S./Russia MPC&A Upgrades."
49. Atomenergoexport, "Beloyarskaya Nuclear Power Plant," p. 6.
50. CNS staff discussions with Russian scientist, May 2000.
51. Ibid.

BOCHVAR ALL-RUSSIAN SCIENTIFIC RESEARCH INSTITUTE OF INORGANIC MATERIALS (VNIINM)

Всероссийский научно-исследовательский институт неорганических материалов им. А. А. Бочвара (ВНИИНМ)
Vserossiyskiy nauchno-issledovatelskiy institut neorganicheskikh materialov im. A. A. Bochvara (VNIINM)
<www.bochvar.ru>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Moscow

SITE ACTIVITIES
1. Scientific research in the areas of fuel-cycle technologies and fissile-material processing[52]
2. Development of MOX fuel-fabrication technology[53]
3. Production of experimental MOX fuel and fuel rods
4. Measurement of nuclear materials in bulk form[54]
5. Nuclear reactor fuel design[55]

RELEVANT ASSETS
1. Experimental MOX fuel-fabrication facility[56]
2. Fissile-material storage

WEAPONS-USABLE URANIUM Yes. Less than 1,000 kg of HEU and/or plutonium is located on site.[57]

SEPARATED PLUTONIUM Yes. Less than 1,000 kg of HEU and/or plutonium is located on site.[58]

MPC&A TIMELINE Work begun: 1995[59]
Work completed: Not yet completed.

MPC&A STATUS In early 1994, Gosatomnadzor ordered certain activities at this facility to be shut down for six months owing to its lax measures for protecting plutonium.[60]

Most DOE-funded MPC&A-related work here supports the improvement of VNIINM's current methods for measuring bulk nuclear materials. As VNIINM is the Minatom-designated institute for bulk nuclear material measurements, these improved methods may be applied broadly throughout the Minatom complex. In addition, VNIINM is working with DOE to develop a general

52. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 50.
53. Ibid.
54. CNS staff discussion with DOE official, January 1998.
55. A. Dubor, "Nuclear Research Institute Shown for First Time," Vesti newscast, Russian Public Television, December 8, 1995, FBIS–SOV–95–242, 12/8/95.
56. U.S. Department of Energy, Office of Fissile Materials Disposition, "Strategic Plan," June 2000, p. 18.
57. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 17. The proportion of HEU to plutonium at this site is unclear, but the majority of material is believed to be uranium.
58. Ibid.
59. W. Ruhter et al., "U.S./Russian Laboratory-to-Laboratory Material Protection, Control, and Accounting Program Efforts at the Institute of Inorganic Materials," *United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1996, pp. L–L25–29.
60. Leonard Spector, Testimony before the Subcommittee on International Security, International Organizations, and Human Rights of the House Foreign Affairs Committee, June 27, 1994.

(MPC&A STATUS) MC&A plan for the entire institute, including a computerized accounting system.[61] Both DOE and Germany have provided physical protection assistance at this site. German government assistance was provided from the German Ministry for Ecology and Nuclear Safety and executed through the state-sponsored Society for Nuclear Safety. The German-funded work, to improve security over civilian nuclear materials, was begun in 1997 and completed in 1999.[62]

61. Ruhter et al., "U.S./Russian Materials Protection, Control."
62. Carnegie Endowment staff conversation with German embassy staff in Washington, D.C., August 2000.

ELECTROCHEMICAL PLANT

Электрохимический завод
Elektrokhimicheskiy zavod

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Zelenogorsk (formerly Krasnoyarsk-45), approximately 200 km east of Krasnoyarsk[63]

SITE ACTIVITIES
1. Uranium enrichment[64]
2. Downblending of HEU to LEU[65]

RELEVANT ASSETS
1. Centrifuge enrichment plant[66]
2. Intermediate storage and fluorination facility, where HEU oxide is converted to HEU hexafluoride[67]
3. Downblending area, where HEU hexafluoride is downblended to LEU hexafluoride[68]
4. HEU storage facility

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[69]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: July 1996[70]
Work completed: Not yet completed.

MPC&A STATUS DOE-funded physical protection upgrades have focused on the HEU storage facility, the intermediate storage and fluoridation facility, the uranium downblending area, and the facility perimeter. The Electrochemical Plant upgraded access controls around the facility perimeter, and DOE provided video surveillance equipment, metal and nuclear material detectors, and x-ray machines.[71] Additional physical protection measures include structural hardening and the installation of alarms and sensors. Upgrades were also made to the Central Alarm Station, and communications equipment was provided to the guard force. MC&A upgrades include scales for material measurements, bar codes, tamper-indicating devices, and hardware and software for a computerized material accounting system.[72]

63. Gennady Skorynin, "The Cooperative Efforts of the Materials Protection, Control, and Accounting Program at the Electrochemical Plant (Krasnoyarsk-45) in Russia," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
64. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 183.
65. Bukharin, "Security of Fissile Materials in Russia."
66. U.S. Department of Energy, Office of Intelligence, "Russian Federation Nuclear Cities Map," June 1999.
67. Skorynin, "Cooperative Efforts."
68. Ibid.
69. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.
70. Steve Mladineo, "U.S. Government-to-Government Cooperation," United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting, December 1996, p. GG–2.
71. Scott MacAllister et al., "Material Protection, Control, and Accounting Activities at the Electrochemical Plant," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
72. Skorynin, "Cooperative Efforts."

NOTES

- This facility currently produces LEU for nuclear reactor fuel. HEU production ceased at this site in 1987.[73]
- HEU from dismantled nuclear warheads is stored at this facility before it is blended down to LEU. This site is one of two facilities (the other is the Siberian Chemical Combine) where HEU from dismantled warheads is converted to gaseous uranium hexafluoride. It is also one of three facilities (the other two being the Siberian Chemical Combine and the Urals Electrochemical Integrated Plant) where uranium hexafluoride is then blended down to approximately 4% LEU, in accordance with the February 1993 U.S.-Russian HEU agreement.[74]

73. *Nuclear Business Directory* (Moscow: 1995), p. 76; and "The Structure and the Production Capabilities of the Nuclear Fuel Cycle in the Countries of the Former Soviet Union," Center for Energy and Environmental Studies, Princeton University, January 1993, p. 2.

74. CNS staff discussion with Oleg Bukharin, May 2000. (See chapter 3 for a discussion of the U.S.-Russian HEU agreement.)

ELEKTROKHIMPRIBOR COMBINE

Комбинат «Электрохимприбор»
Kombinat "Elektrokhimpribor"

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Lesnoy (formerly Sverdlovsk-45), near the city of Nizhnaya Tura, approximately 200 km north of Yekaterinburg

SITE ACTIVITIES Nuclear warhead assembly and dismantlement[75]

RELEVANT ASSETS
1. Nuclear warhead production and dismantlement facility
2. Interim fissile-material storage[76]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[77]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[78]

MPC&A TIMELINE Work begun: Not yet begun.
Work completed: Not yet completed.

MPC&A STATUS DOE was scheduled to begin MPC&A upgrades at the Elektrokhimpribor Combine and other nuclear warhead production facilities in 1998. Some portal monitors and other MPC&A equipment have been sent to these facilities, but U.S. experts have not been given access to any of these sites. In 1999, DOE established a policy that no work would proceed at these sensitive sites until the issue of appropriate access was resolved. DOE officials continue their discussions with Minatom on gaining appropriate access to this site in order to provide adequate oversight for MPC&A cooperation.[79]

NOTES
- Fissile-material components from retired warheads are temporarily stored here before being sent to Ozersk (Chelyabinsk-65) or Seversk (Tomsk-7) for storage.[80]

75. U.S. Department of Energy, Office of Intelligence, "Russian Federation Nuclear Cities Map," June 1999.
76. Bukharin, "Security of Fissile Materials in Russia," p. 476.
77. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment correspondence with DOE officials, July 2000.
78. Ibid.
79. Oleg Bukharin, Matthew Bunn, and Ken Luongo, "Renewing the Partnership: Recommendations for Accelerated Action To Support Nuclear Material in the Former Soviet Union," Russian-American Nuclear Security Advisory Council report, August 2000, p. 71.
80. Bukharin, "Security of Fissile Materials in Russia," p. 476.

ELEKTROSTAL MACHINE BUILDING PLANT (MSZ)

Машиностроительный завод (МСЗ)
Mashinostroitelnyy zavod (MSZ)

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Elektrostal, approximately 54 km east of Moscow[81]

SITE ACTIVITIES
1. HEU fuel fabrication for naval propulsion and fast-breeder (BN) reactors[82]
2. LEU fuel fabrication for VVER–440 and RBMK reactors[83]

RELEVANT ASSETS
1. HEU and LEU fuel production lines
2. Seven critical assemblies[84]
3. Fissile-material storage facilities[85]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[86]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: February 1994[87]
Work completed: Work suspended.[88]

MPC&A STATUS This site has been part of U.S. efforts to improve MPC&A from the earliest days of the Nunn-Lugar Cooperative Threat Reduction (CTR) program. Elektrostal was chosen as the "test" facility for U.S. MPC&A assistance under the auspices of the CTR program in February 1994. (Responsibility for MPC&A projects at Elektrostal was switched from DOD to DOE in mid-1995.) Within the facility, the LEU fuel-fabrication line was selected for upgrades as an initial "confidence-building" exercise.

In this test phase, two specific sites within the LEU line (Building 274 and Building 189) were chosen for full upgrades. Because elaborate physical protection is not essential for an LEU site, initial physical protection assistance focused on a portion of the fast-breeder fuel production line that is located in the same building (Building 274) as the LEU production line. This assistance included enclosing and separating the fast-breeder line within the building, adding access controls, an enhanced alarm system, portal monitors,

81. Hastings Smith et al., "U.S./Russian Collaboration in MPC&A Enhancements at the Elektrostal Uranium Fuel-Fabrication Plant," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
82. "World Nuclear Industry Handbook 1995," *Nuclear Engineering International;* and *Nuclear Business Directory,* 1995, pp. 80–82.
83. "World Nuclear Industry Handbook 1995," *Nuclear Engineering International.*
84. GAN Reactor List.
85. Smith et al., "U.S./Russian Collaboration."
86. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.
87. Ibid.
88. U.S. Department of Energy assistance work was stopped in FY 1999 owing to "access limitations." Carnegie Endowment correspondence with DOE officials, July 2000.

sensors, and perimeter fencing.[89] In addition, a number of MC&A projects were initiated on the LEU line, including the installation of hardware and software for computerized material accounting and the delivery of equipment for nuclear material measurements.[90] A new MPC&A system was commissioned at Building 274 in fall 1997.[91]

A few years after work was initiated on the LEU line, the full fast-breeder fuel-fabrication line, which uses HEU enriched up to 26%, was added to the DOE MPC&A program.[92] However, DOE has not yet been granted access to the higher-enriched HEU fuel-fabrication line, which produces, among other products, highly sensitive submarine reactor fuel.[93] DOE ended all work here in September 1999 owing to problems of U.S. access to sensitive areas within Elektrostal.[94]

NOTES
- Elektrostal is one of Russia's primary nuclear fuel-fabrication plants.
- Uranium on site includes both 90% enriched HEU and large quantities of 26% HEU.[95]

89. Hastings Smith et al., "U.S./Russian Cooperation for Enhancing Nuclear Material Protection, Control, and Accounting at the Elektrostal Uranium Fuel-Fabrication Plant," *United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1996, pp. GG 23–24.
90. Smith et al., "U.S./Russian Collaboration in MPC&A Enhancements at the Elektrostal Uranium Fuel-Fabrication Plant," December 1997.
91. Ken Sheely, "Nuclear Material Protection, Control, and Accounting Program" (unclassified fax message), January 1998.
92. Smith et al., "U.S./Russian Collaboration in MPC&A Enhancements."
93. Matthew Bunn, "The Next Wave: Urgently Needed New Steps To Control Warheads and Fissile Material," Joint Harvard University–Carnegie Endowment for International Peace publication, March 16, 2000; and Carnegie Endowment discussion with DOE officials, June 1999.
94. Carnegie Endowment staff correspondence with DOE official, July 2000.
95. U.S. Department of Energy, Office of Nonproliferation and National Security, January 27, 1995.

INSTITUTE OF MEDICAL AND BIOLOGICAL PROBLEMS (IMBP)

Институт медико-биологических проблем (ИМБП)
Institut mediko-biologicheskikh problem (IMBP)
<www.ibmp.rssi.ru>

SUPERVISING AGENCY Ministry of Health[96]

LOCATION Moscow

SITE ACTIVITIES[97]
1. Scientific research, including medical and biological experiments in space
2. Scientific education

RELEVANT ASSETS One research reactor (under construction)[98]

WEAPONS-USABLE URANIUM Yes. Less than 100 kg of HEU may be located on site.[99]

SEPARATED PLUTONIUM No

MPC&A STATUS No plans to conduct MPC&A activities at this site

NOTES
- The research reactor is a 0.5-MW SVV–1 pool-type reactor.[100]

96. CNS staff correspondence with Russian nuclear scientists, October 1999.
97. "Istoricheskaya Spravka," State Scientific Center of the Russian Federation, Institute of Medical and Biological Problems; web site: <www.ibmp.rssi.ru>.
98. CNS staff correspondence with Russian nuclear scientists, October 1999.
99. Ibid. U.S. Government sources are not aware of any weapons-usable nuclear materials at this site.
100. CNS staff correspondence with Russian nuclear industry official, 1995.

INSTITUTE OF PHYSICS AND POWER ENGINEERING (IPPE)

Физико-энергетический институт (ФЭИ)
Fiziko-energeticheskiy institut (FEI)
<www.ippe.obninsk.ru>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Obninsk, Kaluga Region

SITE ACTIVITIES Research and development for nuclear power engineering[101]

RELEVANT ASSETS
1. Three research reactors[102]
2. Two fast critical assemblies[103]
3. Up to 16 additional critical assemblies[104]
4. Fuel-fabrication laboratory[105]
5. Central storage facility[106]
6. Russian Methodological Training Center (RMTC)[107]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[108]

PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[109]

MPC&A TIMELINE Work begun: September 1994[110]
Work completed: Not yet completed.

MPC&A STATUS IPPE was one of the first Russian facilities to participate in the DOE MPC&A program. Work began at the fast critical assembly facility in 1995. In 1996, work was expanded to the fuel-fabrication laboratory and the old central storage facility. Upgrades at all three facilities include physical protection, improved access control, video surveillance of nuclear materials, implementation of nuclear material measurement techniques, use of methods for automated material accounting, development of local networks for computerized material accounting, and the development of procedures for taking physical inventories. Many of these upgrades will be extended to the entire IPPE site.[111]

In 1996, as part of a long-term MPC&A strategy, IPPE decided to create a "nuclear island" consisting of the fast critical assembly

101. Institute of Physics and Power Engineering (IPPE) web site: "Welcome," <sparc2.ippe.rssi.ru/>.

102. CNS staff interview with IPPE scientist, August 1997; and Institute of Physics and Power Engineering web site: <www.ippe.obninsk.ru/mpca>.

103. V. V. Kuzin et al., "Collaborative Russian/U.S. Work in Nuclear Material Protection, Control, and Accounting at the Institute of Physics and Power Engineering: Extension to Additional Facilities," *United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1996, pp. GG 51–53.

104. CNS staff interview with IPPE staff.

105. IPPE web site: "Technological Laboratory," <www.ippe.obninsk.ru/mpca/mpca.html>.

106. IPPE web site: "Central Storage Facility," <www.ippe.obninsk.ru/mpca/csf_eng.htm>.

107. RMTC web site: <rmtc.ippe.obninsk.ru>.

108. CNS staff interview with IPPE scientist, August 1997.

109. Ibid.

110. Kuzin et al., "Collaborative Russian/U.S. Work in Nuclear MPC&A," December 1997; and IPPE web site: <www.ippe.obninsk.ru/mpca>.

111. Ibid.

(MPC&A STATUS) (BFS) facility and a new central storage facility that will be located adjacent to the BFS facility. One physical protection system will be developed for the "nuclear island," which eventually will house 80–85% of the weapons-grade nuclear materials at IPPE.[112]

The RMTC was established in 1995 by the Russian government to teach the basic principles of nuclear material protection, accounting, and control to Russian nuclear facility staff and inspectors from the Russian Federal Inspectorate for Nuclear and Radiation Safety (GAN). Short courses are offered on various theoretical and practical aspects of MPC&A and make use of a number of laboratories outfitted with modern MPC&A equipment and instrumentation. The RMTC has received assistance from both DOE and the European Commission Joint Research Center and was formally commissioned in a ceremony on November 4, 1998.[113]

NOTES

- More than 1,000 kg of HEU and approximately 1,000 kg of plutonium are located at IPPE.[114]
- The fast critical assembly facility alone houses several metric tons of HEU and several hundred kilograms of plutonium.[115]
- The central storage facility consists of buildings for irradiated and fresh nuclear materials. The building for fresh nuclear materials, which houses several metric tons of HEU, is the receiving and shipping point for all nuclear materials received at IPPE.[116]
- The three research reactors are the BR–1 (.5 MW) and the BR–10 (10 MW), both fast-breeder reactors, and the AM–1 (30 MW), a water-graphite reactor.[117]
- Uranium fuel discs are kept in an interim storage vault at the fuel-fabrication laboratory. [118]
- The AM–1 reactor was the first nuclear power reactor ever built in the Soviet Union.[119]

112. Ibid.; and CNS staff interview with IPPE scientist, August 1997.

113. RMTC web site: <rmtc.ippe.obninsk.ru>.

114. CNS staff interview with IPPE scientist, August 1997.

115. Kuzin, "Collaborative Russian/U.S. Work in Nuclear MPC&A," December 1996, pp. GG 51–53.

116. Ibid.

117. CNS staff interview with IPPE scientist, August 1997.

118. IPPE web site: "Technological Laboratory," <www.ippe.obninsk.ru/mpca>.

119. IPPE web site: "Welcome," <www.ippe.rssi.ru/welcome/welcome eng.html>.

INSTITUTE OF THEORETICAL AND EXPERIMENTAL PHYSICS

Институт теоретической и экспериментальной физики
Institut teoreticheskoy i eksperimentalnoy fiziki
<www.itep.ru>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Moscow

SITE ACTIVITIES Research on heavy-water applications for nuclear weapons production[120]

RELEVANT ASSETS
1. One decommissioned 2.5-MW heavy-water research reactor
2. One "zero-power" reactor
3. Fissile-material storage facility[121]

WEAPONS-USABLE URANIUM Yes. Less than 1,000 kg of HEU is located on site.[122]

SEPARATED PLUTONIUM No[123]

MPC&A TIMELINE Work begun: September 1996[124]
Work completed: February 1998[125]

MPC&A STATUS DOE-funded MPC&A upgrades include provision of instruments for nuclear material measurements and software for computerized material accounting. Physical protection upgrades include establishment of a central alarm station in the area where fissile material is located, access control, intrusion detection, video assessment, delay elements, and a guard communication sytem.[126]

NOTES
- The zero-power reactor, referred to as the *Maket,* is fueled with HEU.

120. CNS staff interview with Russian nuclear official, August 1997.
121. Oleg Shvedov et al., "MPC&A Upgrades at the Institute of Theoretical and Experimental Physics," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
122. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 17.
123. Carnegie Endowment correspondence with DOE official, July 2000.
124. U.S. Department of Energy, Office of Arms Control and Nonproliferation, "Significant Milestones in Securing and Controlling Nuclear Materials," p. 6.
125. Ibid.
126. Shvedov et al., "MPC&A Upgrades."

INSTRUMENT MAKING PLANT

Приборостроительный завод (ПСЗ)
Priborostroitelniy zavod (PSZ)

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Trekhgornyy (formerly Zlatoust-36), Chelyabinsk Oblast

SITE ACTIVITIES
1. Nuclear warhead assembly and dismantlement[127]
2. Assembly-line production of ballistic missile reentry vehicles[128]

RELEVANT ASSETS Nuclear warhead production and dismantlement facility

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[129]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[130]

MPC&A TIMELINE Work begun: Not yet begun.
Work completed: Not yet completed.

MPC&A STATUS DOE was scheduled to begin MPC&A upgrades at the Instrument Making Plant and other nuclear warhead production facilities in 1998. Although some portal monitors and other equipment upgrades have been sent to these facilities, U.S. experts have not been given direct access to any of these sites. In 1999, DOE established a policy that no work would proceed at these sensitive sites until the issue of appropriate access is resolved. DOE officials continue their discussions with Minatom on gaining appropriate access to this site in order to provide adequate oversight for MPC&A cooperation.[131]

NOTES
- This site is slated to produce a range of civilian products, from bathtubs to instrumentation for nuclear power plants, as part of its defense conversion efforts.[132]

127. U.S. Department of Energy, Office of Intelligence, "Russian Federation Nuclear Cities Map," June 1999.
128. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 50.
129. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment correspondence with DOE officials, July 2000.
130. Ibid.
131. Bukharin, Bunn, and Luongo, "Renewing the Partnership," p. 71.
132. *Nuclear Cities News,* vol. 1, December 1999, Center for Energy and Environmental Studies, Princeton University and the Russian-American Nuclear Security Advisory Council (RANSAC), RANSAC web site: <www.ransac.org>.

JOINT INSTITUTE OF NUCLEAR RESEARCH (JINR)

Объединенный институт ядерных исследований (ОИЯИ)
Obedinennyy institut yadernykh issledovaniy (OIYaI)
<www.jinr.ru>

SUPERVISING AGENCY Independent government institute[133]

LOCATION Dubna, approximately 120 km from Moscow[134]

SITE ACTIVITIES JINR is an international scientific research center that conducts theoretical and experimental investigations for peaceful purposes.[135]

RELEVANT ASSETS
1. One plutonium-fueled pulsed research reactor
2. One nonoperational plutonium-fueled pulsed research reactor with a linear electron accelerator
3. Central storage facility (Building 133)[136]

WEAPONS-USABLE URANIUM Yes. Less than 100 kg of HEU is located on site.[137]

SEPARATED PLUTONIUM Yes. Less than 10 kg of plutonium is located on site.[138]

MPC&A TIMELINE Work begun: May 1996[139]
Work completed: February 1998[140]

MPC&A STATUS The DOE-funded upgraded security system includes improved access controls, intrusion sensors, a hardened fresh-fuel vault, personnel portals, upgrades to the central alarm station, upgraded inventory-taking procedures, and a computerized material accounting system.[141] A DOE follow-up team has visited this site as part of the DOE sustainability program.[142]

133. CNS correspondence with Russian nuclear official, October 1999.
134. Joint Institute of Nuclear Research (JINR) web site: <www.jinr.ru>.
135. Valentin Samoilov, "MPC&A Upgrades at the Joint Institute for Nuclear Research, Dubna, Russia," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
136. Jim Stottlemeyer, "Joint Institute for Nuclear Research, Dubna, Russia," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
137. CNS correspondence with Russian nuclear official, October 1999.
138. Stottlemeyer, "Joint Institute for Nuclear Research, Dubna, Russia."
139. Samoilov, "MPC&A Upgrades at the Joint Institute for Nuclear Research Dubna, Russia."
140. U.S. Department of Energy web site: Material Protection Control and Accounting Program: News Archives, "United States and Russia Commission Nuclear Material Control Systems at Four Sites," February 1998, <www.nn.doe.gov/mpca/index.html>.
141. Yuri Volodin and M. Teresa Olascoaga, "Cooperation on Nuclear Material Protection, Control, and Accounting between the Federal Nuclear and Radiation Authority of Russia (Gosatomnadzor) and the U.S. Department of Energy," *United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1996, p. GG–8; and Samoilov, "MPC&A Upgrades."
142. U.S. Department of Energy MPC&A web site: News Archives, "Ensuring Sustainable Security Operations In Russia," July/August 1999, <www.nn.doe.gov/mpca/index.html>.

NOTES

- The operational research reactor is the IBR–2 (2 MW) and the nonoperational reactor is the IBR–30 (.025 MW).[143]
- There is approximately 100 kg of plutonium in irradiated fuel in the two reactors combined.[144]
- There are approximately 9 kg of fresh plutonium fuel in the central storage facility.[145]
- Currently, there are 18 member states of JINR: Armenia, Azerbaijan, Belarus, Bulgaria, Cuba, the Czech Republic, the Democratic People's Republic of Korea, Georgia, Kazakhstan, Moldova, Mongolia, Poland, Romania, the Russian Federation, the Slovak Republic, Ukraine, Uzbekistan, and Vietnam.[146]

143. JINR web site: <www.jinr.ru>.

144. Carnegie Endowment interviews with officials at Dubna, April 6, 1996.

145. Stottlemeyer, "Joint Institute for Nuclear Research, Dubna, Russia."

146. Samoilov, "MPC&A Upgrades."

KARPOV SCIENTIFIC RESEARCH INSTITUTE OF PHYSICAL CHEMISTRY (OBNINSK BRANCH)

Научно-исследовательский институт физической химии им. Карпова (Нифхи)
Nauchno-issledovatelskiy institut fizicheskoy khimii im. Karpova (NIFKhI)

SUPERVISING AGENCY Ministry of Economics[147]

LOCATION Obninsk, Kaluga Region

SITE ACTIVITIES
1. Research on chemical applications[148]
2. Production of medical isotopes[149]

RELEVANT ASSETS One (10 MW) research reactor[150]

WEAPONS-USABLE URANIUM Yes. Less than 100 kg of HEU is located on site.[151]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: February 1996[152]
Work completed: February 1998[153]

MPC&A STATUS The DOE-funded upgraded physical protection for the reactor building and storage vault includes access controls, alarms, sensors, and physical barriers. MPC&A upgrades include tags, seals, and computers for computerized material accounting. The Karpov Institute will use a computerized material accounting system that was developed at the Joint Institute for Nuclear Research in Dubna.[154] A DOE follow-up team has visited this site as part of the DOE sustainability program.[155]

NOTES
- The research reactor is a VVR–Ts tank research reactor, fueled with 3.5 kg of 36% HEU.[156]
- The HEU on site is in a number of forms, including reactor fuel and bulk form.[157]

147. CNS staff correspondence with Russian nuclear scientists, October 1999.
148. CNS interview with Russian nuclear official, August 1997.
149. V. Plotnikov, "U.S./Russian Program in Material Protection, Control, and Accounting at the Karpov Institute of Physical Chemistry," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
150. GAN Reactor List.
151. CNS correspondence with Russian nuclear scientists, October 1999.
152. U.S. Department of Energy, "Significant Milestones," p. 5.
153. U.S. Department of Energy MPC&A web site: News Archives, "United States and Russia Commission Nuclear Material Control Systems at Four Sites," February 1998, <www.nn.doe.gov/mpca/index.html>.
154. Plotnikov, "U.S./Russian Program."
155. U.S. Department of Energy MPC&A web site: News Archives, "Ensuring Sustainable Security Operations in Russia," July/August 1999, <www.nn.doe.gov/mpca/index.html>.
156. GAN Reactor List.
157. Plotnikov, "U.S./Russian Program."

KHLOPIN RADIUM INSTITUTE, ST. PETERSBURG BRANCH

Радиевый институт им. В. Г. Хлопина
Radiyevyy institut im. V. G. Khlopina
<www.atom.nw.ru/>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION St. Petersburg

SITE ACTIVITIES[158]
1. Research and development for the nuclear industry, including research on reprocessing technologies
2. Production of radioactive isotopes

RELEVANT ASSETS Nuclear-materials storage facility[159]

WEAPONS-USABLE URANIUM Yes. Less than 5 kg of HEU and/or plutonium is located on site.[160]

SEPARATED PLUTONIUM Yes. Less than 5 kg of HEU and/or plutonium is located on site.[161]

MPC&A TIMELINE Work begun: May 1996[162]
Work completed: May 1998[163]

MPC&A STATUS DOE-funded physical protection upgrades include a hardened storage vault and improved access control at the central storage facility. MC&A upgrades include a computerized material accountancy system.[164]

158. V. G. Khlopin, "Radiochemical Analysis of Environmental Samples," Radium Institute brochure, St. Petersburg; and Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 36.
159. G. C. Hauser, "Khlopin Radium Institute," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
160. Ibid.
161. Ibid.
162. U.S. Department of Energy, "Significant Milestones," p. 5.
163. U.S. Department of Energy MPC&A web site: News Archives, "Commissioning Ceremonies in St. Petersburg for Two Completed Nuclear Material Control Systems," April 1998, <www.nn.doe.gov/mpca/index.html>.
164. Hauser, "Khlopin Radium Institute."

KHLOPIN RADIUM INSTITUTE, GATCHINA BRANCH

Радиевый институт им. В. Г. Хлопина
Radiyevyy institut im. V. G. Khlopina
<www.atom.nw.ru/rie/>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Gatchina, St. Petersburg Oblast, approximately 40 km from St. Petersburg

SITE ACTIVITIES[165]
1. Research and development for the nuclear industry, including research on reprocessing technologies[166]
2. Production of radioactive isotopes

RELEVANT ASSETS Hot cells[167]

WEAPONS-USABLE URANIUM Yes. Gram quantities of HEU are kept in hot cells at this site.[168]

SEPARATED PLUTONIUM Yes. Gram quantities of plutonium are kept in hot cells at this site.[169]

MPC&A TIMELINE Work begun: May 1996[170]
Work completed: May 1998[171]

MPC&A STATUS DOE-funded physical protection upgrades include improved access control at the main entrance to this facility.[172]

165. Khlopin, "Radiochemical Analysis of Environmental Samples"; and Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 36.
166. Hauser, "Khlopin Radium Institute."
167. Ibid.
168. Ibid.
169. Ibid.
170. U.S. Department of Energy, "Significant Milestones."
171. U.S. Department of Energy MPC&A web site: News Archives, "Commissioning Ceremonies in St. Petersburg for Two Completed Nuclear Material Control Systems," April 1998, <www.nn.doe.gov/mpca/index.html>.
172. Hauser, "Khlopin Radium Institute."

KURCHATOV INSTITUTE, RUSSIAN RESEARCH CENTER

Российский научный центр «Курчатовский институт»
Rossiyskiy nauchnyy tsentr "Kurchatovskiy institut"
<www.kiae.ru>

SUPERVISING AGENCY Independent government institute[173]

LOCATION Moscow

SITE ACTIVITIES
1. Scientific research in the areas of solid state physics, fusion and plasma physics, nuclear physics, and nuclear power and reactor safety[174]
2. Kurchatov Analytic Center for Nonproliferation and Control[175]

RELEVANT ASSETS
1. Ten research and power reactors[176]
2. Sixteen critical assemblies[177]
3. Two subcritical assemblies[178]
4. Central storage facility for fissile material[179]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[180]

SEPARATED PLUTONIUM Yes[181]

MPC&A TIMELINE Work begun: 1994[182]
Work completed: Not yet completed.

MPC&A STATUS U.S. MPC&A assistance at the Kurchatov Institute began in 1994 as part of the DOE laboratory-to-laboratory program. Initial efforts focused on improving MPC&A at Building 116, where substantial amounts of HEU are located in two critical assemblies. These upgrades were completed in early 1995.[183] The central storage facility, which contains several metric tons of nuclear material, was next in line for upgrades. MPC&A work at this facility was completed in November 1996.[184] In 1997–1998, implementation of MPC&A

173. CNS correspondence with Kurchatov Institute scientists, October 1999.

174. Vladimir Sukhoruchkin et al., "U.S./Russian Program in Materials Protection, Control, and Accounting at the RRC Kurchatov Institute: 1997–1998," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.

175. *Nuclear Cities News,* vol. 1, December 1999, Center for Energy and Environmental Studies, Princeton University and the Russian-American Nuclear Security Advisory Council (RANSAC), RANSAC web site: <www.ransac.org>.

176. CNS staff correspondence with Kurchatov Institute scientists, October 1999.

177. Ibid.

178. Ibid.

179. Vladimir Sukhoruchkin, "U.S./Russian Laboratory-to-Laboratory Program in Material Protection, Control, and Accounting at the RRC Kurchatov Institute," *United States/Former Soviet Union: Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1996, pp. LL 32–33; and U.S. Department of Energy Fact Sheet, "Update on MPC&A Developments since June 1996," April 1997.

180. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

181. Less than 1 kg of plutonium may be on site. Carnegie Endowment discussion with U.S. government officials, July 2000.

182. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

183. Mark Mullen, "Status Report on U.S.-Russian Cooperation in Nuclear Materials Protection, Control, and Accounting," paper presented at the 37th annual INMM meeting, Naples, Florida, July 28–21, 1996.

184. Sukhoruchkin, "U.S./Russian Laboratory-to-Laboratory Program," pp. LL 32–33; and U.S. Department of Energy Fact Sheet, "Update on MPC&A Developments."

upgrades focused on Building 106, where several research reactors and critical assemblies are located, and Building 135, where three critical assemblies are located.[185]

DOE-funded physical protection upgrades consist primarily of access control systems, physical barriers, and alarms and sensors. For material accounting and control (MC&A), Kurchatov Institute staff developed a computerized MC&A system called KI–MACS (Kurchatov Institute Material Accounting and Control System), which includes bar coding, tamper-indicating devices, and electronic scales.[186] The KI–MACS system has been certified by the Russian government, and as of April 1999 five buildings at the Kurchatov Institute had been equipped with the system. There are also plans for the Russian navy to use this software to account for its nuclear materials.[187]

The Kurchatov Institute has also been working closely with DOE to facilitate MPC&A upgrades at Russian naval facilities (see section on Russian naval facilities, tables 4.2 and 4.3).

NOTES

- Of the ten research and power reactors, six are operational (the *Gamma* [125 kW], *Argus* [50 kW], IIN-3M *Hydra* [10 MW], *OR* [300 kW], *F1* [24 kW], *IR-8* [8 MW]), and four are nonoperational (*MR* [40 MW], *VVR-2* [5 MW], *RFT* [20 MW], and *Romashka* [40 kW]).[188]
- The 16 critical assemblies include the *Delta, Kvant, SF–1, SF–3, SF–5, SF–7, UG, Grog, Filin,* and *Chaika*.[189]

185. Sukhoruchkin, "U.S./Russian Program in MPC&A at the RRC, Kurchatov Institute: 1997–1998," September 1998.

186. Ibid.

187. U.S. Department of Energy MPC&A web site: News Archives, "KI–MACS (Kurchatov Institute Material Accounting and Control System): A Triumph for the MPC&A Program," March/April 1999.

188. CNS database.

189. Sukhoruchkin, "U.S./Russian Program," December 1996.

LUCH SCIENTIFIC PRODUCTION ASSOCIATION (NPO LUCH)

Научно-производственное объединение «Луч» (НПО «Луч»)
Nauchno-proizvodstvennoye obedineniye "Luch" (NPO "Luch")

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Podolsk, 35 km south of Moscow

SITE ACTIVITIES[190]

1. Research on development, production, and testing of high-temperature uranium fuel elements, fuel assemblies, and reactor cores
2. Research on and production of rare-earth metals for the nuclear industry
3. Research and development on space power reactors (Topaz), nuclear rocket engines, and high-temperature gas-cooled reactors
4. Reprocessing of HEU scrap

RELEVANT ASSETS

1. Three research reactors[191]
2. Central storage facility

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[192]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: 1996[193]
Work completed: Not yet completed.

MPC&A STATUS By mid-1998, NPO Luch had consolidated HEU from 28 separate locations within the Luch complex to four sites. Although Luch had initiated this effort in 1992, economic constraints limited its progress until 1996, when DOE began to provide the facility with MPC&A assistance. DOE gave the highest priority to improving MPC&A at the central storage facility (CSF). Completed physical protection upgrades include building modifications, improved access controls, and the installation of alarms, sensors, video surveillance, and metal and radiation detectors. In addition, the HEU storage capacity of CSF was increased by the installation of cabinets and shelving. MC&A upgrades include the use of tamper-indicating devices and bar codes. U.S. equipment for nuclear-material measurement has been delivered, and a computerized database for the location and identification of nuclear items has been developed.[194]

190. Pavel Mizin et al., "Material Consolidation at Luch: Lessons Learned," paper presented at the INMM 40th annual meeting, Phoenix, AZ, July 26–29, 1999.

191. GAN Reactor List.

192. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

193. Mizin, "Material Consolidation at Luch."

194. Ibid.

MPC&A upgrades are now being put into place at the three processing buildings where the remainder of the HEU is located. Most of these upgrades will be completed in the year 2000. NPO Luch is also working on the installation of a computer network for sitewide computerized nuclear material accounting.[195]

In May 1999, DOE's new Material Consolidation and Conversion Program began a pilot project at the NPO Luch. Under this pilot project, 100 kg of HEU from Luch was downblended to LEU. In addition, a significant quantity of HEU from the Research Institute for Instruments in Lytkarino was consolidated to Luch for storage.[196] In November 1999, the DOE Material Consolidation and Conversion program signed an agreement with Luch that will continue this initial work to consolidate and downblend approximately 500 kg of HEU to LEU. The material was scheduled to be downblended by the end of October 2000.[197]

NOTES

- The three research reactors are a uranium graphite IGR reactor (1,000 MW), a channel-type IVG reactor (300 MW), and a prototype 11B91–IR reactor (100 MW).[198]

195. Ibid.
196. U.S. Department of Energy MPC&A web site: News Archives, "Significant Milestones Reached for the MPC&A Program's Material Consolidation and Conversion (MCC) Project," September/October 1999, <www.nn.doe.gov/mpca/index.html>.
197. U.S. Department of Energy MPC&A web site: News Archives, "Material Consolidation and Conversion Update," November/December 1999, <www.nn.doe.gov/mpca/index.html>.
198. GAN Reactor List.

MAYAK PRODUCTION ASSOCIATION

Производственное объединение «Маяк»
Proizvodstvennoye obyedineniye "Mayak"
<www.x-atom.ru/mayak/>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Ozersk (formerly Chelyabinsk-65), approximately 200 km south of Yekaterinburg

SITE ACTIVITIES

1. Formerly, production of plutonium for use in nuclear weapons[199]
2. Warhead component production
3. Spent-fuel reprocessing[200]
4. Fissile-material storage[201]
5. Pilot production of mixed-oxide (MOX) fuel pellets[202]
6. Tritium production[203]

RELEVANT ASSETS

1. Five nonoperational plutonium production reactors, which were permanently shut down between 1987 and 1991[204]
2. Two HEU-fueled tritium production reactors, which are also used to produce isotopes[205]
3. RT–1 spent-fuel reprocessing facility, including interim and long-term plutonium dioxide and HEU storage[206]
4. Plant 1: HEU oxidation and purification facilities[207]
5. The Granat pilot MOX fuel production plant[208]
6. Complex-300 MOX fuel production plant (under construction)[209]
7. Storage facility for fissile material from dismantled nuclear weapons (under construction)[210]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[211]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[212]

199. Mayak Production Association web site: "History," <hp.x-atom.ru/mayak/>.
200. Ibid.
201. A. I. Prishchepov et al., "Cooperation between the Russian Federation and the United States To Enhance the Existing Nuclear-Material Protection, Control, and Accounting Systems at Mayak Production Association," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
202. Cochran, Norris, Bukharin, *Making the Russian Bomb,* p. 92.
203. Ibid.
204. Mayak Production Association web site: "History," <hp.x-atom.ru/mayak/>.
205. Ibid.; and CNS staff discussion with Russian scientist, May 2000.
206. Prishchepov et al., "Cooperation between the Russian Federation and the United States," July 1999.
207. Ibid.
208. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 92.
209. Ibid.; and Mayak Production Association web site: "History," <hp.x-atom.ru/mayak/>.
210. For additional information on the current status of this facility, please see chapter 3, "U.S. Nonproliferation Assistance Programs."
211. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment correspondence with DOE officials, July 2000.
212. Ibid.

MPC&A TIMELINE Work begun: June 1996[213]
Work completed: Not yet completed.

MPC&A STATUS Minatom has given its approval for DOE to provide MPC&A upgrades at two Mayak plants that house weapons-usable material: the RT–1 spent-fuel facility and Plant 1, where the HEU oxidation and purification facilities are located.[214]

MPC&A upgrades at the RT–1 facility include repairs to and installation of metal and nuclear-material detectors on the security perimeter, upgrades to the central alarm station (including video surveillance), upgrades to the interim and long-term plutonium dioxide vault and storage areas (hardening of walls and doors, improved intrusion detection, access delay cage, the provision of measurement and accounting equipment),[215] and the provision of a physical inventory laboratory to help update inventory records of plutonium dioxide.[216] Installation of an access control fence around the long-term plutonium dioxide and HEU storage vault and physical protection upgrades to the interim plutonium dioxide vault were scheduled to be completed in 2000.[217] The joint U.S.-Mayak MPC&A team is also working on the design of a new long-term plutonium dioxide storage facility, as the current one will be completely full within the next few years.[218]

In addition to the upgrades to the perimeter and the storage vaults, MPC&A upgrades at RT–1 include improving nuclear material measurements, the accuracy and timeliness of nuclear material accounting, and the computerization of data gathering. A computerized nuclear-material accounting network is being developed that will allow for a computerized inventory of plutonium and uranium through all phases at the RT–1 combine. Last, upgrades to the existing badging and access control systems and to the RT–1 HEU facilities are being negotiated.[219]

Joint MPC&A work began more slowly at Plant 1. In early 1999, Mayak prepared and submitted reports describing the current status of Plant 1, and a few months later, in May 1999, a joint U.S.-Mayak team toured the plant. Minatom, however, has not yet provided the necessary approvals and site access to conduct upgrades. As of July 2000, negotiations were under way to continue this work.[220]

213. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

214. Prishchepov et al., "Cooperation between the Russian Federation and the United States," July 1999.

215. Ibid.

216. U.S. Department of Energy MPC&A web site: News Archives, "Mayak Plutonium Measurement Laboratory," April 1998, <www.nn.doe.gov/mpca/index.html>.

217. *Nuclear Cities News,* vol. 1, December 1999, Center for Energy and Environmental Studies, Princeton University and the Russian-American Nuclear Security Advisory Council (RANSAC), RANSAC web site: <www.ransac.org>.

218. Prishchepov et al., "Cooperation between the Russian Federation and the United States," July 1999.

219. Ibid.

220. Ibid.; and Carnegie Endowment correspondence with DOE officials, July 2000.

NOTES

- The five plutonium production reactors are the A, IR, AV–1, AV–2, and AV–3. The tritium production reactors are the *Ruslan* and the *Ludmila*.[221]
- The RT–1 facility reprocesses spent fuel from VVER–440, fast-breeder, naval, and research reactors.[222] Plutonium dioxide and HEU are recovered from the spent fuel and stored at the RT–1 facility.[223]
- Mayak has accumulated a stockpile of approximately 30 metric tons of plutonium dioxide from its civilian reprocessing program at RT–1.[224] An additional 1 metric ton of plutonium is extracted from spent fuel each year.[225]
- The Mayak Production Association is one of two principal storage sites (the other is the Siberian Chemical Combine) for HEU and plutonium recovered from dismantled nuclear warheads.[226]
- HEU from dismantled nuclear weapons is processed and prepared for subsequent downblending to LEU in accordance with the February 1993 U.S.-Russian HEU purchase agreement at the Plant 1 HEU oxidation and purification facilities.[227]
- The storage facility for fissile material from dismantled nuclear weapons is currently under construction and is a major U.S.-Russian project under the U.S. DOD Cooperative Threat Reduction program. (See chapter 3 for additional information about the status of this project.)

221. Cochran, Norris, and Bukhkarin, *Making the Russian Bomb,* p. 75.
222. Ibid.
223. Prishchepov et al., "Cooperation between the Russian Federation and the United States," July 1999.
224. N. N. Egorov, V. M. Murogov et al., "Management of Plutonium in Russia," in E. Merz, C. Walter, and G. Pshakin, *Mixed Oxide Fuel (MOX) Exploitation and Destruction, Power Reactors* (Netherlands: Kluwer Academic Publisher, 1995), p. 5.
225. Bukharin, "Security of Fissile Materials in Russia," p. 473.
226. Ibid., p. 475.
227. Prishchepov et al., "Cooperation between the Russian Federation and the United States," July 1999. Downblending itself takes place at the Electrochemical Plant in Zelenogorsk (Krasnoyarsk-45), the Siberian Chemical Combine in Seversk (Tomsk-7), and the Urals Electrochemical Integrated Plant in Novouralsk (Sverdlovsk-44).

MINING AND CHEMICAL COMBINE (MCC)

Горно-химический комбинат (ГХК)
Gorno-khimicheskiy kombinat (GKhK)

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Zheleznogorsk (formerly Krasnoyarsk-26)

SITE ACTIVITIES
1. Formerly, production of plutonium for use in nuclear weapons
2. Spent-fuel reprocessing

RELEVANT ASSETS
1. One operational plutonium production reactor[228]
2. Two nonoperational plutonium production reactors, which were permanently shut down in 1992[229]
3. Underground reprocessing facility[230]
4. Plutonium oxide storage facility[231]
5. HEU storage facility[232]
6. RT–2 reprocessing plant (construction suspended)[233]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[234]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[235]

MPC&A TIMELINE Work begun: January 1996[236]
Work completed: Not yet completed.

MPC&A STATUS There are three layers of physical protection at the MCC: the *protective zone,* which includes the outer perimeter; the *inner zone,* which includes the production site within the mountain, and the most sensitive, the *high-security zone,* which is within the inner zone. Personnel access each zone through security checkpoints. The outer, protective zone is surrounded by a double-barbed-wire fence with a patrol path between fences. The external threat to this site is considered minimal.[237]

Initial DOE-funded MPC&A upgrades focused on the plutonium oxide storage facility (POSF), which is located in the high-security zone. Emphasis was placed on upgrading the MC&A systems. Material control upgrades include increased access control, material surveillance equipment, sensors, and tamper-indicating devices. A new computerized material accountancy system has been developed

228. *Nuclear Business Directory,* 1995, pp. 77–78; and *Komsomolskaya pravda,* September 30, 1992, p. 2.

229. *Nuclear Business Directory,* 1995, pp. 77–78.

230. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 153.

231. Krystyna Dziewinska, "Development of an Enhanced Materials Protection, Control, and Accountability Plan at the Mining and Chemical Combine," paper presented at the INMM 40th annual meeting, Phoenix, AZ, July 26–29, 1999.

232. Ibid.

233. V. Mikheev and V. Khizhnyak, *GKhK: problemy i realnost,* 1995, p. 24.

234. Carnegie Endowment discussions with U.S. National Laboratory staff, June, 1999. HEU in significant quantities is used in the operational ADE–2 reactor and stored on site.

235. CNS staff discussion with Russian scientist, January 1998.

236. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

237. Dziewinska, "Development of an Enhanced Materials Protection, Control, and Accountability Plan."

(MPC&A STATUS) and is currently being installed and integrated into the MCC system. The MPC&A program has also delivered equipment for nuclear-material measurement and for taking physical inventories. The next stage of MPC&A work will include the development of an upgrade plan for the reprocessing facility, the reactor complex, and new plutonium oxide storage areas.[238]

NOTES

- The remaining operational plutonium production reactor, the ADE–2, is used primarily to produce heat and electricity for the local population but continues to produce approximately 500 kg of weapons-grade plutonium per year.[239] (The MCC is estimated to have produced 45 metric tons of plutonium since it was founded in 1950.)[240] As of November 1, 1994, Minatom ceased using plutonium from the ADE–2 in nuclear weapons.[241]
- Plutonium from the ADE–2 is reprocessed on site and is subsequently stored at the plutonium oxide storage facility.[242]
- The plutonium production reactors are fueled by natural uranium but use HEU elements to increase reactivity and to stabilize power density. The HEU for these reactors is stored on site.[243]
- If and when the RT–2 plant is finished, it will be able to reprocess spent fuel from VVER–1000 nuclear power reactors and foreign light-water reactors.[244]

238. Ibid.

239. *Nuclear Business Directory,* 1995, pp. 77–78; A. Gubar, "ADE Reactor Fuel," *Zelenyy mir,* no. 6, 1996, p. C–3; and CNS staff discussion with Russian scientist, January 1998.

240. Oleg Bukharin, "Nuclear Safeguards and Security in the Former Soviet Union," *Survival,* winter 1994–1995, p. 61.

241. On June 23, 1994, U.S. Vice President Al Gore and then–Russian Prime Minister Viktor Chernomyrdin signed the "Agreement concerning the Shutdown of Plutonium Production Reactors and Cessation of Use of Newly Produced Plutonium for Nuclear Weapons," which stipulated that Russia would not use any plutonium produced by the production reactors in nuclear weapons after the agreement entered into force. In addition, the agreement obligated the Russian Federation to stop producing weapons-grade plutonium by shutting down the ADE–2 at Krasnoyarsk-26 and the additional two remaining plutonium-production reactors in Tomsk by the year 2000. On September 23, 1997, the U.S. DOD and the Russian Minatom signed the "Agreement concerning the Modification of the Operating Seversk (Tomsk Region) and Zheleznogorsk (Krasnoyarsk Region) Plutonium Production Reactors," in which the United States agreed to provide assistance to Russia to convert the cores of the remaining plutonium production reactors so that they would no longer produce weapons-grade plutonium. According to this agreement, core conversion must take place before December 31, 2000. See Center for Nonproliferation Studies, NIS Nuclear Profiles Database, *Russia: Full Text Documents,* "Gore-Chernomyrdin Commission Documents."

242. Dziewinska, "Development of an Enhanced Materials Protection."

243. Ibid.

244. The construction of the RT–2 plant has been subject to numerous delays, including local opposition to the plant, a review of required ecological reports, and a scarcity of funds. Yevgeniy Kuksin, "Dollary dlya gorno-khimicheskoy kopilki," *Segodnyashnyaya gazeta,* August 18, 1999, p. 7.

MOSCOW ENGINEERING AND PHYSICS INSTITUTE (MEPHI)

Московский инженерно-физический институт (МИФИ)
Moskovskiy inzhenerno-fizicheskiy institut (MIFI)
<www.mephi.ru>

SUPERVISING AGENCY Ministry of Education[245]

LOCATION Moscow

SITE ACTIVITIES Educational institution, issuing academic degrees in physics, engineering, and, since 1997, a two-year master's degree program in MPC&A[246]

RELEVANT ASSETS
1. One (2.5 MW) research reactor[247]
2. Five subcritical assemblies[248]
3. Central storage facility[249]

WEAPONS-USABLE URANIUM Yes. Less than 100 kg of HEU is located on site.[250]

SEPARATED PLUTONIUM Yes. Small amounts for research[251]

MPC&A TIMELINE Work begun: February 1996[252]
Work completed: June 1998[253]

MPC&A STATUS DOE-funded physical protection upgrades were implemented at the research reactor building, the nuclear training facility (where the two graphite pile reactors and seven subcritical assemblies are located), and the nuclear material storage center.[254] Upgrades include building and minor perimeter modifications, access control, internal and external video systems, and sensors. Improvements were also made to the guard posts. MC&A upgrades include computerized material accounting and the provision of instruments for improved nuclear material measurements.[255] A DOE follow-up team has visited this site as part of the DOE sustainability program.[256]

NOTES
- The research reactor is an HEU-fueled IRT-pool reactor.[257]

245. CNS staff correspondence with Russian nuclear scientists, October 1999.
246. Edward F. Kryuchkov et al., "Experience of Specialists Training at the Level of Master of Sciences Degree in Nuclear Materials Physical Protection, Control, and Accountability at Moscow State Engineering Physics Institute (Technical University)," paper presented at the INMM 40th annual meeting, Phoenix, AZ, July 26–29, 1999.
247. GAN Reactor List; and N. S. Pogozhin et al., "Atomic Center of Moscow Engineering-Physics Institute," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
248. CNS staff correspondence with Russian nuclear engineer, April 2001.
249. Pogozhin, "Atomic Center of Moscow Engineering-Physics Institute."
250. CNS staff correspondence with Russian nuclear scientists, October 1999.
251. Pogozhin, "Atomic Center of Moscow Engineering-Physics Institute."
252. U.S. Department of Energy, "Significant Milestones," p. 5.
253. Ibid.
254. Pogozhin, "Atomic Center of Moscow Engineering-Physics Institute."
255. Ibid.
256. U.S. Department of Energy MPC&A web site: News Archives, "Ensuring Sustainable Security Operations In Russia," July/August 1999, <www.nn.doe.gov/mpca/index.html>.
257. GAN Reactor List.

NOVOSIBIRSK CHEMICAL CONCENTRATES PLANT (NCCP)

Новосибирский завод химических концентратов (НЗХК)
Novosibirskiy zavod khimicheskikh kontsentratov (NZKhK)

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Novosibirsk

SITE ACTIVITIES
1. HEU fuel fabrication for nuclear research reactors, plutonium production reactors, and tritium production reactors[258]
2. LEU fuel fabrication for VVER-1000 power reactors[259]
3. Lithium production[260]

RELEVANT ASSETS[261]
1. HEU and LEU fuel production lines
2. Central storage facility, consisting of four HEU storage buildings
3. Lithium hydride storage facility

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[262]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: January 1996[263]
Work completed: November 2000

MPC&A STATUS Highest priority has been given to improving MPC&A at the central storage facility, where HEU was consolidated from four buildings to only one building. A storage building annex was constructed, and several physical protection measures were put into place in the building where the fuel has been consolidated. These measures include structural modifications to the building, the installation of sensors, cameras, and radiation detectors, and improved access controls. MC&A upgrades included the development of an automated accounting system and nuclear material measurements. The upgraded CSF was commissioned in November 2000.[264]

In addition, a new central alarm station is being built. (The U.S. team was unable to gain access to the old central alarm station owing to the high sensitivity of information there.) After the new alarm station has been built, any necessary alarms and information from the old alarm station will be transferred to the new one, and the old station will be destroyed. Substantial upgrades to the

258. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 191–192.

259. Oleg Bukharin, "Integration of Defense and Civil Fuel Cycles of Russia," *Byulleten Tsentra Obshchestvennoy Informatsii po Atomnoy Energii,* no. 5–6, 1995, p. 11.

260. Alexander Ustuygov, "Material Protection, Control, and Accountability Upgrades at the Novosibirsk Chemical Concentrates Plant, Novosibirsk, Russia," paper presented at the INMM 40th annual meeting in Phoenix, AZ, July 26–29, 1999.

261. Ibid.

262. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

263. Gore-Chernomyrdin Commission, "U.S./Russian Joint Commission on Economic and Technological Cooperation: Report of the Energy Policy Committee, Nuclear," February 1997.

264. U.S. Department of Energy press release, November 17, 2000.

MPC&A system at the HEU processing facilities are also planned and should be completed by the end of FY 2003.[265]

NOTES

- There are several thousand kilograms of HEU at this site.[266]
- The lithium hydride storage facility was commissioned in December 1997 and is the only such storage depot in Russia. It can hold up to 60 metric tons of lithium hydride from dismantled nuclear weapons.[267]

265. Ustuygov, "Material Protection, Control, and Accountability Upgrades"; and Carnegie Endowment correspondence with DOE officials, July 2000.
266. CNS staff interview with DOE official, March 1996; and Ustuygov, "Material Protection, Control, and Accountability Upgrades."
267. Ustuygov, "Material Protection, Control and Accountability Upgrades."

PETERSBURG INSTITUTE OF NUCLEAR PHYSICS

Петербургский институт ядерной физики
Peterburgskiy institut yadernoy fiziki
<www.pnpi.spb.ru/>

SUPERVISING AGENCY Russian Academy of Sciences[268]

LOCATION Gatchina, St. Petersburg Oblast, approximately 40 km from St. Petersburg

SITE ACTIVITIES Scientific research on high-energy theoretical physics

RELEVANT ASSETS
1. One operational (18 MW) research reactor[269]
2. One research reactor (100 MW), under construction[270]
3. One reactor critical assembly test unit[271]
4. Nuclear material storage vault[272]

WEAPONS-USABLE URANIUM Yes. More than 100 kg of HEU is located on site.[273]

SEPARATED PLUTONIUM No[274]

MPC&A TIMELINE Work begun: February 1996[275]
Work completed: May 1998[276]

MPC&A STATUS DOE-funded physical protection upgrades to the facility exterior include a video-monitored, double-fenced perimeter with a vehicle portal and crash barrier. A new entry control station on the perimeter includes video surveillance, a pedestrian portal monitor, metal and radiation detectors, and a badging system. Physical protection upgrades to the VVR–M reactor building include building modifications, video monitors, sensors, access control, and a hardened HEU vault. Fresh fuel for all reactors and critical assemblies is stored at the VVR–M facility.[277]

A new computerized MC&A system is in operation and working in "real time." The system tracks the movement of nuclear materials and assists with computerized nuclear material inventory.[278]

268. CNS correspondence with Russian nuclear scientists, October 1999.

269. GAN Reactor List.

270. *Nuclear Engineering International,* March 1998, p. 4.

271. I. A. Baranov et al., "U.S. Department of Energy/Gosatomnadzor of Russia Project at the Petersburg Nuclear Physics Institute, "U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.

272. Ibid.

273. Ibid.; and CNS correspondence with Russian nuclear scientists, October 1999. Other sources have indicated that there is less than 100 kg of HEU at this site.

274. Ibid.

275. U.S. Department of Energy, "Significant Milestones," p. 5.

276. Ibid.

277. Baranov, "U.S. Department of Energy/Gosatomnadzor of Russia Project."

278. Alexander Beltchenko, "'Real Time' Computerized Nuclear Material Accounting System at Petersburg Nuclear Physics Institute," paper presented at the INMM 40th annual meeting, Phoenix, AZ, July 26–29, 1999.

NOTES

- The operational reactor is an HEU-fueled pool-type VVR–M.[279]
- The reactor currently under construction is an HEU-fueled tank-type PIK reactor.[280]
- The critical assembly test unit is a 100 W PIK.[281]

279. GAN Reactor List.
280. *Nuclear Engineering International,* March 1998, p. 4.
281. Baranov, "U.S. Department of Energy/Gosatomnadzor of Russia Project."

SCIENTIFIC RESEARCH INSTITUTE OF ATOMIC REACTORS (NIIAR)

Научно-исследовательский институт атомных реакторов (НИИАР)
Nauchno-issledovatelskiy institut atomnykh reaktorov (NIIAR)
<www.niiar.simbirsk.su>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Dimitrovgrad, Ulyanovsk Region

SITE ACTIVITIES
1. Scientific research on nuclear power reactors, the nuclear fuel cycle, and nuclear safety[282]
2. Production of radioactive isotopes for export[283]
3. Research on the conversion of excess weapons-grade plutonium into MOX fuel[284]

RELEVANT ASSETS
1. Seven operational research reactors[285]
2. One nonoperational research reactor[286]
3. Two critical assemblies[287]
4. MOX fuel-fabrication and experimental reprocessing facilities (Building 180)[288]
5. Central storage facility for fissile materials (Building 132)[289]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[290]

SEPARATED PLUTONIUM Yes. At least 100 kg of plutonium is located on site.[291]

MPC&A TIMELINE Work begun: February 1996[292]
Work completed: Not yet completed.

MPC&A STATUS DOE-funded MPC&A work focused initially on the central storage facility (CSF), the MOX fuel facility, and the BOR–60 fast-reactor facility. These three buildings handle the largest amounts of HEU and plutonium. Building 106, which houses two of the seven reactors, was added to the DOE program in December 1996. In July 1997, NIIAR agreed to include all remaining buildings containing appreciable quantities of HEU or plutonium in the program.[293]

282. Scientific Research Institute of Atomic Reactors (NIIAR) web site: <www.niiar.simbirsk.su>.
283. "Dmitrovgrad Atomic Center 'Dying' Due to Funds Shortage," *Vesti Newscast,* February 4, 1997, in FBIS–SOV–97–023.
284. In May 1999, NIIAR signed a five-year contract with the Japan Nuclear Cycle Development Institute to conduct joint research in this area. "Joint Russian-Japanese Research for Disposition of Excess Plutonium from Nuclear Dismantlement: JNC-Russian Research Institute Contract To Burn about 20 Kg in Fast-breeder Reactor," *Genshiryoku Sangyo Shimbun,* May 27, 1999.
285. Yuri Kharlanov et al., "U.S./Russia Cooperation in Material Protection, Control, and Accounting at the SSC–RIAR, Dimitrovgrad," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
286. Scientific Research Institute of Atomic Reactors web site: <www.niiar.simbirsk.su>.
287. Ibid.
288. Kharlanov et al., "U.S./Russia Cooperation," September 1998.
289. Kharlanov et al., "U.S./Russia Cooperation," September 1998.
290. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment correspondence with DOE officials, July 2000.
291. Kharlanov et al., "U.S./Russia Cooperation," September 1998.
292. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.
293. Kharlanov et al., "U.S./Russia Cooperation," September 1998.

Significant MPC&A upgrades at the CSF were completed in December 1998. These upgrades included modifications to the interior and exterior of the building, the installation of alarms, and the installation of several MC&A technologies, including bar coding, electronic scales, tamper-indicating devices, and computerized accounting. (Before the upgrades, there was no confirmation of nuclear material type or quantity when it was received at the CSF from off site. Receipt of material was confirmed only once it had been moved for use to another NIIAR building on site.) All upgrades at the CSF were scheduled to be completed by the end of FY 2000.[294]

Several additional sitewide MPC&A improvements have been made, including specific improvements at the MOX fuel facility, the BOR–60 fast-reactor facility, and Building 106. Sitewide upgrades include relocation and enhancement of the central alarm station, the installation of vehicle portals, the use of hand-held radiation monitors, and the use of various nuclear-material measurement equipment. Work was also being done on the development of a sitewide computerized MC&A system.[295]

In November 1999, the DOE Material Consolidation and Conversion program signed an agreement with NIIAR to consolidate approximately 250 kg of HEU and downblend it to LEU. The material was scheduled to be downblended by the end of October 2000.[296]

NOTES

- Reactors include the MIR–M1 and SM–3 (100-MW reactors fueled with 90% HEU), the RBT–10/1 (fueled with 50–85% HEU), the RBT–10/2 (fueled with 3% LEU), the RBT–6 (fueled with 63% HEU), the VK–50 (fueled with 1.5–2% LEU), and the BOR–60 (a 12-MW sodium-cooled fast-breeder reactor fueled with 90% HEU or a MOX fuel containing 45–90% HEU).[297]
- There are approximately 50 hot cells at the MOX fuel-fabrication facility. Nuclear materials used in fuel fabrication include HEU and 54–94% Pu_{239}. Approximately 500 kg of plutonium have been reprocessed at the experimental reprocessing facility. Currently, 10% of the nuclear fuel at Dmitrovgrad is reprocessed on site.[298]
- The central storage facility is the central transit point for all nuclear materials at NIIAR. It contains at least 550 kg of HEU and 100 kg of plutonium.[299]

294. Carnegie Endowment discussion with DOE officials, July 2000.

295. Ibid.

296. U.S. Department of Energy MPC&A web site: News Archives, "Material Consolidation and Conversion Update," November/December 1999 News, <www.nn.doe.gov/mpca/index.html>; and Carnegie Endowment staff correspondence with DOE official, July 2000.

297. Kharlanov et al., "U.S./Russia Cooperation," September 1998; and NIIAR web site: <www.niiar.simbirsk.su/eng/expb.htm>.

298. Kharlanov et al., "U.S./Russia Cooperation," September 1998.

299. Kharlanov et al., "U.S./Russia Cooperation," September 1998.

SCIENTIFIC RESEARCH INSTITUTE FOR INSTRUMENTS

Научно-исследовательский институт приборов (НИИП)
Nauchno-issledovatelskiy institut priborov (NIIP)

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Lytkarino, approximately 30 km southeast of Moscow

SITE ACTIVITIES Research and design of radio-electronic instruments used in radioactive environments[300]

RELEVANT ASSETS Five nonoperational pulsed research reactors[301]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[302]

SEPARATED PLUTONIUM No[303]

MPC&A TIMELINE Work begun: July 1997[304]
Work completed: Not yet completed.

MPC&A STATUS Although this site was added to the DOE MPC&A program in July 1997, work did not begin until October 1997, and progress reportedly has been slow.[305] In 1999, as part of DOE's Material Consolidation and Conversion program, a significant quantity of HEU was moved from the Research Institute for Instruments to NPO Luch for storage.[306]

NOTE
- The five research reactors are the TIBR–1M, BARS–2, BARS–3M, BARS–4, and the IRV.[307]

300. From the Lytkarino city web site: "Nauchnyye instituty i organizatsii" (Scientific Institutes and Organizations), <www.istina.inion.ru/lytkarin.htm>.
301. GAN Reactor List; and CNS staff interview with DOE officials, April 1999.
302. CNS staff interview with DOE officials, April 1999.
303. Carnegie Endowment correspondence with DOE official, July 2000.
304. Ibid.
305. CNS staff interview with DOE officials, April 1999.
306. U.S. Department of Energy, "Significant Milestones."
307. GAN Reactor List.

SCIENTIFIC RESEARCH AND DESIGN INSTITUTE OF POWER TECHNOLOGY (NIKIET), MOSCOW BRANCH

Научно-исследовательский и конструкторский институт энергетической технологии (НИКИЭТ)
Nauchno-issledovatelskiy i konstruktorskiy institut energeticheskoy tekhnologii (NIKIET)
<www.entek.ru/>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Moscow

SITE ACTIVITIES[308]

1. Design of nuclear reactors for power generation, naval propulsion, heat production, and research on space applications
2. Scientific research in the areas of reactor materials and reactor physics
3. Development and testing of instruments and control systems for the nuclear power industry

RELEVANT ASSETS

1. One inactive (50 kW) research reactor[309]
2. Three critical assemblies, located on the campus of Bauman University[310]
3. Four subcritical assemblies[311]
4. Fissile-material storage[312]

WEAPONS-USABLE URANIUM Yes. Less than 10 kg of HEU is located on site.

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: February 1996[313]
Work completed: February 1998[314]

MPC&A STATUS DOE-funded physical protection upgrades were made to a new fresh-fuel vault at NIKIET headquarters. Fresh HEU fuel was moved from its previous storage place at Bauman University to the new vault. Upgrades include facility hardening, access control, video monitors, sensors, improved guard communications, alarms, and a central alarm station. Minimal physical protection upgrades were made at the critical assembly facility at Bauman University. MC&A upgrades include tamper-indicating devices and a basic computerized material accounting system.[315]

308. *Nuclear Business Directory,* 1995, pp. 102–104.

309. Mark Baumann, "Moscow Scientific Research and Design Institute of Power Technology," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.

310. Baumann, "Moscow Scientific Research and Design Institute."

311. GAN Reactor List.

312. Baumann, "Moscow Scientific Research and Design Institute."

313. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

314. U.S. Department of Energy MPC&A web site: News Archives, "United States and Russian Commission Nuclear Material Control Systems at Four Sites," February 1998, <www.nn.doe.gov/mpca/index.html>.

315. Baumann, "Moscow Scientific Research and Design Institute."

NOTES

- The research reactor is an IR–50 pool-type reactor.[316]
- There are approximately 3–4 kg of fresh HEU fuel in storage and approximately 1 kg in the critical assemblies.[317]
- NIKIET is one of three Russian organizations placed under U.S. sanctions in January 1999 for "materially contributing to Iran's nuclear weapons and missile programs."[318]
- Before his appointment to the post of minister of atomic energy in March 1998, Yevgeny Adamov was the director of this institute.[319]

316. GAN Reactor List.
317. Baumann, "Moscow Scientific Research and Design Institute."
318. White House press release, "Trade Penalties against Three Russian Entities," statement of the White House press secretary, January 12, 1999.
319. "Yeltsin Appoints Yevgeny Adamov Minister for Atomic Energy," *Interfax*, March 4, 1998.

SCIENTIFIC RESEARCH AND DESIGN INSTITUTE OF POWER TECHNOLOGY (NIKIET), YEKATERINBURG BRANCH

Научно-исследовательский и конструкторский институт энергетической технологии, Екатеринбургский филиал (НИКИЭТ)
Nauchno-issledovatelskiy i konstruktorskiy institut energeticheskoy tekhnologii, Yekaterinburgskiy filial (NIKIET)

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Zarechnyy, 30 km from Yekaterinburg

SITE ACTIVITIES Nuclear reactor design and development[320]

RELEVANT ASSETS
1. One research reactor[321]
2. Three critical assemblies[322]
3. Hot cells[323]
4. Fissile-material storage[324]

WEAPONS-USABLE URANIUM Yes. More than 100 kg of HEU is located on site.[325]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: May 1996[326]
Work completed: May 1998[327]

MPC&A STATUS DOE-funded MPC&A upgrades include improved protection at the fresh- and spent-fuel vault,[328] equipment for nuclear-material measurement, tamper-indicating devices, and hardware and software for computerized nuclear material accounting.[329]

NOTES
- The research reactor is an HEU-fueled IVV–2M pool-type reactor.[330]
- From 1996 to 1998, more than 100 kg of Russian-owned 90% HEU from Kazakhstan's National Nuclear Center on the former Semipalatinsk Nuclear Test Site was shipped to the Yekaterinburg branch of NIKIET. The material will be temporarily stored at this site. [331]

320. "Lead-cooled Fast Reactor Gets Okay from Government," *Nuclear News*, September 1998, pp. 23–24.
321. GAN Reactor List.
322. Ibid.
323. CNS staff interview with Russian nuclear official, August 1997.
324. A. Chebykin, "'Yadernyy poyezd' dlinoyu v dva goda," *Uralskiy rabochiy (Yekaterinburg),* June 16, 1998, p. 2; in *WPS Yadernyye Materialy,* no. 13, July 6, 1998.
325. Ibid.
326. U.S. Department of Energy, "Significant Milestones," p. 5.
327. Ibid.
328. Chebykin, "'Yadernyy poyezd' dlinoyu v dva goda."
329. Michael Haase, et al., "U.S./Russian MPC&A Upgrades at the Beloyarsk Nuclear Power Plant and SF NIKIET," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Production, Control, and Accounting,* December 1997.
330. GAN Reactor List.
331. Chebykin, "'Yadernyy poyezd' dlinoyu v dva goda."

SIBERIAN CHEMICAL COMBINE (SCC)

Сибирский химический комбинат (СХК)
Sibirskiy khimicheskiy kombinat
<www.shk.tsk.ru>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Seversk (formerly known as Tomsk-7), 15 km north of Tomsk

SITE ACTIVITIES The Siberian Chemical Combine is the largest multifunction compound in the Russian nuclear complex. Activities include:
1. Former production of plutonium and HEU for use in nuclear weapons[332]
2. Spent-fuel reprocessing[333]
3. Uranium enrichment[334]
4. HEU oxidation and purification[335]
5. Downblending of HEU to LEU[336]
6. Development of specialty fuels[337]
7. Fissile-material storage[338]

RELEVANT ASSETS
1. Two operational plutonium production reactors[339]
2. Three nonoperational plutonium production reactors, which were permanently shut down between 1990 and 1992[340]
3. Reprocessing plant[341]
4. Uranium enrichment plant. HEU is also downblended to LEU at this plant.[342]
5. HEU oxidation and purification facilities[343]
6. Plutonium-pit fabrication facilities[344]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[345]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[346]

332. Siberian Chemical Combine web site: "Zavody;" <www.shk.tsk.ru>.
333. Ibid.
334. Ibid.
335. *Nuclear Cities News,* vol. 1, December 1999, Center for Energy and Environmental Studies, Princeton University and the Russian-American Nuclear Security Advisory Council (RANSAC), RANSAC web site: <www.ransac.org>.
336. Bukharin, "Security of Fissile Materials in Russia."
337. General Atomics web site: "The Gas Turbine-Modular Helium Reactor," <www.ga.com/gtmhr.html>.
338. Valeriy Menshchikov, "Vokrug situatsii s khraneniyem plutoniya i obogashchennogo urana v Tomske-7," *Yaderniy Kontrol,* February 1995, pp. 2–5.
339. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 138.
340. Ibid.
341. Siberian Chemical Combine web site: "Radiokhimicheskiy zavod," <www.shk.tsk.ru>.
342. Ibid., "Zavod razdeleniya izotopov."
343. Victor Petrushev et al., "U.S./Russian Cooperative Efforts To Enhance Nuclear Material Protection, Control, and Accounting (MPC&A) at the Siberian Chemical Combine in Seversk (Tomsk-7)," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
344. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 141.
345. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment correspondence with DOE officials, July 2000.
346. Ibid.

MPC&A TIMELINE Work begun: 1995[347]
Work completed: Not yet completed.

MPC&A STATUS DOE-funded MPC&A work began with the installation of more than 27 pedestrian portal monitors and metal detectors at principal access control points within the Siberian Chemical Combine (SCC). By mid-2000, a total of 17 vehicle and 31 pedestrian portal monitors had been delivered and installed at this site.[348] Other sitewide improvements include installation of a sitewide communications computer network to link access control at all SCC facilities, an upgraded radio communications system, and delivery of a transport truck with a fissile-material vault for transporting fissile materials between facilities within the SCC.[349]

Of the facilities within the SCC, the reactor plant was the highest priority for MPC&A upgrades. Upgrades have been made both to the 4.5-km perimeter and to the interior of the plant, including the installation of a variety of alarms and sensors.[350] The access control system at this facility was scheduled to be completed in 2000.[351]

The SCC has received an International Science and Technology Center (ISTC) grant to develop a plan for a new MC&A system at the reprocessing plant. The ISTC project was completed by 1997, and the plan has provided the basis for the DOE-funded MC&A upgrades. These include the provision of bar codes and other equipment for nuclear-material measurement and inventory and equipment for computerized nuclear-material accounting. The MC&A system at the radiochemical plant has been identified as the model for MC&A implementation at the remaining SCC facilities. Physical protection upgrades have also been made to the reprocessing plant.

NOTES
- Many tens of tons of HEU and plutonium are stored at this site.
- The SCC is one of two principal storage sites (the other is the Mayak Production Association) for HEU and plutonium recovered from dismantled weapons.[352] Between 1989 and 1992 approximately 23,000 canisters, each containing 1–4 kg of fissile material from disassembled nuclear weapons, were shipped to this site. Each canister contains one of the following: about 1.5 kg of plutonium metal, about 2 kg of plutonium oxide, or 3–4 kg of uranium in metal or oxide form. Shipments ceased in April 1992 owing to a lack of suitable storage space.[353]

347. U.S. Department of Energy, "MPC&A Program Strategic Plan."

348. Carnegie Endowment correspondence with DOE official, July 2000.

349. I. Goloskokov et al., "U.S./Russian Cooperative Efforts in Nuclear Material Protection, Control, and Accounting," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.

350. Ibid.

351. RANSAC web site: <www.ransac.org>.

352. Bukharin, "Security of Fissile Materials in Russia," p. 475.

353. Menshchikov, "Plutonium and Enriched Uranium Storage Tomsk-7," pp. 2–5.

(NOTES)

- The three nonoperational plutonium production reactors are the Ivan-1, Ivan-2, and ADE–3.[354] The two operational plutonium production reactors, the ADE-4 and ADE-5. The SCC is estimated to have produced 70 metric tons of plutonium since it was founded in 1951.[355] As of November 1, 1994, Minatom ceased using plutonium from these reactors in nuclear weapons.[356] Large quantities of spent fuel and other fissile materials are stored at this site.[357]
- Plutonium from the ADE–4 and ADE–5 is reprocessed at the radiochemical plant. Once these reactors cease to produce weapons-grade plutonium, this plant will be shut down.[358]
- Previously, the uranium-enrichment plant produced HEU for use in nuclear weapons. Currently, the plant is licensed to produce up to 5% LEU, which is made into uranium fuel pellets for nuclear power plants.[359]
- HEU from dismantled nuclear weapons is processed and prepared for subsequent downblending to LEU in accordance with the February 1993 U.S.-Russian HEU purchase agreement at the HEU oxidation and purification facilities. Fissile material is also stored here.[360]
- The SCC is one of two Russian facilities at which HEU from dismantled warheads is converted to gaseous uranium hexafluoride. This is one of three facilities where it is then blended down to approximately 4% LEU in accordance with the February 1993 U.S.-Russian HEU agreement.[361]
- MOX fuel is being developed at this site using weapons-grade plutonium for use in a gas-turbine modular helium reactor. This reactor, which is being designed by Russian, U.S., French, and Japanese experts, will replace the energy generated by the ADE–4 and ADE–5 reactors once these reactors have reached the end of their service life.[362]

354. Ibid.
355. Alexander Bolsunovskiy and Valeriy Menshchikov, "Nuclear Security Is Inadequate and Outdated," *Moskovskiye novosti,* 12/9–15/94, p. 14.
356. Gore-Chernomyrdin Commission, "Agreement concerning the Shutdown of Plutonium Production Reactors and Cessation of Use of Newly Produced Plutonium for Nuclear Weapons," June 23, 1994.
357. Petrushev et al., "U.S./Russian Cooperative Efforts."
358. RANSAC, "The Nuclear Weapons Complexes: Meeting the Conversion Challenge—A Proposal for Expanded Action," September 1997, p. 8, web site: <www.ransac.org>.
359. Cochran, Norris, and Bukharin, *Making the Russian Bomb,* p. 187.
360. Petrushev et al., "U.S./Russian Cooperative Efforts."
361. HEU is also converted to uranium hexafluoride at the Electrochemical Plant in Zelenogorsk (Krasnoyrask-45). HEU is also downblended at both the Electrochemical Plant and the Urals Electrochemical Integrated Plant in Novouralsk (Sverdlovsk-44). CNS staff discussion with Oleg Bukharin, May 2000. (See chapter 3 for a discussion of the U.S.-Russian HEU Agreement.)
362. General Atomics web site: "The Gas Turbine-Modular Helium Reactor," <www.ga.com/gtmhr.html>.

START PRODUCTION ASSOCIATION

Производственное объединение «Старт»
Proizvodstvennoye obyedineniye "Start"

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Zarechnyy (formerly known as Penza-19), approximately 12 km east of Penza

ACTIVITIES Nuclear warhead assembly and dismantlement[363]

RELEVANT ASSETS Nuclear warhead production and dismantlement facility

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[364]

SEPARATED PLUTONIUM Yes. More than 1,000 kg of plutonium is located on site.[365]

MPC&A TIMELINE Work begun: Not yet begun.
Work completed: Not yet completed.

MPC&A STATUS DOE was scheduled to begin MPC&A upgrades at the Start Production Association and other nuclear warhead production facilities in 1998. Although some portal monitors and other equipment upgrades have been sent to these facilities, U.S. experts have not been given direct access to any of these sites. In 1999, DOE established a policy that no work would proceed at these sensitive sites until the issue of appropriate access was resolved.[366] DOE officials continue their discussions with Minatom on gaining appropriate access to this site in order to provide adequate oversight for MPC&A cooperation.

NOTES

- The Ministry of Atomic Energy announced that it would discontinue the assembly of nuclear ammunition at this plant by the end of the year 2000. Warhead dismantlement will be completed at this site by the end of the year 2003.[367]

363. A. Bolsunovskiy and V. Menshchikov, "Perechen predpriyatiy, kotoryye dolzhny byt pervymi v spiske na vnedreniye sovremennykh sistem ucheta, kontrolya i fizicheskoy zashchity yadernykh materialov," *Yadernyy kontrol,* September 1995, p. 18.

364. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment correspondence with DOE officials, July 2000.

365. Ibid.

366. Bukharin, Bunn, and Luongo, "Renewing the Partnership," p. 71.

367. "Nuclear Weapons Plants To Be Wound Down," *ITAR-TASS*, February 9, 1999.

TOMSK POLYTECHNICAL UNIVERSITY

Томский политехнический университет
Tomskiy politekhnicheskiy universitet
<www.phtd.tpu.edu.ru:8101>

SUPERVISING AGENCY Ministry of Education[368]

LOCATION Tomsk

SITE ACTIVITIES Educational institution specializing in physics and nuclear research.[369]

RELEVANT ASSETS
1. One research reactor[370]
2. Fresh-fuel storage vault[371]

WEAPONS-USABLE URANIUM Yes. Less than 100 kg of HEU is located on site.[372]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: April 1996[373]
Work completed: July 1998[374]

MPC&A STATUS DOE-funded physical protection upgrades to the reactor building, where both the reactor and the fresh-fuel storage vault are located, included bricking up windows, replacing doors, hardening the roof, and the installation of an electronic access control system, a central alarm station, video cameras, and sensors. MC&A assistance included the provision of a tamper-indicating device system, a non-destructive assay system, a special nuclear-material portal monitor, and hand-held monitors.[375]

NOTES
- The research reactor is an IRT–T tank-type reactor.[376]

368. Correspondence with Russian nuclear scientists, October 1999.

369. William Toth and Yuri Usov, "Nuclear Material Protection, Control, and Accounting at the Tomsk Polytechnical University IRT–T Research Reactor," U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.

370. Ibid.

371. U.S. Department of Energy MPC&A web site: News Archives, "Nuclear Security and Material Control System Installed at Tomsk Polytechnical University," August 1998, <www.nn.doe.gov/mpca/index.html>.

372. CNS staff correspondence with Russian nuclear scientists, October 1999.

373. U.S. Department of Energy, "Significant Milestones," p. 5.

374. Ibid.

375. U.S. Department of Energy MPC&A web site: News Archives, "Nuclear Security and Material Control System Installed at Tomsk Polytechnical University," August 1998, <www.nn.doe.gov/mpca/index.html>.

376. Toth and Usov, "Nuclear Material."

URALS ELECTROCHEMICAL INTEGRATED PLANT (UEIP)

Уральский электрохимический объединенный завод
Uralskiy elektrokhimicheskiy obyedinennyy zavod
<www.ricon.e-burg.ru>

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Novouralsk (formerly Sverdlovsk-44), approximately 50 km northwest of Yekaterinburg

SITE ACTIVITIES[377]
1. Uranium enrichment
2. Development of centrifuge technology
3. HEU downblending

RELEVANT ASSETS
1. Gas centrifuge enrichment plant[378]
2. HEU downblending facilities[379]
3. HEU storage vaults

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located on site.[380]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: January 1996[381]
Work completed: Not yet completed.

MPC&A STATUS Although this site was added to the DOE MPC&A program in January 1996, work did not get under way until September 1997.[382] MPC&A upgrades include enhanced radio communications; video surveillance along the perimeter of the site and at buildings that store or process HEU; an access control system with portal monitors, metal detectors, and x-ray machines; equipment for nuclear material measurement; and hardware for computerized accounting. (The Urals plant is developing its own accounting software without DOE assistance.)[383]

VNIITF is currently acting as the general contractor for MPC&A upgrades at this site.[384]

NOTES
- The Urals Electrochemical Integrated Plant is the largest uranium enrichment plant in Russia.[385]

377. "Uralskiy Elektrokhimicheskiy: Krupnyy Plan," *Atompressa* 16(252), April 1997, p. 2–3; and Center for Nonproliferation Studies, NIS Nuclear Profiles Database, *Russia: Fissile Material: Uranium Enrichment,* "Urals Electrochemical Combine."

378. Ibid.

379. Pyotr Kirillov et al., "Material Protection, Control, and Accounting Cooperation at the Urals Electrochemical Integrated Plant (UEIP), Novouralsk, Russia," U.S. Department of Energy, *Partnership for Nuclear Material Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.

380. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16; and Carnegie Endowment staff discussions with U.S. officials, April 2000.

381. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

382. Scott MacAllister et al., "Material Protection, Control, and Accounting Activities at the Electrochemical Plant," U.S. Department of Energy, *Partnership for Nuclear Security*, December 1997.

383. Kirillov et al., "Material Protection."

384. Tsygankov, "Progress and Future Plans for MPC&A at Chelyabinsk-70."

385. U.S. Department of Energy Fact Sheet, "Update on MPC&A Developments since June 1996," April 1997.

(NOTES)

- This plant is the only Russian facility licensed to produce HEU enriched to 30%. However, it currently produces only LEU for nuclear reactor fuel.[386]
- HEU production for use in nuclear weapons ceased at the site in 1989.[387]
- This is one of three Russian facilities at which HEU from dismantled warheads is blended down to approximately 4% LEU in accordance with the February 1993 U.S.-Russian HEU agreement. Until 1998, HEU oxide was converted to gaseous uranium hexafluoride at this site before downblending.[388]

386. UEIP web site: <www.ricon.e-burg.ru>.
387. "Uralskiy Elektrokhimicheskiy Krupnyy Plan," *Atompressa* 5, April 1997, pp. 2–3; UEIP web site: <www.ricon.e-burg.ru>.
388. Currently HEU is converted to uranium hexafluoride at the Electrochemical Plant in Zelenogorsk (Krasnoyarsk-45) and at the Siberian Chemical Combine in Seversk (Tomsk-7). HEU is also downblended at both facilities. CNS staff discussion with Oleg Bukharin, May 2000. Please see chapter 3 for a discussion of the U.S.-Russian HEU agreement.

TABLE 4.2: RUSSIAN NAVAL FACILITIES, NORTHERN FLEET

ARA BAY NAVAL BASE (ARA GUBA)

SUPERVISING AGENCY	Ministry of Defense
LOCATION	Vidyayevo, approximately 48 km north and northwest of Murmansk, 16 km east of Zapadnaya Litsa, Murmansk Oblast[1]
SITE ACTIVITIES	1. Operational naval base serving nuclear submarines 2. Decommissioned nuclear submarine storage
RELEVANT ASSETS	1. One Sierra I–class SSN, one Sierra II–class SSN, three Oscar II–class SSGNs, and fewer than seven Victor III–class SSNs[2] 2. Fourteen decommissioned submarines, with fuel still on board[3] 3. Liquid (and possibly solid) radioactive-waste storage facilities[4]
WEAPONS-USABLE URANIUM	Yes. An unknown amount of HEU is located in fuel on active duty and decommissioned submarines.
SEPARATED PLUTONIUM	No
MPC&A STATUS	At present, this site is not receiving any MPC&A assistance from the Department of Energy (DOE). Nuclear fuel in a submarine reactor is considered self-protecting once the reactor is operational because of the difficulty of opening a sealed submarine reactor, especially on a vessel in active military service. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.
NOTES	• This site was previously the home base for four Oscar II–class SSGNs, including the submarine *Kursk,* which sank on August 12, 2000.

1. Joshua Handler, "The Russian Naval Nuclear Complex," in *The Nuclear Legacy of the Former Soviet Union: Implications for Security and Ecology,* Gerd Busmann, Oliver Meier, and Otfried Nassauer, eds., BITS Research Report 97.1, November 1997, p. 24.
2. *Jane's Fighting Ships 1999/2000* (Coulsdon, Surrey, U.K.; Alexandria, Va.: Jane's Information Group, 1999), pp. 558–571; "Intervyu so spasshimsya matrosom 'Kurska'," *Kommersant*, 19 August 2000, <www.online.ru/rproducts/commersant-daily-month/19-Aug-2000/17374243.DOC.rhtml>.
3. Thomas Nilsen, Igor Kudrik, and Alexandr Nikitin, "Radioactive Waste at Naval Bases," *The Russian Northern Fleet,* Bellona Foundation, August 1996, online edition: <www.bellona.no/imaker?sub=1&id=11088>.
4. Ibid.

ATOMFLOT

SUPERVISING AGENCY Ministry of Transportation. Atomflot is operated by the Murmansk Shipping Company, which is largely owned by Lukoil.[5]

LOCATION Two kilometers north of Murmansk, Murmansk Oblast

SITE ACTIVITIES
1. Operational nuclear-powered icebreaker base
2. Management, repair, and refueling of nuclear icebreaker fleet and one nuclear transport vessel
3. Radioactive-waste processing and storage

RELEVANT ASSETS
1. Six nuclear-powered icebreakers[6]
2. Five service ships (the *Lepse, Lotta, Imandra, Volodarskiy,* and *Serebryanka*), used for storing fresh fuel, spent fuel, and liquid and solid radioactive waste
3. Liquid and solid radioactive-waste processing facilities[7]

WEAPONS-USABLE URANIUM Yes. More than 500 kg of HEU is located on the service ship *Imandra* and in the reactors of active icebreakers.[8]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: July 1996[9]
Work completed: September 1999[10]

MPC&A STATUS Atomflot has a 2-km perimeter, which is guarded by navy patrol boats along the water (northern and western perimeters) and Ministry of Interior (MVD) soldiers on land. A double fence with intrusion-detection systems and staffed guard towers protect the eastern perimeter. The southern perimeter includes an administration building and fencing with intrusion-detection systems.[11]

Fresh fuel for Atomflot arrives from the Elektrostal Machine Building Plant by rail and is immediately stored in two compartments in the hull of the service ship *Imandra*. DOE MPC&A assistance at Atomflot focused on the fresh-fuel storage on the *Imandra*. MPC&A enhancements include access-control systems, intrusion-detection systems with alarm control display, computerized material accounting, video assessment systems, and radio

5. Thomas Nilsen, “Lukoil Goes Nuclear,” Bellona Foundation web site: <www.bellona.no/e/>, December 1, 1998.
6. “Putin vyskazyvayetsya za razrabotku gosudarstvennoy sudokhodnoy politiki,” *Interfax,* April 5, 2000.
7. “Pererabotka zhidkikh RAO: Yest realnyye peremeny,” *Polyarnaya zvezda,* January 17, 1996, p. 2.
8. MIIS Center for Nonproliferation Studies (CNS) NIS Nuclear Profiles (NISNP) Database, Naval Nuclear Reactors section, correspondence with Russian nuclear scientist, October 14, 1999.
9. Michael O’Brien et al., “MPC&A Activities with Russian Icebreaker Fleet,” in U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1997.
10. Statements by DOE officials, “Assessing U.S. Dismantlement and Nonproliferation Assistance Programs in the Newly Independent States,” Monterey, Calif., December 11–13, 1999.
11. O’Brien et al., “MPC&A Activities with Russian Icebreaker Fleet.”

communications. In addition, *Imandra*'s physical protection systems were integrated with those of the port.[12] A Russian firm served as the general contractor for the DOE-funded upgrades, working with the Kurchatov Institute and the Murmansk Shipping Company.

NOTES

- According to Russian officials, fuel stored at this site has an enrichment level of between 36 and 92% U_{235}.[13]
- Sweden and Norway have provided assistance to protect the icebreaker fleet, service ships, and nuclear materials at this site against sabotage.[14]

12. Anatoly Gorshkovsky et al., "MPC&A Activities with Russian Icebreaker Fleet," in U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
13. CNS staff interview with Russian nuclear official, August 1997.
14. O'Brien et al., "MPC&A Site Activities with Russian Icebreaker Fleet."

GADZHIYEVO NAVAL BASE

also known as Yagelnaya, Skalistyy, and Murmansk-130[15]

SUPERVISING AGENCY Ministry of Defense

LOCATION Gadzhiyevo, Sayda Bay, Murmansk Oblast

SITE ACTIVITIES
1. Operational naval base serving nuclear submarines
2. Nuclear submarine defueling
3. Temporary decommissioned nuclear submarine storage[16]

RELEVANT ASSETS
1. One Delta III–class SSBN, seven Delta IV–class SSBNs, and three Akula-class SSNs[17]
2. Up to 15 nonoperational and decommissioned submarines in Sayda Bay[18]
3. Defueling facility
4. Liquid and solid radioactive-waste storage facility[19]

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located in fuel on active-duty submarines, on decommissioned submarines, and in spent fuel.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE. Nuclear fuel in a submarine reactor is considered self-protecting once the reactor is operational because of the difficulty of opening a sealed submarine reactor, especially on a vessel in active military service. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

Security at the Gadzhiyevo Naval Base has been problematic. There have been several criminal incidents at this site. On September 11, 1998, a 19-year-old Russian sailor serving on the *Vepr* attack submarine (Akula class), which was docked at Gadzhiyevo, killed eight crew members and died in an attempt to blow up the submarine.[20] The *Vepr* had been docked next to another Akula-class SSN, the *Leopard*. Although one person should have been guarding each submarine, personnel shortages caused the naval command to post only one guard at a time on the dock between the submarines.[21] In a

15. Geir Honneland and Anne-Kristen Jorgensen, "Cross-Border Perspectives on a North Russian Gateway," *Post-Soviet Georgraphy and Economics* 40(1) (1999): 44–61.
16. Nilsen, Kudrik, and Nikitin, "Radioactive Waste at Naval Bases."
17. Sergei Shokut, "Reconnoitering Has Been Conducted in the Northern Fleet, but Supreme High Commander Vladimir Putin Still Doesn't Have a Finished Military Reform Program," *Nezavisimoye voyennoye obozreniye,* April 14, 2000, in "Sokut: Despite Putin's Early April Visit to the Northern Fleet . . ." FBIS Document CEP20000418000290; and *Jane's Fighting Ships 1999/2000,* pp. 558–571.
18. Kvaerner Maritime, "Status and Review of the Master Plan for Disposal of Russian Nuclear Submarines," June 1, 1999.
19. Nilsen, Kudrik, and Nikitin, "Radioactive Waste at Naval Bases."
20. Mikhail Osokin, *Segodnya* newscast, NTV, September 11, 1998, *Television Program Summary,* FBIS document FTS19980913000320; *Interfax,* September 12, 1998; "Defense Ministry Reports Suicide of Submarine Sailor," FBIS Document FTS19980912000053; *ITAR–TASS*, September 12, 1998, "Northern Fleet Confirms Sailor Committed Suicide," FBIS Document FTS19980912000290; "Russian Conscript Kills Eight on Atom Sub," *New York Times,* September 12, 1998, p. 6.
21. Vyacheslav Gudkov, "Vyklyuchite muziku i prigotovtes k smerti," *Kommersant* online edition, June 5, 1999.

more recent incident, Gadzhiyevo sailors, warrant officers, and commanding officers were arrested for stealing and selling the silver from the submarine's silver-zinc torpedo batteries.[22]

NOTES
- Gadzhiyevo is the Northern Fleet's largest SSBN base.
- The defueling infrastructure at this site could indicate the existence of interim spent-fuel storage.

22. Vyacheslav Gudkov, "Moryaki razvorovali boyevyye torpedy," *Kommersant* online edition, April 23, 1999.

GREMIKHA NAVAL BASE

also known as Yokanga

SUPERVISING AGENCY Ministry of Defense[23]

LOCATION Near Ostrovnoy (Murmansk-140), approximately 300 km east of Murmansk, Murmansk Oblast[24]

SITE ACTIVITIES
1. Former naval base
2. Nuclear submarine defueling
3. Decommissioned nuclear submarine storage

RELEVANT ASSETS
1. Submarine defueling facility
2. Seventeen to 21 decommissioned submarines
3. Spent-fuel storage facility with 795 spent-fuel assemblies in storage
4. Six spent-fuel reactor cores from submarines with liquid metal-cooled reactors
5. Liquid and solid radioactive-waste facility

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located in low-irradiated and spent fuel on decommissioned submarines and on site in spent-fuel assemblies.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

Security at the Gremikha Naval Base has been problematic. In August 1999, two ax-wielding sailors attacked a sentry guarding a radioactive-waste storage facility and stole his assault rifle. They went on a shooting spree that resulted in the deaths of five men, including the two sailors.[25]

NOTES
- There were four November-, one Hotel-, three Delta-, and 13 Victor-class submarines at Gremikha as of June 1, 1999,[26] all of which have been decommissioned.
- Active submarines have not been stationed here since April 1997.[27] This base previously served Alfa-class SSNs and Oscar-class SSGNs.

23. Supervision of this site is being transferred to a new federal enterprise under the control of the Ministry of Atomic Energy, under Government Directive 220-r, "O peredache Minatomu Rossii radiatsionno-opasnykh obyektov Minoborony Rossii i poryadke ikh funktsionirovaniya," February 9, 2000, *Legislation in Russia,* <law.optima.ru>.
24. Honneland and Jorgensen, "Cross-Border Perspectives."
25. Aleksandr Alf, "Soldaty 'dyryavyat' yadernyy shchit," *Nezavisimaya gazeta* online edition: <home.mosinfo.ru/news/ng>, August 7, 1999.
26. Kvaerner Maritime, "Status and Review."
27. Joshua Handler, "Russia Seeks To Refloat a Decaying Fleet: The Future of the Northern Fleet's Nuclear Submarines," *Strategic Digest,* April 1997, p. 423.

NERPA SHIPYARD

SUPERVISING AGENCY Russian Shipbuilding Agency[28]

LOCATION Snezhnogorsk (formerly Murmansk-60), Olenya Bay, Murmansk Oblast[29]

SITE ACTIVITIES
1. Submarine repair, maintenance, and defueling[30]
2. START-designated submarine dismantlement facility[31]

RELEVANT ASSETS
1. One dry dock and one floating dock for defueling and preparing submarines for fresh fuel
2. Equipment for transferring spent fuel to Malina-class service ships
3. A Malina-class PM–12 fuel-transfer ship operates at this base
4. Solid radioactive-waste storage facilities (full)[32]
5. Interim storage of decommissioned and dismantled submarines

WEAPONS-USABLE URANIUM Yes. Approximately 1,000 kg of HEU is located on the PM–12 fuel-transfer ship.[33]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: 1998[34]
Work completed: May 2000 (estimated)[35]

MPC&A STATUS Through the mid-1990s, security at Nerpa Shipyard was problematic. There were multiple reported breaches at the site's perimeter fencing, there was a lack of surveillance around the entire perimeter, the entrances were easily reached, and the site's rudimentary alarm system could easily be deactivated.[36]

A December 12, 1997, protocol signed by the DOE and the Russian navy added the PM–12 fuel-transfer ship at this site to the DOE MPC&A program.[37] MPC&A upgrades include the installation of improved radio communications, a guard force aboard the ship, and improved security in the storage area, including the use of camera surveillance and alarm systems.

NOTES
- The PM–12 ship also operates from the Olenya Bay Naval Base.
- The defueling infrastructure at this site could indicate the existence of interim spent-fuel storage.

28. The Russian Shipbuilding Agency was created by Presidential Edict No. 651 of May 25, 1999. It absorbed some of the functions formerly performed by the Ministry of the Economy and is now in charge of the shipyards formerly under the Ministry of the Economy, Government Decree No. 665, *O Kommissii Pravitelstva Rossiyskoy Federatsii po voyenno-promyshlennym voprosam,* June 22, 1999.
29. Honneland and Jorgensen, "Cross-Border Perspectives."
30. Thomas Nilsen, Igor Kudrik and Aleksandr Nikitin, "Bellona Report 1: The Russian Northern Fleet," Bellona Foundation, August 28, 1996, section 5.5.
31. Evy Ann Midttun, "The Murmansk Corridor," *International Affairs* 43(4) (1997): 84.
32. Nilsen, Kudrik and Nikitin, "Bellona Report 1."
33. Comments from MPC&A task force personnel, January 2000.
34. U.S. Department of Energy, "MPC&A Program Strategic Plan," Office of Nonproliferation and National Security, January 1998, p. 16.
35. Comments from MPC&A task force personnel, January 2000.
36. Mikhail Kulik, *Yadernyy kontrol,* no. 2, February 1995.
37. U.S. Department of Energy, "MPC&A Program Strategic Plan."

NORTHERN MACHINE BUILDING ENTERPRISE

also known as Sevmash, the Production Association (PO) Sever, or PO Sevmashpredpriyatiye

SUPERVISING AGENCY Russian Shipbuilding Agency

LOCATION Severodvinsk, Arkhangelsk Oblast

SITE ACTIVITIES
1. Construction of submarines and other naval vessels
2. START-designated submarine dismantlement facility

RELEVANT ASSETS
1. Shipbuilding infrastructure
2. One critical assembly
3. Fresh-fuel storage facility
4. Spent-fuel storage facility
5. Interim storage of decommissioned and dismantled submarines
6. A Malina-class PM–63 service ship (with a capacity of 1,000 fresh-fuel assemblies) operates from this site.

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of spent fuel is located on site and on the PM–63 service ship.[38]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: 1998[39]
Work completed: May 2000

MPC&A STATUS A December 12, 1997, protocol, signed by both the Russian navy and the U.S. Department of Energy, added the Sevmash shipyard and the PM–63 fresh-fuel storage ship to the DOE MPC&A program.[40] MPC&A upgrades to the PM–63 fresh-fuel storage were completed in September 1999, while improvements for spent-fuel storage were completed by May 2000. Initial upgrades for Sevmash fresh-fuel storage were completed in December 1999.[41]

38. Ibid.
39. Ibid.
40. Ibid.
41. Comments from MPC&A task force personnel, January 2000.

OLENYA BAY NAVAL BASE (OLENYA GUBA)[42]

SUPERVISING AGENCY Ministry of Defense

LOCATION Olenya (Olenya Bay is 3–4 km south of Sayda Bay, and the bay's entrance is 3 km northwest of Polyarnyy), Murmansk Oblast[43]

SITE ACTIVITIES Operational naval base serving nuclear submarines and a PM–12 service ship

RELEVANT ASSETS

1. Up to three decommissioned submarines (two Delta-class submarines and one Echo II)
2. Three Project 1910 Uniform-class mini-submarines[44]
3. A Malina-class PM–12 fuel-transfer ship operates from this base.[45]
4. One Yankee stretch submarine and one converted Yankee-class submarine now used for underwater research
5. Two Paltus-class nuclear submarines used for research

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located in active duty submarines and in fresh and spent fuel on the PM–12 service ship.[46]

SEPARATED PLUTONIUM No

MPC&A STATUS The PM–12 fuel-transfer ship also operates at the Nerpa Shipyard in Snezhnogorsk. This ship was added to the DOE MPC&A program in December 1997. (See entry for Nerpa Shipyard for more details on the MPC&A status of this ship.)

NOTES

- The Yankee stretch submarine is the mother ship to the two Paltus-class submarines.

42. Honneland and Jorgensen, "Cross-Border Perspectives."
43. Handler, "The Russian Naval Nuclear Complex," p. 24.
44. *Jane's Fighting Ships 1999/2000,* pp. 558–571.
45. Joshua Handler, "The Northern Fleet's Nuclear Submarine Bases," *Jane's Intelligence Review,* December 1993, pp. 554–555.
46. U.S. Department of Energy, "MPC&A Program Strategic Plan."

PALA BAY SUBMARINE REPAIR FACILITY (PALA GUBA)

SUPERVISING AGENCY Ministry of Defense Location Polyarnyy, Murmansk Oblast

SITE ACTIVITIES Nuclear submarine repair

RELEVANT ASSETS
1. Two covered floating dry docks capable of docking and repairing nuclear-powered attack submarines[47]
2. Radioactive-waste storage facility
3. Seven decommissioned submarines[48]

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located on board docked submarines.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE.

47. Handler, "The Northern Fleet's Nuclear Submarine Bases."

48. Kvaerner Maritime, "Status and Review."

SEVEROMORSK NAVAL BASE

SUPERVISING AGENCY	Ministry of Defense
LOCATION	Severomorsk, Murmansk Oblast
SITE ACTIVITIES	Operational naval base serving three nuclear-powered battle cruisers
RELEVANT ASSETS	1. Site 49, the largest fresh-naval-fuel storage facility in Russia 2. Three nuclear-powered battle cruisers: the *Admiral Ushakov,* the *Admiral Nakhimov,* and the *Pyotr Velikiy*[49]
WEAPONS-USABLE URANIUM	Yes. More than 1,000 kg of fresh and spent fuel is located at Site 49; and fresh fuel on board battle cruisers.[50]
SEPARATED PLUTONIUM	No
MPC&A TIMELINE	Work begun: 1996[51] Work completed: September 1999
MPC&A STATUS	DOE-funded MPC&A upgrades to the Site 49 fresh-fuel storage facility include construction of annexes to the previously existing storage location, providing increased delay and detection at the outer boundary of the facility, improved voice and alarm communication, increased material capacity, material-accountability upgrades, and enhanced perimeter detection.[52] All fresh nuclear fuel for the Northern Fleet is now being consolidated at this facility.
NOTES	• This is the Northern Fleet's main administrative base.

49. The *Ushakov* and *Nakhimov* were at Zvezdochka, in Severodvinsk, for repairs as of fall 1999.

50. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.

51. Ibid.

52. U.S. Department of Energy, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting;* and comments from MPC&A task force personnel, January 2000.

SEVMORPUT NAVAL SHIPYARD NO. 35

also known as No. 3–30, and military unit 31326[53]

SUPERVISING AGENCY Ministry of Defense[54]

LOCATION Rosta district of Murmansk, Murmansk Oblast

SITE ACTIVITIES
1. First-generation nuclear submarine[55] and conventional submarine repairs[56]
2. Decommissioned nuclear submarine storage
3. Formerly, nuclear submarine refueling

RELEVANT ASSETS Two decommissioned nuclear submarines: one Hotel-class with fuel and one Echo II-class without fuel

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is in low-irradiated and spent fuel on decommissioned submarines.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

4.5 kg of 20% enriched HEU from three fuel assemblies was stolen from this site in November 1993. Following the theft, all fresh fuel stored here was moved to Site 49 in Severomorsk.[57]

NOTES
- This site used to store fresh-fuel assemblies for the entire Northern Fleet.[58] All fresh fuel from Sevmorput has been consolidated to Site 49 in Severomorsk as part of the MPC&A consolidation cooperation between DOE and the Russian navy.
- Before 1991, nuclear submarine refueling was performed here. In 1991, safety concerns caused Murmansk Oblast officials to halt refueling activities at Sevmorput, which is located close to populated areas of the city of Murmansk.
- The Hotel-class and Echo II–class submarines have been located at Sevmorput since 1995.[59]

53. Nilsen, Kudrik, and Nikitin, "Radioactive Waste at Naval Bases."
54. Igor Kudrik, "Naval Repair Yards in the North-west of Russia," *Current Status* online edition: <www.bellona.no/e/>, March 30, 1998.
55. Nilsen, Kudrik, and Nikitin, "Naval Bases."
56. Handler, "The Russian Naval Nuclear Complex," p. 24.
57. Nilsen, Kudrik, and Nikitin, "Radioactive Waste at Naval Bases"; and CNS staff interview with U.S. administration official, December 18, 1995.
58. Brooks Tigner, "Report Cites Russian Waste Risk," *Defense News,* 21 November 1994, p. 10; "Nuclear Wastes in the Arctic: An Analysis of Arctic and Other Regional Impacts from Soviet Nuclear Contamination," OTA–ENV–623, Washington, D.C.: U.S. Government Printing Office, September 1995, p. 121.
59. Kudrik, "Naval Repair Yards in the North-west of Russia."

SHKVAL NAVAL YARD NO. 10

also known as Shipyard No.10

SUPERVISING AGENCY Ministry of Defense[60]

LOCATION Near the town of Polyarnyy, Murmansk Oblast

SITE ACTIVITIES
1. Nuclear submarine repair
2. Nuclear submarine refueling
3. Decommissioned nuclear submarine storage

RELEVANT ASSETS
1. Two covered floating docks
2. Submarine refueling facility[61]
3. Naval-waste storage facility and two ships that store and transport liquid radioactive-waste from the yard: the Pinega-class *Amur* and the Vala-class TNT–12.[62]
4. Four decommissioned submarines and two operational but inactive submarines[63]

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is in low-irradiated and spent fuel in decommissioned submarines.

SEPARATED PLUTONIUM No

MPC&A STATUS DOE is considering conducting MPC&A upgrades at Shkval.[64]

NOTES
- This is the only shipyard in Murmansk Oblast capable of servicing second- and third-generation submarines.[65]
- The refueling infrastructure at this site could indicate the existence of interim spent-fuel storage.

60. Ibid.
61. Nilsen, Kudrik, and Nikitin, "Radioactive Waste at Naval Bases."
62. OTA report, "Nuclear Wastes in the Arctic," 1995.
63. Nilsen, Kudrik, and Nikitin, "Radioactive Waste at Naval Bases."
64. Comments from MPC&A task force personnel, January 2000.
65. Nilsen, Kudrik, and Nikitin, "Radioactive Waste at Naval Bases."

ZAPADNAYA LITSA NAVAL BASE

with four naval facilities: Bolshaya Lopatka, Malaya Lopatka, Nerpichya, and Andreyeva Bay

SUPERVISING AGENCY Ministry of Defense[66]

LOCATION Zaozersk, Murmansk Oblast, on Litsa Bay, about 45 km from the Norwegian border[67]

SITE ACTIVITIES
1. Operational naval base serving nuclear submarines
2. Nuclear submarine refueling

RELEVANT ASSETS
1. Four Typhoon-class SSBNs (one of which is being repaired), one Sierra II–class SSN, and fewer than seven Victor III–class SSNs[68]
2. Nuclear submarine refueling facilities[69]
3. Former fresh-fuel storage facility (at Andreyeva Bay)
4. Spent-fuel storage facility (at Andreyeva Bay)
5. An inactive river freighter storing an unknown quantity of spent fuel
6. Radioactive-waste storage facility

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located in fuel on active duty submarines and in spent fuel.

SEPARATED PLUTONIUM No

MPC&A STATUS DOE and the Russian navy are discussing upgrading MPC&A at the spent-fuel storage facility at this site.[70]

In 1993, 1.8 kg of 36% enriched uranium in two fresh-fuel rods was stolen from this facility.[71]

NOTES
- All fresh fuel from this site was consolidated to Site 49 in Severomorsk as of December 25, 1999.
- The spent-fuel storage facility at Andreyeva Bay contains more than 23,000 spent-fuel assemblies (equivalent to at least 90 nuclear reactors). This facility, also known as Installation 928–III, is filled to capacity, and new deliveries of spent fuel are

66. Supervision of this site is being transferred to a new federal enterprise under the control of the Ministry of Atomic Energy, under Government Directive No. 220-r, “O peredache Minatomu Rossii radiatsionno-opasnykh obyektov Minoborony Rossii i poryadke ikh funktsionirovaniya,” February 9, 2000, *Legislation in Russia,* <law.optima.ru>.
67. Handler, “The Northern Fleet’s Nuclear Submarine Bases”; Nilsen, Kudrik, and Nikitin, “Bellona Report 1.”
68. *Jane’s Fighting Ships 1999/2000,* pp. 558–571.
69. Nilsen, Kudrik, and Nikitin, “Bellona Report 1”; “Nuclear Wastes in the Arctic.”
70. Comments from MPC&A task force personnel, January 2000.
71. William C. Potter, “Before the Deluge? Assessing the Threat of Nuclear Leakage from the Post-Soviet States,” *Arms Control Today,* October 1995, p. 9.

stored unprotected out in the open.[72] It is the largest spent-fuel storage site for the Northern Fleet.[73]

- Radioactive waste is stored in special containers in a concrete bunker.
- The three Typhoon-class SSBNs not being repaired are expected to be decommissioned when it comes time to refuel them.[74]

72. This storage facility, built in the 1960s, is in need of modernization. Reportedly, the spent-fuel rods are stored in three concrete containers, which have been filled to capacity since early 1990. New deliveries of containers of spent nuclear fuel are stored out in the open and unprotected as a result of the termination of spent-fuel transportation to Mayak in 1997. In addition, TK–11 and TK–18 containers, storing 35 spent-fuel rods each, are located on the grounds of the facility and may potentially develop cracks and leak radioactivity. As of 1996, 32 such containers, which had been stored in the open, were leaking radioactivity into the sea and possibly into a small river. In February 1998, the Ministry of Defense allocated 3 million rubles for reconstruction of a radioactive-waste storage site and a spent nuclear fuel storage site at Andreyeva Bay. "Gosudarstvenniye tayny Rossii neizvestny tolko rossiyanam," *Segodnya,* February 17, 1996, p. 2; Thomas Nilsen, "Bellona Fact Sheet No. 87: Nuclear Waste Storage in Andreeva Bay," The Bellona Foundation, online edition: <www.bellona.no/e/fakta/fakta87.htm>, October 10, 1997; Kay van der Horst, "Pitfalls of Operational Arms Control and Environmental Security," *The Nuclear Legacy of the Former Soviet Union: Implications for Security and Ecology,* edited by Gerd Busmann, Oliver Meier, and Otfried Nassauer, BITS Research Report 97.1, November 1997, p. 14; "V Andreyevoy gube zhivut nadezhdoy," *Krasnaya zvezda,* February 24, 1998, p. 3.
73. Handler, "The Northern Fleet's Nuclear Submarine Bases."
74. *Jane's Fighting Ships 1999/2000,* pp. 558–571.

ZVEZDOCHKA STATE MACHINE BUILDING ENTERPRISE

formerly known as Ship Repair Plant 893

SUPERVISING AGENCY Russian Shipbuilding Agency

LOCATION Yagra Island, Severodvinsk, Arkhangelsk Oblast

SITE ACTIVITIES
1. Submarine and ship repair
2. START-designated submarine dismantlement facility

RELEVANT ASSETS
1. One PM–124 service ship and one PM–78 service ship
2. Twelve decommissioned nuclear submarines
3. Four reactor compartments from decommissioned nuclear submarines[75]
4. Liquid radioactive-waste processing facility
5. Spent-fuel storage facilities
6. Radioactive-waste storage
7. Interim storage of dismantled submarines
8. Defueling infrastructure

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located in low-irradiated and spent fuel on decommissioned submarines and on the two service ships.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

NOTES
- The PM–124 and PM–78 service ships have been used to carry spent fuel from Zvezdochka to ports where it was transferred to rail cars for transport to Mayak. Each support barge can carry up to 560 fuel assemblies and 200 cubic meters of liquid radioactive waste.[76] Murmansk authorities prohibited this practice in 1992 owing to safety concerns, but it was resumed in 1998.[77]
- In theory, all spent fuel from decommissioned submarines is sent from these storage facilities to the Mayak Production Association for reprocessing. However, financial difficulties have limited the number of shipments sent, and as a result the storage facilities are reportedly full. Five trainloads of spent fuel were to be shipped in 1999 to Mayak on the PM–63 service ship and then by train.[78]

75. The “reactor compartment” is the nuclear reactor’s housing. It remains radioactive for hundreds of years, even when the fuel core is removed. It usually contains lead shielding and other metals. Currently there is no long-term storage plan for reactor compartments that have been cut out from the rest of the submarine.

76. OTA Report, “Nuclear Wastes in the Arctic,” 1995.

77. Judith Perera, “Submarine Purgatory,” *Nuclear Engineering International,* December 1995, p. 43; Viktor Fillipov, “Nuclear Submarines Are Calling for Help,” *Rossiyskaya gazeta,* May 24, 1995, p. 4.

78. Igor Kudrik and Alexey Klimov, “Nuclear Train Leaves Severodvinsk,” Bellona Foundation web site: <www.bellona.no/e/russia/nfl/news/990430.htm>, April 30, 1999.

- As of fall 1999, the *Admiral Ushakov* and *Admiral Nakhimov* battle cruisers were at Zvezdochka for repairs.[79]
- The rate of submarine dismantlement at this site is approximately one to two submarines per year.

79. "Russia To Patch up Nuclear Cruisers," October 4, 1999, Bellona Foundation web site: <www.bellona.no>.

TABLE 4.3: **RUSSIAN NAVAL FACILITIES, PACIFIC FLEET**

AMURSKIY ZAVOD

also known as the Leninskiy Komsomol Shipyard; formerly Shipyard No. 199[1]

SUPERVISING AGENCY	Russian Shipbuilding Agency
LOCATION	Komsomolsk-na-Amure, Khabarovskiy Kray
SITE ACTIVITIES	SSBN and SSN construction
RELEVANT ASSETS	Two partially completed nuclear submarines, one of which has a fueled reactor
WEAPONS-USABLE URANIUM	Yes. An unknown amount of HEU is located in fuel in the reactor of the partially completed submarine.[2]
SEPARATED PLUTONIUM	No
MPC&A STATUS	At present, DOE is considering cooperation with Gosatomnadzor (GAN) at this site.[3]

1. Oleg Bukharin and Joshua Handler, "Russian Nuclear-powered Submarine Decommissioning," *Science & Global Security* 5 (1995): 250–251.
2. James Clay Moltz, "Trip Report: Vladivostok and Khabarovsk, Russia," October 15–22, 1999.
3. CNS staff discussion with DOE official, June 2000.

CAPE SYSOYEVA

also known as Cape Maydel and Site 32

SUPERVISING AGENCY Ministry of Defense[4]

LOCATION Southern coast of the Shkotovo Peninsula, south of Dunay, approximately 50 km southeast of Vladivostok, Primorskiy Kray

SITE ACTIVITIES This is the main land-based nuclear submarine-waste storage facility in the Far East.

RELEVANT ASSETS
1. Three PM–124 class service ships
2. Two technical support ships, the TNT–5 and TNT–27[5]
3. Land-based spent-fuel storage facility containing approximately 8,400 spent-fuel assemblies
4. Five burial trenches for low-level solid radioactive wastes
5. Highly radioactive-waste storage

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located on site in spent fuel.

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: No date available.
Work completed: January 2000

MPC&A STATUS DOE provided assistance to improve MPC&A of spent fuel at this site. Upgrades were completed in January 2000.[6]

NOTES
- The three PM–124 class (PM–80, PM–125, PM–133) service ships hold 1,680 spent-fuel assemblies, including 118 damaged fuel assemblies on the PM–80. The PM–133 was contaminated during rescue efforts that followed the August 10, 1985, reactor explosion on board an Echo II–class submarine in Chazhma Bay.[7]

4. U.S. Department of Energy, MPC&A Task Force Personnel Presentation. Supervision is being transferred to the Far Eastern Federal Enterprise for Handling Radioactive Waste, under the Ministry of Atomic Energy.

5. Joshua Handler, *Greenpeace Trip Report: Guide to Russian Navy Pacific Fleet Nuclear-powered Submarine Bases and Facilities,* January 12, 1994; Bukharin and Handler, "Russia Submarine Decomissioning," p. 258; "Nuclear Wastes in the Arctic: An Analysis of Arctic and Other Regional Impacts from Soviet Nuclear Contamination," OTA–ENV–623, Washington, D.C.: U.S. Printing Office, September 1955; Handler, "Russia's Pacific Fleet: Problems with Nuclear Waste;" and NISNP interview with Russian nuclear scientist, September 21, 1999.

6. U.S. Department of Energy, MPC&A Task Force Personnel Presentation; and comments from MPC&A task force personnel, January 2000.

7. E. A. Goriglejan, *Design Support To Minimize Rise of the Environmental Impact of Damaged Nuclear Steam-generating Plants of Russian Submarines during Their Long-term Storage in Sarcophaguses* (Moscow: Kluwer, 1997).

CHAZHMA SHIP REPAIR FACILITY

SUPERVISING AGENCY Ministry of Defense[8]

LOCATION Eastern coast of the Shkotovo Peninsula, western side of Strelok Bay, 45 km southeast of Vladivostok, Primorskiy Kray

SITE ACTIVITIES
1. Submarine repair, refueling, and defueling
2. Decommissioned submarine storage

RELEVANT ASSETS
1. One PM–74 service ship, three PM–124 service ships, and two technical support ships
2. An unknown number of decommissioned submarines
3. Submarine refueling and defueling facility
4. Fresh-fuel storage facility (Site 34)

WEAPONS-USABLE URANIUM Yes. More than 2,000 kg of fresh and spent fuel is located at Site 34, on board the PM–74 service ship, and in low-irradiated and spent fuel in decommissioned submarines.[9]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: March 1998
Work completed: September 2000[10]

MPC&A STATUS In March 1998, a DOE team visited and conducted an initial site characterization assessment of the PM–74 service ship. DOE-funded MPC&A upgrades on this ship were completed in September 2000.[11]

In September 1998, DOE began to implement a plan to upgrade MPC&A at Site 34, the land-based fresh-fuel storage facility at Chazhma. The enhancements initially included rapid upgrades and will incorporate long-term measures as well.[12] These long-term measures include a permanent storage facility completed in September 2000.[13]

NOTES
- As of 1993, there was enough fresh fuel for 24 submarines in land storage at Chazhma.[14]
- The PM–74 service ship transports fresh and spent fuel back and forth to Kamchatka.[15]
- The refueling infrastructure at this site could indicate the existence of interim spent-fuel storage.

8. U.S. Department of Energy, MPC&A Task Force Personnel Presentation.
9. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.
10. CNS discussion with Cmdr. Ken Baker, CTR office, DTRA, December 5, 2000.
11. Ibid.
12. Nikolay Yurasov et al., "Upgrades to the Russian Navy's Fuel Transfer Ships and Consolidated Storage Locations," *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* U.S. Department of Energy, September 1998.
13. Ibid.
14. Oleg Bukharin and William Potter, "Potatoes Were Guarded Better," *Bulletin of the Atomic Scientists,* May–June 1995, p. 47.
15. U.S. Department of Energy, MPC&A Task Force Personnel Presentation; and Yurasov et al., "Upgrades to the Russian Navy's Fuel Transfer Ships."

GORNYAK SHIPYARD

also known as Site 49K[16]

SUPERVISING AGENCY Ministry of Defense[17]

LOCATION Near Vilyuchinsk (Petropavlovsk-Kamchatskiy-50), western end of Krasheninnikova Bay just north of Seldevaya Cove across from Rybachiy, near Petropavlovsk, Kamchatskaya Oblast[18]

SITE ACTIVITIES
1. Submarine repairs
2. Submarine refueling
3. Possible submarine dismantlement

RELEVANT ASSETS
1. A PM–74 service ship
2. Decommissioned PM–32 service ship, with spent fuel on board[19]
3. Two piers and a radioactive-waste burial site[20]

WEAPONS-USABLE URANIUM Yes. More than 1,000 kg of HEU is located in fresh and spent fuel on the PM–74 and possibly on the decommissioned PM–32 service ship.[21]

SEPARATED PLUTONIUM No

MPC&A STATUS DOE is conducting MPC&A upgrades on the PM–74 ship. (See entry for Chazhma Ship Repair Facility for more details on the MPC&A status of that ship.) At present, DOE is not providing any MPC&A assistance at the Gornyak Shipyard itself.

NOTES
- DOE is currently considering a Russian proposal to upgrade this facility to enable it to undertake dismantlement of SSNs.
- Although the fuel generally moves directly from the PM–74 to the submarine reactor during refueling, fresh fuel has been stored temporarily on land here in the past. According to one report, the facility contained enough fuel for six to seven submarines in 1995.[22]
- The PM–74 service ship operates out of the Chazhma Ship Repair Facility and delivers fuel to Gornyak for refueling nuclear submarines based at Rybachiy.[23] The PM–74 is at Gornyak during the summer months only.
- Sources indicate that a PM–32 service ship is docked at this facility. Reportedly, it is being monitored, but there are no plans for the spent fuel on board to be removed or relocated.

16. NISNP Interview with Russian nuclear scientist, September 21, 1999.
17. U.S. Department of Energy, MPC&A Task Force Personnel Presentation. Supervision is being transferred to the Far Eastern Federal Enterprise for Handling Radioactive Waste, under the Ministry of Atomic Energy.
18. Richard H. Rowland, "Secret Cities of Russia and Kazakhstan in 1998," *Post-Soviet Geography and Economics* 40(4) (1999): 281–304.
19. NISNP interview with Kamchatka Oblast official, June 2000.
20. Handler, *Greenpeace Trip Report,* pp. 8–10.
21. U.S. Department of Energy, "MPC&A Program Strategic Plan," p. 16.
22. Handler, "Russia's Pacific Fleet."
23. Yurasov et al., "Upgrades to the Russian Navy's Fuel Transfer Ships."

PAVLOVSK BAY

SUPERVISING AGENCY Ministry of Defense

LOCATION Eastern edge of Strelok Bay, across from Dunay, Primorskiy Kray

SITE MISSION
1. Main operational submarine base for the Pacific Fleet
2. Decommissioned nuclear submarine storage facility

RELEVANT ASSETS
1. One active-duty Victor III–class SSN[24]
2. One second-category reserve nuclear-powered battle cruiser, the *Admiral Lazarov,* in nearby Abrek Bay[25]
3. One inactive Project 1941 Titan *(Kapusta)* nuclear-powered communications and operations ship, the *Ural*[26]
4. One START-accountable Delta-1 SSBN, not in operation
5. Unknown number of fueled decommissioned submarines
6. Temporary storage of sealed reactor compartments from defueled and partially dismantled nuclear submarines

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located in fuel on the active-duty submarine and nuclear-powered ships, as well as in low-irradiated and spent fuel in decommissioned submarines.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE. Nuclear fuel in a submarine reactor is considered self-protecting once the reactor is operational because of the difficulty of opening a sealed submarine reactor, especially on a vessel in active military service. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

NOTES
- As a second category reserve, the *Admiral Lazarov* can put to sea with 20 days of preparation.[27]
- Owing to technical problems, the *Ural* was taken out of use a short time after commissioning. Discussions continue on whether to sell or decommission the ship. There has been talk of using it for power generation.[28]
- As of September 1997, 21 submarines were docked at this facility awaiting defueling and dismantlement, including three Pacific Fleet submarines damaged in nuclear accidents.[29]

24. *Jane's Fighting Ships 1999/2000* (Coulson, Surrey, U.K.; Alexandria, Va.: Jane's Information Group, 1999), pp. 558–571.

25. Igor Vandenko, "The Cemetery for Healthy Ships: The Pacific Fleet Can Oppose 17 American Missile Cruisers with Only Two. At the Same Time, Entirely Combat Capable Ships Are Rusting While Laid Up," *Novoye Izvestiya,* July 15, 1999, Document FTS19990730000098.

26. Thomas Nilsen, Igor Kudrik, and Alexander Nikitin, "Project 1941 (Titan): Kapusta Class," August 19, 1998, Bellona Foundation web site: <www.bellona.no>.

27. Vandenko, "Cemetery for Healthy Ships."

28. Nilsen, Kudrik, and Nikitin, "Project 1941 (Titan)."

29. Nina Kolesnichenko and Viktor Korytko, "Grozit li Primoryu yadernaya opasnost? Atomnyye reaktory s chasovym mekhanizmom," *Vladivostok* 173 (Sept. 16, 1997): 1, 11.

RAZBOYNIK BAY

SUPERVISING AGENCY Ministry of Defense

LOCATION Razboynik Bay, western side of Strelok Bay, Primorskiy Kray

SITE ACTIVITIES
1. Previously, an operational naval base serving nuclear and diesel submarines
2. Decommissioned nuclear submarine and reactor compartment storage

RELEVANT ASSETS
1. Nine decommissioned nuclear submarines, with fuel still on board
2. Eleven reactor compartments[30]

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located in low-irradiated and spent fuel in decommissioned submarines.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

NOTES
- Nuclear submarines were formerly based at this site.

30. Kolesnichenko and Korytko, “Grozit li Primoryu yadernaya opasnost?”

RYBACHIY NUCLEAR SUBMARINE BASE

also includes nearby Tarya Bay

SUPERVISING AGENCY Ministry of Defense

LOCATION Southern edge of the Krasheninnikova Peninsula, across Krasheninnikova Bay from Vilyuchinsk, near Petropavlovsk, Kamchatskaya Oblast[31]

SITE ACTIVITIES
1. Operational naval base serving nuclear submarines
2. Decommissioned nuclear submarine storage

RELEVANT ASSETS
1. Four Delta III–class SSBNs, six Akula-class SSNs, and six Oscar-class SSGNs[32]
2. Twenty-two decommissioned SSNs and one decommissioned SSBN, some of which still have fuel on board[33]

WEAPONS-USABLE URANIUM Yes. There is an unknown amount of HEU located in fuel on active duty and decommissioned submarines.

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE. Nuclear fuel in a submarine reactor is considered self-protecting once the reactor is operational because of the difficulty of opening a sealed submarine reactor, especially on a vessel in active military service. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

31. Richard H. Rowland, "Secret Cities of Russia and Kazakhstan in 1998," *Post-Soviet Geography and Economics* 40(4) (1999): 281–304.
32. *Jane's Fighting Ships 1999/2000,* pp. 558–571.
33. James Clay Moltz, "Russian Nuclear Submarine Dismantlement and the Naval Fuel Cycle," *Nonproliferation Review* 7(1) (spring 2000): 80.

ZAVETY ILYICHA

also known as Sovetskaya Gavan

SUPERVISING AGENCY Ministry of Defense

LOCATION Postavaya Bay, between the cities of Sovetskaya Gavan and Vanino, Khabarovskiy Kray

SITE ACTIVITIES
1. Former operational naval base
2. Temporary decommissioned submarine storage

RELEVANT ASSETS Three decommissioned submarines: two November-class and one Echo I–class[34]

WEAPONS-USABLE URANIUM Yes. An unknown amount of HEU is located in low-irradiated and spent fuel in decommissioned submarines.

SEPARATED PLUTONIUM No

MPC&A STATUS In January 1996, in an unconfirmed incident, 7 kg of HEU was reportedly stolen from Zavety Ilyicha. 2.5 kg of the same material is also reported to have appeared later at a metals trading firm in Kaliningrad.[35] If true, given the history of activities at the base, the material is likely to have been spent fuel.

At present, this site is not receiving any MPC&A assistance from DOE. Spent fuel is considered self-protecting owing to its radioactivity; however, low-irradiated fuel and older spent fuel lose their self-protecting characteristics over time.

NOTES
- This was an operational naval base until 1990.
- The Pacific Fleet committed itself to removing one nuclear submarine from Zavety Ilyicha per year beginning in 1991. The first of four was removed in October 1993.[36] However, as of May 2000 three decommissioned submarines remain temporarily housed at the facility.
- Some of the reactors on the decommissioned nuclear submarines hold damaged spent fuel.[37]
- This had been the site of a planned submarine defueling facility, but the plans were canceled in 1991.

34. CNS discussions with Mark Ettesvold, Pacific Northwest National Laboratory, May 2000.
35. Rensselaer W. Lee III, "Smuggling Update," *Bulletin of the Atomic Scientists,* May–June 1997: 52–56.
36. Handler, "Russia's Pacific Fleet."
37. Moltz, "Trip Report."

ZVEZDA FAR EASTERN SHIPYARD

SUPERVISING AGENCY	Russian Shipbuilding Agency
LOCATION	Bolshoy Kamen, Primorskiy Kray, approximately 25 km east of Vladivostok, across Ussuriskiy Bay
SITE ACTIVITIES	1. Repair, maintenance, defueling, and dismantlement of nuclear submarines 2. START-designated submarine dismantlement facility
RELEVANT ASSETS	1. Equipment for dismantling submarines 2. Underground liquid radioactive-waste storage facilities 3. Floating liquid radioactive-waste filtration facility 4. Interim storage of decommissioned and dismantled submarines 5. Equipment to defuel submarines 6. Equipment for transferring spent fuel to Malina-class service ships
WEAPONS-USABLE URANIUM	Yes. An unknown amount of HEU is located in spent fuel on decommissioned submarines.
SEPARATED PLUTONIUM	No
MPC&A TIMELINE	Work begun: No date available. Work completed: June 2001 (est.)
MPC&A STATUS	U.S. Cooperative Threat Reduction (CTR)–funded upgrades to PM–74 defueling vessel are ongoing. Cask pads for the dry storage of spent fuel will also be provided through CTR. A CTR-funded on-shore defueling facility is due for completion in June 2001.[38]

38. Information provided by CTR office, December 2000.

TABLE 4.4: **OTHER RUSSIAN NAVAL FACILITIES**

ADMIRALTEYSKIYE VERFI SHIPYARD

also known as Admiralty-Sudomekh, United Admiralty, and Leningradskoye Admiralteyskoye Obedineniye (LAO)[1]

SUPERVISING AGENCY Russian Shipbuilding Agency

LOCATION St. Petersburg

SITE ACTIVITIES Construction of submarines and other naval vessels

RELEVANT ASSETS
1. Shipbuilding infrastructure
2. Possible fresh-fuel storage facility for startup of reactors
3. One critical assembly

WEAPONS-USABLE URANIUM Possibly in fresh fuel and in critical assembly

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE.

NOTES
- This shipyard previously produced nuclear submarines and currently produces Kilo-class diesel submarines.

1. U.S. Department of Commerce, *Directory of Russian Defense Enterprises of St. Petersburg and Leningrad Oblasts,* Bureau of Export Administration.

BALTIC SHIPYARD

SUPERVISING AGENCY	Russian Shipbuilding Agency
LOCATION	St. Petersburg[2]
SITE ACTIVITIES	Construction of nuclear-propelled surface vessels, including ice-breakers
RELEVANT ASSETS	1. Shipbuilding infrastructure 2. Interim fresh-fuel storage[3]
WEAPONS-USABLE URANIUM	Yes. An unknown amount of HEU is stored at this site in fresh fuel.
SEPARATED PLUTONIUM	No
MPC&A TIMELINE	Work begun: 1997[4] Work completed: Information not available.
MPC&A STATUS	This site participates in the DOE MPC&A program.[5]
NOTES	• Fresh fuel is temporarily stored here before being loaded into nuclear-powered ice-breakers. According to Russian officials, fresh fuel can be temporarily stored here for up to one year.[6]

2. Robin Lee, "Ongoing Naval Construction Programs," State of the Russian Navy, October 1995, <www.webcom.com/~amraam/build.html#shipyards>.
3. CNS staff discussion with Russian nuclear official, summer 1997.
4. U.S. Department of Energy, "MPC&A Program Strategic Plan."
5. CNS staff correspondence with Department of Energy, March 4, 1999.
6. Ibid.

CENTRAL PHYSICAL-TECHNICAL INSTITUTE (TsFTI)

SUPERVISING AGENCY Ministry of Defense, 12th Main Directorate[7]

LOCATION Sergiyev Posad (formerly Zagorsk), Moscow Oblast[8]

SITE ACTIVITIES

1. Research on nuclear propulsion for naval vessels and space vehicles[9]
2. Research on protection of military equipment under conditions of gamma and neutron flux[10]
3. Research on naval spent-fuel and radioactive-waste storage options[11]

RELEVANT ASSETS At least two pulsed research reactors[12]

WEAPONS-USABLE URANIUM Yes. At least 5–10 kg of fresh fuel, approximately 90% enrichment.[13]

SEPARATED PLUTONIUM No

MPC&A STATUS The DOE MPC&A program is beginning work at an unnamed facility in Sergiyev Posad under the rubric of its work in the naval complex.[14] Because of TsFTI's probable focus on naval propulsion research, it is likely to be the unnamed facility at which DOE is working. If this conclusion is correct, this cooperation suggests that HEU is located here, since DOE generally has focused its MPC&A work on sites with weapons-usable material.

7. Center for Arms Control, Energy, and Environmental Studies, Moscow Institute of Physics and Technology, "Rezhim transparentnosti v otnoshenii arsenalov yadernykh boyegolovok," Conference Proceedings, November 9–10, 1998, Moscow Institute of Physics and Technology web site: <www.armscontrol.ru/start/rus/publications/tr1198.htm>.
8. Catalogue "Kompyuternaya Rossiya," <www.catalog.ru>.
9. NISNP discussion with Russian nuclear scientist, July 1999.
10. NISNP discussion with Russian nuclear physicist, December 1999.
11. Leonid S. Yevterev et al., "Expert Appraisal: Fighting Fire with Fire: Underground Nuclear Explosions Can Be Used To Destroy Accumulated Radioactive Wastes Safely, Quickly and Economically," *Nezavisimoye voyennoye obozreniye,* no. 23, June 18–24, 1999, p. 4, "Nuc Explosion To Destroy Radioactive Waste," FBIS Document FTS19990625000139.
12. NISNP dscussion with Russian nuclear scientist, July 1999.
13. Ibid.
14. U.S. Department of Energy, Russian Nuclear Materials Security Task Force web site: <www.nn.doe.gov/mpca/image/org_lrg.gif>.

EXPERIMENTAL MACHINE BUILDING DESIGN BUREAU

also known as OKB Mashinostroyeniye, or OKBM

SUPERVISING AGENCY Ministry of Atomic Energy

LOCATION Nizhniy Novgorod[15]

SITE ACTIVITIES Nuclear reactor design, including small pressurized-water reactors, fast-breeder reactors, floating reactors, and reactors for nuclear submarines and icebreakers[16]

RELEVANT ASSETS Four critical assemblies

WEAPONS-USABLE URANIUM Yes. There is an unknown amount of HEU at a military-controlled location on site.[17]

SEPARATED PLUTONIUM No

MPC&A STATUS At present, this site is not receiving any MPC&A assistance from DOE.

NOTES

- This facility participated in the development of Russia's centrifuge technology.[18]
- OKBM designed small floating nuclear power plants using model KLT–40 pressurized-water reactors such as those used in nuclear icebreakers.[19]

15. U.S. Department of Commerce, *Russian Defense Business Directory* (Washington, D.C.: Bureau of Export Administration, 1995), p. 125.
16. "GA, Minatom Finalize Agreements on Developing GT–MHR," *Post-Soviet Nuclear and Defense Monitor,* March 14, 1995, p. 9.
17. CNS staff interview with Russian nuclear scientist, Monterey, December 1999.
18. Thomas Cochran, Robert S. Norris, and Oleg Bukharin, *Making the Russian Bomb: From Stalin to Yeltsin* (Boulder: Westview Press, 1995), p. 36.
19. Oleg Demenin, "Pod flagom 'maloy energetiki,'" *Stroitelnaya gazeta,* March 24, 2000, Natsionalnaya sluzhba novostey, <nel.nns.ru>.

KRYLOV CENTRAL SCIENTIFIC RESEARCH INSTITUTE

SUPERVISING AGENCY Ministry of Economics

LOCATION St. Petersburg

SITE ACTIVITIES Research and design of nuclear reactors for naval vessels[20]

RELEVANT ASSETS
1. One 0.5-MW research reactor
2. Two critical assemblies
3. One subcritical assembly

WEAPONS-USABLE URANIUM Yes. Less than 100 kg of HEU

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: 1997
Work completed: Unknown

MPC&A STATUS This site was added to the DOE MPC&A program under an agreement between DOE and Gosatomnadzor.[21]

NOTES
- The research reactor is a U–3 reactor.

20. M. Lee, "Appendix B: Krylov Shipbuilding Research Institute," *Research Submersibles and Undersea Technologies,* World Technology Center Panel Report, June 1994, <itri.loyola.edu/subsea/b_krylov.htm>.

21. CNS staff interview with Russian nuclear official, September 1997.

TABLE 4.5: **NUCLEAR FACILITIES IN BELARUS**

INSTITUTE OF ENERGY PROBLEMS (IEP), SOSNY SCIENCE AND TECHNOLOGY CENTER[1]

Институт проблем энергетики, Академический научно-технический комплекс (АНТК) «Сосны»
Institut problem energetiki, Akademicheskiy nauchno-tekhnicheskiy kompleks (ANTK) "Sosny"

SUPERVISING AGENCY Academy of Sciences of the Republic of Belarus

LOCATION Sosny, approximately 16 km from Minsk

SITE ACTIVITIES Research on nuclear power, energy conservation, and nuclear safety[2]

RELEVANT ASSETS
1. One nonoperational research reactor[3]
2. Two nonoperational critical assemblies[4]
3. Fissile-material storage facility[5]
4. Spent-fuel storage[6]

WEAPONS-USABLE URANIUM Yes. Approximately 370 kg of HEU is located on site.[7]

SEPARATED PLUTONIUM Yes. Approximately 15 g of plutonium is located on site.[8]

MPC&A TIMELINE Work begun: April 1994[9]
Work completed: October 1996[10]

MPC&A STATUS U.S.-funded physical protection upgrades focused on two buildings where all direct-use fissile material has been consolidated. Security upgrades include improved access controls, a strengthened nuclear material storage vault, installation of motion sensors, sealed windows, and a central alarm system. Perimeter upgrades include new

1. The Belarusian Academy of Sciences has maintained a multi-disciplinary research center at Sosny for several years. Until 1989, the name of this facility was the Institute of Nuclear Energy. In 1991, the facility was divided into three separate research institutes, all three of which continue to be overseen by the Academy of Sciences and remain physically located at Sosny. They are the Institute of Energy Problems (sometimes translated as the Institute of Power Engineering Problems), the Institute for Physical and Chemical Radiation Problems, and the Institute for Radiation-Ecological Problems. Weapons-usable materials in Sosny are located only at the Institute of Energy Problems. (Alexandr Mikhalevich, "Evaluation of the Effectiveness of Physical Protection, Control, and Accounting of Fissile Materials at the Institute of Energy Problems, National Academy of Sciences of Belarus," unpublished paper, August 1999.)
2. Belapan Radio, February 4, 1998, "Lukashenka Says People Will Decide on Nuclear Power Plant," FBIS–SOV–98–035.
3. *World Nuclear Industry Handbook 1993,* Nuclear Engineering International, p. 127.
4. K. Murakami et al., "IAEA Safeguards and Verification of the Initial Inventory Declarations in the NIS," July 1997, p. 3, distributed at a workshop held at Stanford University, "A Comparative Analysis of Approaches to the Protection of Fissile Materials," July 28–30, 1997.
5. Ibid.
6. A. Mikhalevich, A. Iakoushev, A. Batalov, and Yuriy Sivakov, "Ensuring Physical Protection of Nuclear Materials in Belarus," Center for Nonproliferation Studies, Monterey Institute of International Studies, June 1995.
7. Center for Nonproliferation Studies (CNS), interviews with Belarusian nuclear officials, Sosny, Belarus, June 1994 and April 1995.
8. Ibid.
9. U.S. Department of Energy, "Improving Nuclear Material Security at the Sosny Science and Technical Center, Minsk, Belarus," Office of Arms Control and Nonproliferation, June 1997, <www.nn.doe.gov/mpca/pubs>.
10. U.S. Department of Energy press release, "DOE Secures Nuclear Material in Belarus and Uzbekistan, Reduces Risk of Nuclear Proliferation," October 1, 1996.

fences, exterior lighting, and installation of intrusion detection sensors and video surveillance.[11]

The United States and Japan provided nuclear-material accounting and control system upgrades, including computer software, information systems, and advanced telecommunications equipment to facilitate data exchange between Belarus and the IAEA.[12] The United States also provided physical inventory-related equipment.[13]

Sweden also provided MPC&A assistance to Belarus.[14]

NOTES

- The 5-MW IRT–M was shut down in 1988 and officially decommissioned in 1996.[15]
- 40 kg of 90% HEU and approximately 330 kg of HEU, enriched to between 20% and 89%, are located on site.
- The two critical assemblies are nonoperational owing to a lack of funding. One of the critical assemblies operates on approximately 234 kg of 20% HEU, and the other on 15 kg of 90% HEU.[16] The fuel from these assemblies has been moved to the fissile-material storage facility.[17]

11. U.S. Department of Energy, "Improving Nuclear Materials Security at the Sosny Science and Technical Center."
12. *Nihon Keizai Shimbun,* November 1, 1994, "Tokyo To Give Technical Aid on Nuclear Material to Belarus," JPRS–TND–94–020, November 17, 1994, pp. 6–7; and U.S. Department of Energy, "Improving Nuclear Materials Security."
13. U.S. Department of Energy, "Improving Nuclear Materials Security."
14. U.S. Department of Energy press release, "DOE Secures Nuclear Material."
15. CNS staff interviews with Alexandr Mikhalevich, Monterey, Calif., April 1995, and Anatoliy Iakoushev, Minsk, Belarus, March 1996.
16. Ibid.
17. Murakami, "IAEA Safeguards and Verification."

TABLE 4.6: **NUCLEAR FACILITIES IN KAZAKHSTAN**[1]

INSTITUTE OF NUCLEAR PHYSICS

	Институт ядерной физики Institut yadernoy fiziki
SUPERVISING AGENCY	National Nuclear Center, Ministry of Energy, Industry, and Trade <www.nnc.kz>[2]
LOCATION	Alatau, located approximately 16 km from Almaty[3]
SITE ACTIVITIES	Scientific research
RELEVANT ASSETS	1. One 10-MW research reactor[4] 2. One critical assembly[5] 3. Hot cells[6] 4. Nuclear-material storage vaults for fresh fuel, spent fuel, and nuclear material in bulk form[7]
WEAPONS-USABLE URANIUM	Yes. At least 5.4 kg HEU is located on site.[8]
SEPARATED PLUTONIUM	No
MPC&A TIMELINE	Work begun: September 1995[9] Work completed: October 1998[10]
MPC&A STATUS	Both the United States and Japan have provided MPC&A assistance to this site. U.S. assistance focused on the reactor building itself, while Japanese assistance focused on the perimeter of the reactor complex. New physical protection equipment in the reactor building includes alarms, electronic locks, video surveillance, and controls at all key points in the reactor building, including at doors

1. The Ulba metallurgical plant in Ust-Kamenogrosk, Kazakhstan, is not included in this section as it no longer houses any weapons-usable material. Nearly 600 kg of 90% HEU was removed from this facility and airlifted to the United States in November 1994 in an operation known as Project Sapphire. It is believed that all weapons-usable material was removed from the Ulba plant at that time. The Ulba plant currently produces fuel pellets for nuclear reactors using LEU enriched up to 4%. See William Potter, "The 'Sapphire' File: Lessons for International Nonproliferation Cooperation," *Transition,* November 17, 1995, pp. 14–19.
2. Formerly under the administrative control of the Alatau branch of the Institute of Atomic Energy.
3. Boris Kuznetsov, "Implementation of Material Control and Accounting at the Nuclear Facilities in Kazakhstan," *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
4. Ibid.
5. National Nuclear Center (NNC), "Invitation for Cooperation," undated marketing brochure.
6. Emily Ewell, "Trip Report: Uzbekistan, Kazakhstan, Ukraine," CNS, Monterey, Calif., May 1996.
7. Kuznetsov, "Implementation of Material Control."
8. U.S. General Accounting Office, *Nuclear Safety: Concerns with Nuclear Facilities and Other Sources of Radiation in the Former Soviet Union (Letter Report),* GAO/RCED–96–4, November 7, 1995, appendix 2, pp. 23–25.
9. Albert Eras et al., "Department of Energy Nuclear Material Physical Protection Program in the Republic of Kazakhstan," *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
10. U.S. General Accounting Office, *Nuclear Nonproliferation: Limited Progress in Improving Nuclear Materials Security in Russia and the Newly Independent States,* GAO/RCED/NSIAD–00–82, March 6, 2000.

and at the fuel-storage area. In addition, improved telephone and radio communications have been installed. Upgrades to the perimeter include a new fence that is outfitted with video cameras.[11]

Material control and accounting upgrades include the provision of scales and nuclear-material measurement equipment, as well as computers and software for nuclear-material accounting.[12]

NOTES

- In addition to the Institute of Nuclear Physics, the Alatau branch of the Institute of Atomic Energy is located at this site.
- The VVR–K reactor was shut down in 1989 in order to bring it up to higher seismic standards. The reactor was recommissioned and resumed operation in December 1997.[13]
- Both the research reactor and the critical assembly use 36% enriched HEU fuel.[14]

11. Z. Zhotabayev, "Increased MPC&A at the Institute of Atomic Energy's Alatau Reactor," presentation described in Emily Ewell Daughtry and Martin Daughtry, "Trip Report: Second International Nonproliferation Conference, Kurchatov, Kazakhstan, September 15–18, 1998," CNS, Monterey, Calif.
12. Kuznetsov, "Implementation of Material Control."
13. "Agenstvo po atomnoy energii Kazakhstana razreshilo pusk issledovatelskogo yadernogo reaktora v 30 km ot Almaty," *Panorama,* December 5, 1997, p. 10.
14. U.S. General Accounting Office, *Nuclear Safety*; and NNC, "Invitation for Cooperation."

INSTITUTE OF ATOMIC ENERGY, KURCHATOV BRANCH

Институт атомной энергии
Institut atomnoy energii

SUPERVISING AGENCY National Nuclear Center, Ministry of Energy, Industry, and Trade <www.nnc.kz>

LOCATION Kurchatov, on the former Semipalatinsk Test Site, near the northeastern Kazakhstani city of Semey (Semipalatinsk)

SITE ACTIVITIES[15]
1. Research on reactor safety
2. Participation in the International Thermonuclear Energy Reactor (ITER) program

RELEVANT ASSETS Baikal-1 complex (near the geographic center of the former Semipalatinsk Test Site)
1. One 1-MW IVG–1M water-cooled pulsed research reactor[16]
2. One nonoperational RA gas-cooled research reactor[17]
3. Fresh-fuel storage[18]

IGR complex (in the north central portion of the former Semipalatinsk Test Site)
1. One IGR pulse research reactor[19]
2. Fresh- and spent-fuel storage[20]

WEAPONS-USABLE URANIUM Yes. Approximately 600 g of fresh 90% HEU fuel is located at the Baikal-1 complex, and approximately 7 kg of fresh fuel and 7 kg of spent fuel, both 90% HEU, are located at the IGR complex.[21]

SEPARATED PLUTONIUM No

MPC&A TIMELINE[22] Work begun: October 1994
Work completed: September 1997

MPC&A STATUS Both facilities have perimeter fencing protected by Ministry of Internal Affairs guard forces.[23]

DOE-funded physical protection upgrades include the installation of metal and nuclear-material detectors, building modifications to harden access points to nuclear materials, the installation of alarm and access control systems, and the provision of radio communications systems to facility guard forces.[24] Material control and

15. NNC, "Invitation for Cooperation."
16. CNS staff discussions with NNC of Kazakhstan scientists, September 1997, unpublished report by the Kazakhstan Atomic Energy Agency, July 7, 1995.
17. NNC of the Republic of Kazakhstan, "Transfer of the Research Reactor Highly Enriched Nuclear Fuel to Russia," Semipalatinsk Test Site, 2nd International Conference on Nonproliferation Problems, Kurchatov, Kazakhstan, September 14–17, 1998, p. 14.
18. CNS staff discussions with NNC of Kazakhstan scientists, September 1997.
19. Unpublished report written for the CNS.
20. CNS staff discussions with NNC of Kazakhstan scientists, September 1997.
21. Ibid.
22. Eras et al., "Department of Energy."
23. Emily Ewell, "International Conference on Nonproliferation Problems," NIS Nonproliferation Project Trip Report, September 1997.
24. Eras et al., "Department of Energy."

accounting upgrades at this facility include the provision of software for nuclear-material accounting.[25]

NOTES

- In the Soviet era, the Baikal-1 complex was a branch of the Luch Scientific Production Association in Podolsk, Russia. The complex was previously used for the experimental testing of reactor prototypes for nuclear rocket engines.[26]
- The IGR is a pulse graphite reactor used to test nuclear fuel and to simulate conditions within power reactors.[27]
- The two operational research reactors use 90% enriched HEU fuel.[28]
- Approximately 138 kg of irradiated HEU fuel was shipped to the Scientific Research and Design Institute of Power Technology in Yekaterinburg, Russia, and 44 kg of fresh HEU fuel was shipped to the Luch Scientific and Production Association in Podolsk, Russia, from the Baikal-1 complex between 1996 and 1998.[29]

25. Kuznetsov, "Implementation of Material Control."
26. NNC of the Republic of Kazakhstan, "Tests Conducted under the Programs of Space Nuclear Power Plant Development," 2nd International Conference on Nonproliferation Problems, Kurchatov, Kazakhstan, September 14–17, 1998.
27. CNS staff discussions with NNC of Kazakhstan scientists, September 1997.
28. Ibid.
29. O. Pivovarev, "Movement of HEU from Kurchatov to Russia," presentation described in Emily Ewell Daughtry and Martin Daughtry, "Trip Report: Second International Nonproliferation Conference, Kurchatov City, Kazakhstan, September 15–18, 1998," CNS, Monterey, Calif.

MANGYSHLAK ATOMIC ENERGY COMBINE (MAEK)

Мангышлакский атомный энергетический комбинат (МАЭК)
Mangyshlakskiy atomnyy energeticheskiy kombinat (MAEK)

SUPERVISING AGENCY Ministry of Energy, Industry, and Trade

LOCATION Aktau, located in western Kazakhstan on the coast of the Caspian Sea

SITE ACTIVITIES Water desalination, and heat and power production[30]

RELEVANT ASSETS
1. Nonoperational BN–350 liquid-metal-cooled, fast-breeder reactor[31]
2. Spent-fuel pond[32]
3. Hot cells[33]

WEAPONS-USABLE URANIUM Yes. There is an unknown amount of HEU in fresh and spent fuel located at this site.

SEPARATED PLUTONIUM No. (See Notes, below.)

MPC&A TIMELINE Work begun: September 1995[34]
Work completed: November 1998[35]

MPC&A STATUS DOE-funded physical protection upgrades focused on the reactor building, which also houses the spent-fuel pond.[36] Upgrades included the installation of automated access control systems and uninterrupted power sources at the main entrance and main guard post; the installation of alarms and locks; the installation of physical barriers and radiation detectors at the nuclear-material storage facility; and the provision of radio communications systems to facility guard forces.[37] Japan assisted with the modernization of physical protection around the perimeter and at the main entrances of the MAEK combine.[38]

To protect plutonium-containing materials further, DOE coordinated an operation to place highly irradiated "hot" spent-fuel assemblies together in six-packs with less-irradiated "cool" spent-fuel assemblies, which were then welded into steel canisters.[39]

U.S. material control and accounting assistance included computer hardware and software for calculating and measuring the nuclear

30. V. Bolgarin et al., "Department of Energy Nuclear Material Protection, Control, and Accounting Program, the Mangyshlak Atomic Energy Complex, Aktau, Republic of Kazakhstan," *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
31. "Kazakhstan: BN–350 Breeder Shut Permanently," *Nucleonics Week,* June 24, 1999, p. 16.
32. Bolgarin et al., "Department of Energy."
33. Ibid.
34. Eras et al., "Department of Energy."
35. "Usileniye fizicheskoy zashchity, kontrolya i ucheta yadernykh materialov na kazakhstanskikh yadernykh ustanovakh," unpublished paper prepared for CNS by the Kazakhstani Institute of Nonproliferation, May 1999, p. 1.
36. Bolgarin et al., "Department of Energy Nuclear Material Protection."
37. "Usileniye fizicheskoy zashchity."
38. Ibid.
39. CNS discussions with DOE officials, December 1999.

loss and production characteristics of the fuel assemblies, as well as the provision of equipment for unattended radiation monitoring in the fuel-handling areas.[40] Japan provided uninterrupted fuel-flow monitors, which use various detectors and computers to allow for verification of what types of fuel have been removed from the active zone of the reactor. Japan also provided computer hardware and software for keeping physical inventory of nuclear materials and established a local-area network. The new computerized accounting system was put in use in September 1996.[41]

The guard force at this facility currently consists of soldiers from the Ministry of Internal Affairs. The MAEK combine is also in the process of forming its own private guard force.[42]

NOTES

- The BN–350 reactor was designed to use HEU fuel enriched to 17–26% and MOX fuel with 23.19% plutonium.[43]
- The reactor was permanently shut down in April 1999[44] and is currently being prepared for decommissioning.[45]
- The reactor was capable of generating more than 110 kg of plutonium annually.[46] Three metric tons of plutonium are present in approximately 300 metric tons of spent fuel.[47]
- In July 1996, Kazakhstan and the United States formed a joint action team to study options for the long-term disposition of the plutonium-laden spent fuel.[48] One option that was discussed and planned for was the removal of the fuel for long-term storage to the more remote, and therefore more secure, former Semipalatinsk Test Site.[49] However, there were some doubts on both the Kazakhstani and the U.S. side as to the desirability of this option,[50] and in December 1999, DOE announced that a joint U.S.-Kazakhstani expert group would begin a new study in early 2000 to explore options for long-term storage of this fuel.[51]

40. Bolgarin et al., "Department of Energy."
41. Yu Hashimoto, "Japanese Support for the Physical Protection and Accountancy for Nuclear Materials in Kazakhstan," abstract from proceedings of the 2nd Annual International Conference on Nonproliferation Problems, Kurchatov and Almaty, Kazakhstan, September 14–17, 1998.
42. Ibid.
43. *World Nuclear Industry Handbook 1992,* Nuclear Engineering International, p. 58.
44. "Kazakhstan: BN–350 Breeder Shut," p. 16.
45. Petr Nazarenko, presentation on the BN–350 reactor at an international seminar, "Nuclear Power Technologies," May 14–17, 2000, Astana, Kazakhstan, as described in Margarita Sevcik, "Trip Report to Astana," June 2, 2000.
46. Vladimir Shmelev, "Estimation of the Quantities of Nuclear Materials at the Facilities in the Newly Independent States," unpublished manuscript, Monterey Institute of International Studies, December 1992.
47. "U.S. Secretary Richardson Highlights Strong U.S.-Kazakhstan Economic Relationship, Expands Energy Cooperation, Announces Nonproliferation Progress," *U.S. Department of Energy News,* August 29, 2000.
48. Fred Crane et al., "MPC&A Aspects of the BN–350 Nuclear Material Disposition Joint Action Team (JAT) Study," *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* September 1998.
49. Sergey Borisov, "Nuclear Wastes Will Remain in Kazakhstan: America Aided the Republic in this Respect," *Obshchaya gazeta,* no. 21, May 28–June 3, 1998, p. 5; and "Problem of Radioactive Waste Disposal Eyed," FBIS–TEN–98–167.
50. CNS staff correspondence with Kazakhstani nonproliferation specialists, November 1999.
51. "U.S., Kazakhstan Agree To Decommission, Secure Kazakhstani Nuclear Reactor Near Iranian Border," Department of Energy press release, December 21, 1999.

TABLE 4.7: NUCLEAR FACILITIES IN LATVIA

NUCLEAR RESEARCH CENTER	
SUPERVISING AGENCY	Latvian Academy of Sciences <www.lza.lv>
LOCATION	Salaspils, approximately 20 km from Riga
SITE ACTIVITIES	Research on nuclear physics, solid-state physics, solid-state radiation physics, radiation metrology, and neutron activation analysis[1]
RELEVANT ASSETS	1. One nonoperational 5-MW research reactor[2] 2. Fresh-fuel storage[3] 3. Spent-fuel storage[4]
WEAPONS-USABLE URANIUM	Yes. There is an unknown amount of HEU located on site.
SEPARATED PLUTONIUM	No
MPC&A TIMELINE[5]	Work begun: July 1994 Work completed: March 1996
MPC&A STATUS	Physical-protection upgrades include strengthened doors and windows in storage areas; improved access controls; the installation of intrusion-detection sensors, alarms, and video surveillance cameras; a new central alarm station; and hand-held radios for guards. Material control and accounting upgrades include the provision of a gamma-ray spectroscopy system, tamper-proof seals, and a computerized accounting program that can be tailored to meet the specific requirements of this facility.[6]
NOTES	• The Nuclear Research Center was founded in 1992 after the nuclear research reactor and several additional laboratories were separated from the Institute of Nuclear Physics.[7] • The 5-MW IRT reactor was shut down and decommissioned in June 1998.[8] The dismantlement of the reactor is scheduled to begin in 2001.[9] The reactor operated with 90% HEU fuel.[10] • The director of the Nuclear Research Center was quoted in the Latvian press as saying there is enough nuclear material at Salaspils to build five nuclear weapons.[11]

1. Latvian Academy of Sciences web site: <www.lza.lv>.
2. Radio Riga Network, "Latvian Government Shuts Down Nuclear Research Reactor," FBIS–SOV–98–170, June 19, 1998.
3. U.S. Department of Energy, "Improving Nuclear Materials Security at the Latvian Academy of Sciences Nuclear Research Center," Partnership for Nuclear Security, Office of Arms Control and Nonproliferation, June 1997.
4. Ibid.
5. Ibid.
6. Ibid.
7. Latvian Academy of Sciences web site: <www.lza.lv>.
8. Radio Riga Network.
9. *Baltic News Service,* "Latvia To Dismantle Salaspils Nuclear Reactor," October 27, 1999, FBIS Document FTS19991027001574.
10. U.S. General Accounting Office, *Nuclear Safety: Concerns with Nuclear Facilities and Other Sources of Radiation in the Former Soviet Union (Letter Report),* GAO/RCED–96–4, November 7, 1995, appendix 2, pp. 23–25.
11. Iveta Tomsone, "Na Salaspilsskom Reaktore Uluchshayut Systemu Bezopasnosti," *Rigas Balss,* January 3, 1996, p. 5.

TABLE 4.8: NUCLEAR FACILITIES IN UKRAINE

INSTITUTE OF NUCLEAR RESEARCH

Институт ядерных исследований
Institut yadernykh issledovaniy
<www.kinr.kiev.ua>

SUPERVISING AGENCY	Ukrainian Academy of Sciences
LOCATION	Kiev
SITE ACTIVITIES	Research in the areas of nuclear physics, nuclear power, radiation, material science, plasma physics, radiobiology, and radioecology[1]
RELEVANT ASSETS	1. One 10-MW research reactor[2] 2. One nonoperational critical assembly[3] 3. Hot cells[4] 4. Fresh-fuel storage[5] 5. Spent-fuel storage[6] 6. George Kuzmycz Training Center for Material Protection, Control, and Accounting[7]
WEAPONS-USABLE URANIUM	Yes. Less than 100 kg of HEU is located on site.[8]
SEPARATED PLUTONIUM	Yes. Small amounts[9]
MPC&A TIMELINE	Work begun: December 1993[10] Work completed: October 1997[11]
MPC&A STATUS	DOE-funded physical-protection upgrades include improved access controls, a strengthened fresh-fuel vault, the installation of interior-intrusion detection sensors and cameras, a new central alarm station, and the construction of a new fence around the reactor building that has been outfitted with cameras and other sensors. Guards have been provided with radios for communication.[12]

1. Institute of Nuclear Research web site, "About the Institute": <www.kinr.kiev.ua>.
2. Ibid.
3. Emily Ewell, interview with Sergei Lopatin, Ukrainian Ministry of Environmental Protection and Nuclear Safety, June 1995.
4. Institute of Nuclear Research web site, "About the Institute": <www.kinr.kiev.ua>.
5. Greg Sheppard, "The U.S. DOE MC&A Assistance Program to Ukraine," *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* U.S. Department of Energy, September 1998.
6. Ibid.
7. "The George Kuzmycz Training Center," U.S. Department of Energy (undated brochure).
8. The exact amount of HEU fuel located at this site is unknown. Research reactors of this size typically have fuel loadings in the tens of kilograms of nuclear material.
9. I. M. Vishnevskiy and V. I. Gavriliuk, "Cooperative Efforts To Improve Accounting, Control, and Physical Protection of Nuclear Material at the Institute for Nuclear Research Scientific Center of the National Academy of Sciences of Ukraine and the State Atomic Energy Commission of Ukraine," *United States/ Former Soviet Union: Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* December 1996, p. NIS–47.
10. Ibid.
11. Unpublished report by Ukrainian nuclear official, summer 1999.
12. "A Report on the Partnership for Nuclear Security," U.S. Department of Energy, October 1995, p. 19; A. Djakov, "Physical Protection Upgrades in Ukraine," *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* U.S. Department of Energy, September 1998; and unpublished report by Ukrainian nuclear official, summer 1999.

(MPC&A STATUS) Material control and accounting upgrades include automation of the inventory system and installation of tamper-indicating devices for nuclear-material containers. In addition, institute scientists worked with DOE to develop the Automated Inventory/Material Accounting System (AIMAS), a software prototype for an MPC&A inventory system for Ukrainian facilities.[13]

DOE funds also helped to establish the George Kuzmycz Training Center, which was formally commissioned in a ceremony in October 1998. The center has provided MPC&A training to hundreds of Ukrainian specialists from scientific research facilities and the energy sector, as well as from the Ministry of Internal Affairs, the Security Service, and the State Export Control Service.[14]

NOTES

- The research reactor is a VVR–M reactor. It operates on 36% HEU fuel, although there remains in the inventory some 90% enriched fuel from its earlier days of operation.[15] A typical reactor core loading is 13.2 kg of 36% HEU.[16]

13. Sheppard, "U.S. DOE MC&A Assistance Program to Ukraine."
14. "Sredstva, predostavlennyye Ukraine po programme Nanna-Lugara, ispolzuyutsya po naznacheniyu, schitayut amerikanskiye chinovniki," UNIAN, no. 21, May 24–30, 1999.
15. Correspondence with Greg Sheppard, Ukraine/Belarus Project Manager, DOE International Safeguards Division, July 2000.
16. Vishnevskiy and Gavriliuk, "Cooperative Efforts."

NATIONAL SCIENCE CENTER: KHARKIV INSTITUTE OF PHYSICS AND TECHNOLOGY (KhIPT)

Харьковский физико-технический институт
Kharkovskiy fiziko-tekhnicheskiy institut
<www.kipt.kharkov.ua/>

SUPERVISING AGENCY Ministry of Science and Technology[17]

LOCATION Kharkiv, in eastern Ukraine, near the Russian-Ukrainian border

SITE ACTIVITIES Research in solid-state physics, plasma physics, thermonuclear fusion, nuclear physics, plasma electronics, physics and the technology of heavy-particle accelerators, and theoretical physics[18]

RELEVANT ASSETS Fissile-material storage facility

WEAPONS-USABLE URANIUM Yes. Up to 75 kg of 90% enriched HEU is located on site.[19]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: June 1995[20]
Work completed: January 1999[21]

MPC&A STATUS U.S. assistance focused on this facility's nuclear material storage facility. Japan and Sweden also provided assistance, focusing on the perimeter of the facility. Physical-protection upgrades include a new perimeter fence outfitted with intrusion-detection sensors, video surveillance cameras, and improved lighting. Storage building modifications include strengthened access control; the installation of radiation, metal, and intrusion detectors; and strengthened walls, windows, and doors. In addition, a modular vault was installed to provide immediate protection of the nuclear materials.[22]

U.S. material control and accounting assistance included provision of gamma-ray nondestructive assay equipment; bar-code equipment, and inventory control software for material accounting.[23] In addition, DOE assisted with the repackaging of HEU into special containers (designed and manufactured by the Kharkiv Institute) that allow for easier material accountability. During the repackaging process, the nuclear materials were weighed and analyzed and a

17. Kharkiv Institute of Physics and Technology web site: "History" <www.kipt.kharkov.ua>.
18. "Natsionalnyy Nauchnyy Tsentr Kharkovskiy Fiziko-Tekhnicheskiy Institut," 1996 (brochure); and Center for Nonproliferation Studies' NIS Nuclear Profiles Database, *Ukraine: Research, Power, and Waste,* "Kharkiv Institute of Physics and Technology."
19. CNS discussions with Ukrainian specialists, 1995.
20. Valerij A. Mikhailov et al., "MPC&A Upgrades at the Kharkov Institute of Physics and Technology [Ukraine]," *Partnership for Nuclear Security: United States/ Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting,* U.S. Department of Energy, September 1998.
21. U.S. Department of Energy MPC&A web site: News Archives, "United States and Ukraine Complete Nuclear Material Control Systems at Three Sites": <www.nn.doe.gov/mpca/index.html>, January/February 1999 *News*.
22. Mikhailov et al., "MPC&A Upgrades."
23. U.S. Department of Energy MPC&A web site: News Archives, "United States and Ukraine Complete Nuclear Material Control Systems at Three Sites."

(MPC&A STATUS) comprehensive inventory was completed.[24] Japan also provided assistance in the repackaging process.[25]

NOTES
- The KhIPT does not appear to be using its HEU in any current projects or experiments.[26]

24. Sheppard, "U.S. DOE MC&A Assistance Program to Ukraine."
25. Mikhailov et al., "MPC&A Upgrades."
26. Unpublished report by Ukrainian nuclear official, summer 1999.

SEVASTOPOL INSTITUTE OF NUCLEAR ENERGY AND INDUSTRY

Севастопольский институт ядерной энергии и промышленности
Sevastopolskiy institut yadernoy energii i promyshlennosti

SUPERVISING AGENCY National Nuclear Generating Company (Enerhoatom)

LOCATION Sevastopol, in southern Ukraine on the coast of the Black Sea

SITE ACTIVITIES Future activities are likely to include the training of nuclear power plant operators and scientific research.

RELEVANT ASSETS
1. One nonoperational 200-kW research reactor[27]
2. Two subcritical assemblies[28]
3. Fresh-fuel storage[29]

WEAPONS-USABLE URANIUM Yes. Less than 100 kg of HEU is located on site.[30]

SEPARATED PLUTONIUM No

MPC&A TIMELINE Work begun: May 1996[31]
Work completed: January 1999[32]

MPC&A STATUS Physical-protection upgrades include exterior lighting, the installation of a second fence around the control zone, interior and perimeter intrusion-detection assessment, vehicle barriers, improved access controls, a new fresh-fuel storage vault, and a new central alarm station.[33] According to Ukrainian specialists, radiation and metal detectors have not been installed at this facility.[34] MPC&A assistance included the provision of nondestructive assay equipment, tamper-indicating devices, computers, and inventory control software for material accounting.[35]

NOTES
- The research reactor previously ran on 10% enriched fuel. Future plans are to operate the reactor using 36% enriched fuel. At least one core loading of such fuel has already been delivered.[36]
- The reactor was previously used to train Soviet nuclear submarine operators.[37]

27. Emily Ewell, "Trip Report: Uzbekistan, Kazakhstan, Ukraine," CNS, Monterey, Calif., June 1–21, 1995.
28. Ibid.
29. CNS correspondence with Phil Robinson, U.S. Department of Energy, December 1999.
30. The exact amount of HEU fuel located at this site is unknown. Research reactors of this size typically have fuel loadings in the tens of kilograms of nuclear material.
31. Correspondence with Greg Sheppard, Ukraine/Belarus project panager, DOE International Safeguards Division, July 2000.
32. Ibid.
33. CNS correspondence with Phil Robinson.
34. Unpublished report by Ukrainian nuclear official, summer 1999.
35. U.S. Department of Energy MPC&A web site: News Archives, "United States and Ukraine Complete Nuclear Material Control Systems at Three Sites."
36. Correspondence with Greg Sheppard.
37. Ewell, "Trip Report," June 1–21, 1995.

(NOTES)

- This institute was previously known as the Sevastopol Naval Academy of the Ukrainian Ministry of Defense. It became the Sevastopol Institute of Nuclear Energy and Industry in September 1996.[38]

38. CNS staff correspondence with Ukrainian nuclear official, January 1998.

TABLE 4.9: NUCLEAR FACILITIES IN UZBEKISTAN

INSTITUTE OF NUCLEAR PHYSICS

	Институт ядерной физики Institut yadernoy fiziki
SUPERVISING AGENCY	Academy of Sciences of the Republic of Uzbekistan
LOCATION	Ulugbek, approximately 30 km from Tashkent
SITE ACTIVITIES[1]	1. Research on particle and nuclear physics, radiation, and material sciences (including semiconducting and high-temperature superconducting materials), activation analysis and radiochemistry, and the production of nonstandard radiation devices. 2. Commercial isotope production
RELEVANT ASSETS[2]	1. One 10-MW research reactor 2. Fresh-fuel storage 3. Spent-fuel storage
WEAPONS-USABLE URANIUM	Yes. Less than 100 kg of HEU is located on site.[3]
SEPARATED PLUTONIUM	No
MPC&A TIMELINE	Work begun: September 1995[4] Work completed: August 1996[5]
MPC&A STATUS	U.S.-provided physical-protection assistance included relocation of fresh fuel to a new vault in the reactor building; building modifications (installing security grills over first-floor windows and adding new doors); improved access control; and the installation of magnetic locks, alarms, video cameras, intrusion detection sensors, and nuclear-material detectors.[6] Material control and accounting upgrades include provision of tamper-indicating devices and a fresh-fuel measurement system. Australia has provided a computer-based material accounting system and accounting software.
NOTES	• The research reactor is a VVR–SM reactor. It previously operated on 90% HEU fuel and is currently operating with a combination of 36% and 90% HEU fuel. The institute hopes to reduce the fuel enrichment level further to 20%.[7] • The fresh fuel in storage is 36% HEU.[8] • Spent fuel is stored in two on-site cooling ponds.[9]

1. Emily Ewell, "Trip Report: Uzbekistan, Kazakhstan, Ukraine," CNS, Monterey, Calif., May 1996.
2. CNS staff visits to the Institute of Nuclear Physics in 1996, 1997, and 1999.
3. The exact amount of HEU fuel at this site is unknown, but research reactors of this size have fuel loadings in the tens of kilograms of nuclear material.
4. U.S. Department of Energy, "Improving Nuclear Material Security."
5. Ibid.
6. Ibid.
7. Interview with Bekhzad Yuldashev, director, Institute of Nuclear Physics, February 1999.
8. Ibid.
9. Ewell, "Trip Report," May 1996.

PHOTON OPEN JOINT-STOCK COMPANY

Открытое акционерное общество (ОАО) «Фотон»
Otkrytoye Aktsionernoye Obshchestvo (OAO) "Foton"
<www.foton.uz/rus/index.htm>

SUPERVISING AGENCY Unknown

LOCATION Tashkent

SITE ACTIVITIES Unknown

RELEVANT ASSETS One research reactor[10]

WEAPONS-USABLE URANIUM Yes. There is at least 4.5 kg of HEU located on site.

SEPARATED PLUTONIUM No

MPC&A STATUS No known MPC&A upgrades or improvements have taken place at this site since Uzbekistan's independence in 1991. DOE officials visited this site when they first began work in Uzbekistan in 1995 but determined that the material did not pose a proliferation risk and therefore did not warrant MPC&A upgrades. DOE officials, however, have noted that they may revisit this site in the future to confirm that their original findings are still valid.[11]

NOTES

- The research reactor is an IIN–3M liquid (water-uranium salt) pulsed reactor and uses liquid salt 90% HEU fuel. The reactor is used to improve the properties of semiconductors. The average power use for the reactor is 10 kW, and the maximum power per pulse is 200 GW.[12]
- According to one Uzbekistani official, there is enough fuel at this site to last at least 20 years.[13] There is approximately 4.5 kg of HEU in the reactor core.[14] It is possible that the only fuel currently at this site is loaded in the reactor. Officials at the Institute of Nuclear Physics in Ulugbek do not believe that any fresh fuel is stored on site.[15]
- Before Uzbekistan's independence this plant fell under the auspices of the Soviet Ministry of Electronic Production and produced microcircuits for submarines.[16]

10. CNS staff correspondence with Uzbekistani nuclear scientist, October 1997.
11. Emily Ewell Daughtry, correspondence with Phil Robinson.
12. CNS staff correspondence with Uzbekistani nuclear scientist, October 1997.
13. Emily Ewell, interview with Uzbekistani nuclear official, June 1995.
14. CNS staff correspondence with Uzbekistani nuclear scientist, October 1997.
15. Emily Ewell Daughtry, interview with Bekhzad Yuldashev.
16. Artem Gorodnov, "Uzbekskoye Predpriyatiye Poluchit Grant v 2 Milliona Dollarov," *Segodnya,* May 22, 1996, p. 9.

CHAPTER 5

Status of Export Controls in the Former Soviet Union

THE DEVELOPMENT OF effective export control systems is one of the biggest nonproliferation challenges facing the states of the former Soviet Union. Over the past decade, the countries of the former Soviet Union have tackled the difficult task of simultaneously opening their markets and expanding foreign trade while trying to develop and implement strict government oversight and controls over exports of weapons of mass destruction (WMD)–related goods and technologies.

By 1997, all fifteen Newly Independent States (NIS) had joined the Nuclear Non-Proliferation Treaty (NPT) and accepted the basic obligation not to export nuclear materials, or equipment for the production of nuclear materials, unless they were covered by International Atomic Energy Agency (IAEA) safeguards. There is a significant gap, however, between a commitment to this basic obligation and the development of an effective nonproliferation-based export control system. Some countries, such as Azerbaijan and Kyrgyzstan, have only the most rudimentary export controls in place. Other countries, such as Georgia and Tajikistan, have taken the important step of passing a comprehensive export control law but have not yet formalized export licensing and decision-making structures.

Russia, Kazakhstan, and Ukraine have the most well developed legal and bureaucratic infrastructures in place of all the states, but they are still refining the implementation of their export control systems. In addition, few NIS countries have joined the four nonproliferation-related multilateral export control regimes (see table 5.1).

This section concentrates on the export control structures that have been put in place in Russia, Kazakhstan, and Ukraine. These three states inherited the bulk of the former Soviet Union's highly developed nuclear and missile industries, necessitating effective export controls that conform to international norms and standards. For each country, this section outlines three basic components of an export control system.

- The legal framework, with a focus on export control laws, regulations, and control lists
- The export licensing process
- Participation in multilateral export control agreements

All three countries have made significant progress in putting basic export control building blocks into place and have a solid understanding of how export controls contribute to nonproliferation. Russia had a head start in its efforts, as it subsumed the reasonably effective export control system of the former Soviet Union. Kazakhstan and Ukraine have both benefited from intense U.S. assistance, which has helped over the past decade to create self-sustaining export control systems.

Export controls are important even for those countries that do not themselves produce and export items that could be used in the development of WMD. Smaller countries, such as those in the Baltics, Caucasus, and Central

TABLE 5.1: NIS MEMBERSHIP IN INTERNATIONAL EXPORT CONTROL REGIMES[1]

	Nuclear Suppliers Group (NSG)	Missile Technology Control Regime (MTCR)	Australia Group	Wassenaar Arrangement
Armenia	No	No	No	No
Azerbaijan	No	No	No	No
Belarus	Yes. Member since 2000.[2]	No	No	No
Estonia	No	No	No	No
Georgia	No	No	No	No
Kazakhstan	No[3]	No	No	No
Kyrgyzstan	No	No	No	No
Latvia	Yes. Member since 1998.[4]	No	No[5]	No[6]
Lithuania	No	No	No	No
Moldova	No	No	No	No
Russia	Yes. Founding member (1975).[7]	Yes. Member since 1995.[8]	No	Yes. Founding member (1996).[9]
Tajikistan	No	No	No	No
Turkmenistan	No	No	No	No
Ukraine	Yes. Member since 1996.[10]	Yes. Member since 1998.[11]	No	Yes. Founding member (1996).[12]
Uzbekistan	No	No	No	No

1. The source for all negative answers in this table is "Table of Membership of Multilateral Military-Related Export Control Regimes," as of March 1, 2000, SIPRI web site: <projects.sipri.se/expcon/natexpcon/country_matrix.html>
2. "Belorussiya stala polnopravnym chlenom gruppy yadernykh postavschikov," *Interfax*, no. 3 (June 1, 2000).
3. Kazakhstan is taking the necessary preparatory steps to join the Nuclear Supplier's Group. At the 1999 NSG meeting in Florence, Italy, the chair was mandated to pursue contacts with Kazakhstan with a view to membership. V. Koroblyev, "Eksportniy kontrol v Kazakhstane: problemy i ikh resheniye," lecture given as part of the CNS Nonproliferation Lecture Series in Almaty, Kazakhstan, September 1999; and the press statement of the plenary meeting of the Nuclear Suppliers Group, Florence, Italy, May 5–6, 1999, on the SIPRI web site: <projects.sipri.se/expcon/nsg_plenary99.htm>.
4. Press statement of the Plenary Meeting of the Nuclear Suppliers Group, Edinburgh, Scotland, April 1–2, 1998, posted on the SIPRI web site: <projects.sipri.se/expcon/nsg_plenary98.htm>.
5. Applied to Australia Group in February 1996; "Export Control System in the Republic of Latvia," SIPRI Export Control Project, SIPRI web site: <projects.sipri.se/expcon/natexpcon/latvia/latvia.htm>.
6. Applied to Wassenaar Arrangement in November 1995; ibid.
7. *Inventory of International Nonproliferation Organizations and Regimes: 2000 Edition*, Center for Nonproliferation Studies (CNS), Monterey Institute of International Studies, August 2000.
8. Press release, Missile Technology Control Regime, Bonn, Germany, October 12, 1995; and CNS NIS Nuclear Profiles database, *Russia: International Organizations and Treaties,* "Missile Technology Control Regime."
9. "Developing the Wassenaar Arrangement"; and CNS NISNP database, "Wassenaar Arrangement/COCOM Successor."
10. Zaborsky, "Ukraine Restructures Its Arms Export Controls," *Jane's Intelligence Review* (November 1999), pp. 19–22.
11. Ibid.
12. Ibid.

Asia, could play an important role in the transit of exports from other NIS countries. While Russia, Kazakhstan, and Ukraine have all taken steps to develop effective export control systems, the state of export controls in the other twelve countries of the NIS is inconsistent. Belarus, Latvia, and some of the other Baltic countries also have fairly well developed systems in place, while others states have a great deal of work ahead of them. Although some steps have been taken in almost all the Newly Independent States (with the possible exception of Turkmenistan, where virtually no export control work has been done),[13] generally these countries are still putting in place the legislation, regulations, and bureaucratic processes needed for a basic export control system.

The Russian Federation

The Russian Federation has been developing its nonproliferation export controls since 1992 and currently has a comprehensive but complicated export control system in place.[14] As noted, Russia inherited the Soviet system of export controls and did not have to build an export control system from scratch. Instead, Russia has faced the challenge of altering its export control system to cope with the demands of a changing economy and an increasing number of private enterprises and export firms, as well as a less centrally controlled society. In this task, Russia has drawn upon the considerable export control expertise and experience that existed in Moscow during the Soviet regime. Despite this advantage, the development and implementation of effective nonproliferation export controls in Russia has been arguably more daunting than in other NIS countries. This is in large part a result of the sheer size of Russia's military-industrial complex—in particular its nuclear and missile industries—and the large number of sensitive goods and technologies that its enterprises produce.

The legislative basis of Russia's export controls consists primarily of a series of executive branch decrees and resolutions, as well as its comprehensive Law on Export Controls, passed in June 1999. The law, which provides a strong legal basis for the Russian export control system, states that nonproliferation is one of the fundamental principles of export control policy. The law requires the development of internal export control compliance programs for all enterprises that regularly trade in controlled goods and technologies. In an effort to improve the effective implementation of export controls, relevant export control-related government bodies have placed particular emphasis in recent years on helping enterprises and potential exporters to understand the export control system and develop their own internal programs.[15] (The Moscow-based nongovernmental Center on Export Controls also plays an important role in this area, holding seminars and workshops on the Russian export control system for enterprises in cities throughout the Russian Federation.)[16]

The interagency Export Control Commission and its working body, the Federal Service for Currency and Export Control (VEK), have played primary roles in the Russian export control system. The commission is responsible for coordinating state nonproliferation export control policies.[17] VEK was the working body and permanent secretariat for the commission and

13. Monterey Institute for International Studies, CNS staff interviews with Turkmenistani government officials, Ashgabat, Turkmenistan, June 1999.

14. For recent analyses in English of the Russian export control system, see Vladimir Orlov, "Export Controls in Russia: Policies and Practices," *Nonproliferation Review,* vol. 6, no. 4 (fall 1999); and Elina Kirichenko, "Technology Transfers and Export Controls: A Russian Perspective," *The Monitor,* vol. 6, no. 2 (spring 2000).

15. Kirichenko, "Technology Transfers and Export Controls," p. 23.

16. Center on Export Controls web site: <www.expcon.ru>.

17. The commission was established by Presidential Decree 388 on April 11, 1992. Emily Ewell and Holly Tomasik, "Nuclear Export Controls of the Russian Federation: A Status Report," CNS unpublished report, prepared for the Office of Arms Control and Nonproliferation, U.S. Department of Energy, December 1996. The Export Control Commission comprises the deputy heads of the Ministry of Foreign Affairs, the Ministry of Defense, the State Customs Committee, the Federal Security Service, the State Committee on Nuclear and Radiation Safety, the Russian Academy of Sciences, and possibly the new Ministry of Economic Development and Trade and the Ministry of Science, Industry, and Technology. (Formerly, the deputy heads of the now-eliminated Ministries of Economics and Trade were included on this commission.) Orlov, "Export Controls in Russia."

had previously been responsible for issuing formal permission for exports—a key step in the export licensing process (see below). In May 2000, however, VEK was eliminated as part of President Vladimir Putin's restructuring of the Russian government;[18] it was replaced by a newly created Department of Export Control in the new Ministry of Economic Development and Trade. Export licenses continue to be issued by the Department of Nontariff Regulation, which was moved from the Ministry of Trade (also eliminated in May 2000) to the Ministry of Economic Development and Trade.[19] Other bodies that play a key role in the export control process include the government (pravitelstvo), which refers to the administrative structure of the office of the prime minister, the Ministry of Atomic Energy (for nuclear-related exports), the Russian Aerospace Agency (for missile-related exports), the Ministry of Foreign Affairs, the Ministry of Defense, and the Customs Committee.

Legal Infrastructure

Because of the great number of laws, decrees, and resolutions pertaining to export controls in the Russian Federation, the following list includes only the most important legislative acts and executive decrees for nuclear- and missile-related export controls.

LAW ON EXPORT CONTROL, JULY 29, 1999. This law was passed by the Russian Duma on June 22, 1999, was approved by the Federation Council on July 2, 1999, signed by President Boris Yeltsin on July 18, 1999, and entered into force on July 29, 1999.

Article 1 of the law gives a legal definition of the term *export control*, which it describes as a group of measures regulating "foreign economic activity with goods, information, work, services, and the results of intellectual activity that could be used in the development of weapons of mass destruction, their delivery systems, and other types of weapons and military equipment." Article 4 declares that the objectives of the Russian export control system are to (1) protect the interests of the Russian Federation; (2) satisfy the requirements of international agreements on the nonproliferation of weapons of mass destruction and their delivery systems; and (3) create the necessary conditions for the integration of Russia into the international economy. Article 6 states that export control lists will be drawn up by the president, in consultation with the Federal Assembly and industry representatives. This process is a change from previous regulations, whereby the executive branch had sole discretion over the content of the lists. The law requires "transparency" and open access to information on the export control system. Article 9 establishes an "interdepartmental export control coordinating body" to oversee federal export control policy. (Despite the fact that this appears to refer to the interagency Export Control Commission, it is not clear whether the commission will in fact fill this role.)[20] Article 9 also authorizes the creation of a "special authorized federal executive body in the export control sphere" to implement that policy. Article 16 directs the Russian government to aid in the establishment of internal export control compliance departments at companies that deal in controlled goods and technologies. This article also makes the establishment of such departments mandatory at Russian firms that conduct "scientific or production activity in support of federal defense and national security requirements" or "regularly earn income from foreign trade operations involving controlled goods and technologies." Article 17 authorizes this latter body to conduct detailed audits of organizations suspected of possible export control violations. Article 20 establishes the legal basis for the use of the catch-all principle, which was introduced into the Russian export control system by Government Resolution 57 in January 1998. Article 25 allows the imposition of export controls on WMD-related technology on the basis of either international agreements or Russian national interests, laying the legal basis for the imposition of unilateral export controls.

18. RFE/RL Newsline, May 19, 2000, on the RFE/RL web site: <www.rferl.org/newsline/2000/05/1-rus/rus-190500.html>.

19. CNS correspondence with Russian export control specialist, August 2000.

20. CNS correspondence with Russian export control specialist, August 2000.

Article 32 calls for sanctions against those entities violating Russian export control regulations. Such sanctions range from fines to more severe measures. The article states that in "extreme cases that result in the infliction of considerable damage to the economic interests of the Russian Federation, national defense, and state security or in the case of a repeat offense, the organization may lose the right to conduct certain types of foreign economic activities for up to three years."[21]

GOVERNMENT RESOLUTION 57, JANUARY 22, 1998, "On Strengthening Export Controls for Dual-Use Goods and Services That Are Related to Weapons of Mass Destruction and Missile Delivery Systems." This resolution introduces the idea of catch-all controls in Russian export control legislation. It states that Russian entities must refrain from exporting any dual-use goods and services, even if they are not on any Russian export control lists, if there is reason to believe that the goods will be used in the production of nuclear, chemical, or biological weapons or in missile delivery systems.[22] In addition, Russian entities are required to inform the Government Commission on Export Control of any decision not to export dual-use goods and services for the aforementioned reasons.[23]

CRIMINAL CODE OF THE RUSSIAN FEDERATION, JANUARY 1, 1997. The Criminal Code was passed on June 13, 1996, and entered into force on January 1, 1997. This law contains several articles addressing export control violations and the illegal handling of nuclear and radioactive materials. In particular, Article 188 provides criminal penalties for smuggling illicit materials, including materials or equipment that could be used in the development of a weapon of mass destruction. Article 189 provides criminal penalties for the illegal export of technologies, scientific-technical information, and services that could be used to develop weapons of mass destruction; means of delivery; and arms and military technology.[24] Penalties range from prison terms of three to seven years and from five to ten years for multiple offenders or government officials making use of their official position to violate such controls.[25] Article 355 makes the production, acquisition, or selling of weapons of mass destruction punishable by up to ten years imprisonment.[26]

PRESIDENTIAL DECREE 1194, AUGUST 16, 1996, "On Control of Exports of Equipment, Materials, and Technology Used To Develop Missile Weapons," amended by Presidential Decree 7, January 1999. This decree approved a new export control list for missile-related equipment, materials, and technologies, in accordance with Russia's accession to the MTCR in October 1995.[27] The control list was amended in January 1999, in accordance with changes made in the MTCR's international control lists.[28]

GOVERNMENT RESOLUTION 575, MAY 8, 1996, "On Approval of the Statute Regulating Exports of Dual-Use Equipment, Materials, and Related Technologies Applied for Nuclear Purposes." This resolution established export procedures for dual-use nuclear-related items on the national control list (Presidential Decree 228).[29]

GOVERNMENT RESOLUTION 574, MAY 8, 1996, "On Approval of the Statute Regulating Exports and Imports of Nuclear Materials, Equipment, and Special Nonnuclear Materials, and Related

21. From the FBIS English-language translation of the law, FBIS Document FTS19990623001475, originally published in Russian in *Rossiyskaya gazeta*, July 29, 1999, pp. 4–5.
22. Orlov, "Export Controls in Russia."
23. From the Russian-language text of the decree.
24. "Excerpts from the Criminal Code of the Russian Federation," *The Monitor*, vol. 2, no. 4 (fall 1996), University of Georgia, pp. 33–35; and CNS correspondence with Russian export control specialist, August 2000.
25. Orlov, "Export Controls in Russia."
26. CNS staff correspondence with Gary Bertsch, University of Georgia, January 1998.
27. *Interfax*, January 5, 1999; and "Yeltsin Decrees 'Confirmed' Commitment to Nonproliferation," FBIS Document FTS19990105000690.
28. CNS correspondence with Russian export control specialist, August 2000.
29. From the Russian-language text of the decree.

Technologies." This resolution established export procedures for nuclear-related items on the national control list (Presidential Decree 202). The resolution introduced significant changes into the export process for critical nuclear items.[30]

PRESIDENTIAL DECREE 228, FEBRUARY 21, 1996, "On Approval of the List of Dual-Use Equipment, Materials, and Related Technology, Export of Which Is Controlled." This decree approves the national control lists of dual-use nuclear materials, equipment, and technology.[31]

PRESIDENTIAL DECREE 202, FEBRUARY 14, 1996, "On Approval of the List of Nuclear Materials, Equipment, Special Nonnuclear Materials and Related Technologies, Subject to Export Controls," amended by Presidential Decree, May 1997. This decree approves the national control list for nuclear materials, equipment, and technology. A May 1997 presidential decree introduced changes and additions to this list.[32]

GOVERNMENT RESOLUTION 70, JANUARY 27, 1993, "On Approval of the Statute Regulating Control of Exports from the Russian Federation of Equipment, Materials, and Technology Employed To Develop Missile Weapons," amended by Government Resolutions in November 1993, May 1995, and September 1996. This resolution establishes export licensing procedures for equipment, materials, and technologies used to produce missiles capable of delivering payloads of at least 500 kg to a range of at least 300 km (the initial parameters of the Missile Technology Control Regime [MTCR]). The resolution also defines the export licensing authority and guidelines for missile exports. Of the three sets of amendments, those adopted in November 1993 were the most significant, changing the export licensing guidelines to more closely reflect MTCR guidelines. The September 1996 amendments change the licensing procedures to reflect the new missile control list, adopted by presidential decree in August 1996 (see below).[33]

PRESIDENTIAL DECREE 312, MARCH 27, 1992, "On Control over Export of Nuclear Materials, Equipment, and Technologies from the Russian Federation," and amended by Presidential Decree 12, May 2000. This decree stipulates Russia's adherence to a policy requiring full-scope IAEA safeguards on all nuclear activities as a condition of export to non-nuclear-weapon states (NNWS).[34] The 1992 decree, however, did include language stating that certain nuclear exports to NNWS without full-scope safeguards could be allowed by "individual government decision under certain conditions."[35] The decree was amended in May 2000 to state more explicitly that nuclear exports to non-nuclear-weapon states that do not have a full-scope safeguard agreement are permissible if the following conditions are met.

- The implementation of the export transaction does not contradict Russia's international commitments.
- The government of the importing country has provided an official pledge that the supplied material, equipment, and technologies shall not be used in any way that may result in the creation of a nuclear explosive device.
- The export transaction is carried out solely for the purposes of ensuring the safe operation of preexisting nuclear installations in the importing country.
- The aforementioned installations are subject to IAEA safeguards.

30. Critical nuclear items are defined as uranium enriched to 20% or higher, plutonium, reprocessing equipment, equipment for uranium isotope separation, equipment for heavy-water production, equipment for the conversion of enriched uranium and plutonium, and technologies related to these items.
31. From the Russian-language text of the decree.
32. From the English-language translation of the decree, published in *Nonproliferation Export Controls in Russia*, no. 2 (4) (May 1997).
33. Ewell and Tomasik, "Nuclear Export Controls of the Russian Federation."
34. Ewell and Tomasik, "Nuclear Export Controls of the Russian Federation."
35. CNS correspondence with Russian export control specialist, August 2000.

The amendment further states that Russia has the right to stipulate additional conditions for such export transactions.[36]

The Export Licensing Process

The Russian export licensing system includes the following steps: an internal review by the exporting company; a ministerial review by the ministry overseeing the particular exporting enterprise; special permission from the government and the Export Control Commission for certain critical nuclear exports; a review by the Department of Export Controls in the Ministry of Economic Development and Trade, including an interagency review; a review by the Federal Agency for the Protection of State Property, located in the Ministry of Justice; a formal export license application review by the Department of Nontariff Regulation in the Ministry of Economic Development and Trade; and a final check of all documents by the Customs Committee.

Exporting companies are required to conduct an internal review of proposed exports, as part of their export control compliance program. Although such programs are mandated by the June 1999 Law on Export Controls, the Ministry of Atomic Energy (Minatom), has required internal compliance programs at its enterprises since May 1996.[37] VEK published guidelines on the establishment of such programs at all Russian enterprises that export controlled goods and technologies in May 1998.[38]

Nuclear-Related Exports

For all nuclear exports, Minatom requires its enterprises to submit export proposals to the Minatom Export Council for review. If the Export Council approves the proposed export but determines that it requires an export license, the applicant may proceed to the next step. In order to export critical trigger list items—uranium enriched to 20% or higher, plutonium, and equipment, material, and technology for use in nuclear-fuel reprocessing, uranium enrichment, heavy-water production, or the conversion of enriched uranium or plutonium—permission must be obtained from the government even to enter into negotiations with a foreign partner. Once permission has been granted and a contract concluded, the Export Control Commission must issue a finding on the possibility of implementing the contract (such permission is not required for dual-use or other noncritical nuclear exports).[39]

The potential exporter must next receive a certificate from the Federal Agency for the Protection of State Property,[40] as well as approval from the Department of Export Control in the Ministry of Economic Development and Trade regarding the possibility of export. The Department of Export Controls sends the potential export contract to a number of other ministries for review, including the Ministry of Foreign Affairs and Ministry of Defense. Only then may the potential exporter formally apply for an export license at the Ministry of Economic Development and Trade's Department of Nontariff Regulation.

The actual export license application is a purely administrative process, as all necessary permissions must be obtained before this stage. In the final step of this process, the exporter must fill out a customs declaration. For the export of controlled items, the Nontariff

36. From an English-language translation of the decree, "On Amending Russian Presidential Edict 312, dated March 27, 1992, 'On Control over the Export of Nuclear Materials, Equipment, and Technologies from the Russian Federation,' " communiqué of the press service of the president of the Russian Federation, May 7, 2000. Minatom officials have emphasized that this amendment refers only to exports necessary for the safe operation of existing nuclear installations and thus does not contradict the guidelines of the NSG. CNS correspondence with Russian export control specialist, August 2000.

37. From the Russian-language text of *Ministry of Atomic Energy Order 432*, "On the Procedures for Export and Import of Nuclear Material, Equipment, Special Nonnuclear Material, and Corresponding Technology," July 17, 1996.

38. From the Russian-language text, "Guidelines for the Establishment of an Internal System for Export Control at the Enterprise (Organization)," approved by R. A. Safaraliyev, deputy director of the Federal Service for Currency and Export Control.

39. CNS staff discussion with Russian export control specialist, October 1997.

40. The Federal Agency for the Protection of State Property (FAPRID) evaluates whether the state has intellectual property rights associated with the potential export if that export was developed with government funding.

Division of the Customs Committee will review the customs declaration, export license, and accompanying documentation. If it appears that an item on the customs declaration might be controlled but does not have an export license, customs officials may begin an investigation, which can include consultations with Minatom, the Ministry of Defense, and other government agencies.

Multilateral Agreements

Russia inherited the former Soviet Union's status as a founding member of the Nuclear Suppliers Group (NSG).[41] Russia was formally admitted into the Missile Technology Control Regime in October 1995[42] and became a founding member of the post–COCOM Wassenaar Arrangement in 1996.[43] Currently, Russia is not a member of the Australia Group, although its control lists in the sphere of biological- and chemical-weapons-related goods and technologies are consistent with the guidelines of the Australia Group.[44]

Russia is also a party to the "Agreement on Coordination Regarding Issues of Export Control of Raw Materials, Materials, Equipment, Technology, and Services That Could Be Used in the Production of Weapons of Mass Destruction and Their Delivery Systems," also known as the Minsk Accords, signed on June 26, 1992, by Commonwealth Independent States (CIS) members.[45] According to the agreement, the parties will create national export control systems, coordinate their efforts to control exports of materials used in the production of weapons of mass destruction, and create uniform control lists based on existing international export control regimes.[46] To date, however, little has been done to implement this agreement. Russia is also a member of a "Customs Union" with Belarus, Kazakhstan, Kyrgyzstan, and Tajikistan and has been a proponent of greater integration among the NIS countries in this sphere.

Kazakhstan

Kazakhstan began developing its export control system upon gaining independence in the early 1990s and now has a fairly well developed control system in place. The country has a strong legislative basis for export controls, an export licensing process with interagency review, and relevant officials have a firm understanding of non-proliferation-related export control issues. Nuclear export controls have been in place the longest and include a mandatory review of all license applications by the Kazakhstani Committee on Atomic Energy. Since 1999, partially in response to the controversial export of MiG aircraft to North Korea, Kazakhstani officials have worked to strengthen export control over military goods and technology.

Export controls in Kazakhstan are primarily implemented by: the government (or pravitelstvo); the Ministry of Energy, Industry, and Trade; the Committee on Atomic Energy; the Ministry of Foreign Affairs; and the newly created Interagency Commission of the Security Council on Issues of Export of Weapons, Military Equipment, and Dual-Use Materials.[47] The interagency State Commission for Export Control Issues, created by a December 1999 government resolution, is responsible for making recommendations on how to strengthen the

41. Michael Beck, "Russia and Efforts To Establish Export Controls," *Global Evaluation of Nonproliferation Export Controls: 1999* (Center for International Trade and Security, University of Georgia, 1999).

42. Press release, Missile Technology Control Regime, Bonn, Germany, October 12, 1995.

43. "Developing the Wassenaar Arrangement: A New Arms Export Control Regime," *Saferworld* report, September 1996, <www.gn.apc.org/sworld/wassen.html>.

44. Beck, "Russia and Efforts To Establish Export Controls."

45. From the Russian-language text of the Minsk Accord, "Agreement on Coordination of Work on Issues of Export Control," June 26, 1992.

46. From the Russian-language text of the Minsk Accord, "Soglasheniye o koordinatsii rabot po voprosom eksportnogo kontrolya," June 26, 1992.

47. The new interagency commission was created by presidential decree in June 2000. Permission from this commission must be secured to export weapons, military equipment, and dual-use materials. CNS correspondence with Kazakhstani export control official, August 2000, and "Kazakhs Set up Special Body To Control Arms Sales," Reuters, June 8, 2000.

export control system. The Customs Committee and the Committee for National Security have primary responsibility for export control enforcement.

Two state-controlled companies export the majority of all controlled goods and technology from Kazakhstan—Kazatomprom and Kazspetseksport. Kazatomprom manages the government's uranium mining and milling assets and the production of nuclear fuel and special dual-use equipment, technology, and materials. Kazatomprom is given preference in all export deals involving these items and is Kazakhstan's representative in these areas on the world market.[48] Kazspetseksport is subordinate to the Kazakhstani Ministry of Defense and has the task of marketing Kazakhstani military equipment and strategic materials globally. Its activities include the sale of arms and military equipment, ammunition, strategic raw materials, and dual-use materials. Kazspetseksport was previously called the Karu-Zharak State Enterprise.[49]

Legal Infrastructure

The following list provides the details of key Kazakhstani export control-related legislative acts and executive decrees.

LAW ON THE EXPORT OF ARMS, MILITARY TECHNOLOGY, AND DUAL-USE PRODUCTS, JULY 18, 1996, amended November 24, 2000. This law provides a broad legal basis for export controls. It states that Kazakhstani export controls are established in the interests of national and international security and in order to strengthen the nonproliferation regime. The law gives the government of Kazakhstan the authority to create and develop an export control system and to define the authority of other executive organs in that system. It broadly defines the items subject to export controls, including weapons and military technology; nuclear and dual-use nuclear materials; chemical and biological agents that could be used in the creation of chemical or biological weapons; missile technologies; military, scientific, and technical information; as well as any other products as determined by the government of Kazakhstan. The law specifically states that nuclear exports must be placed under IAEA safeguards, as well as addressing issues of reexport and transit.[50] This was the first comprehensive export control law to be passed in the NIS. The 2000 amendment introduced a catch-all clause and requires the establishment of internal export control compliance programs at export firms.[51]

GOVERNMENT RESOLUTION 1917, DECEMBER 14, 1999, "On Improving the Export Control System in the Republic of Kazakhstan." This resolution created the State Commission on Export Control Issues and abolished its two predecessors: the State Commission on Export Controls and the State Commission on the Export and Import of Arms, Military Items, and Dual-Use Items. The new commission, headed by the prime minister, is composed of two subcommittees, which make recommendations on strengthening the export control system.[52]

GOVERNMENT RESOLUTION 1919, DECEMBER 14, 1999, "On Approving the Rules for Implementing Export Control in the Republic of Kazakhstan and the Rules for Processing Commitments Regarding Use of Imported Products Which Fall under Export Controls and Verification of Their Use."[53] Together with Government Resolution 1037, this resolution outlines the export licensing process in Kazakhstan.[54]

48. From the Russian-language text of Government Resolution 1659, "Statute of the National Operator for the Export and Import of Uranium and Its Compounds, Nuclear Fuel for Atomic Energy Stations, Special Dual-Use Equipment, Technology, and Materials," November 26, 1997.
49. Promotional brochure for Karu-Zharak, published by the Ministry of Defense of the Republic of Kazakhstan; and CNS correspondence with Kazakhstani export control officials.
50. From the Russian-language text of the law.
51. *Kazakhstanskaya pravda* on-line edition: <www.kazpravda.kz>, November 24, 2000.
52. From the Russian-language text of the law.
53. Ibid.
54. CNS correspondence with Kazakhstani export control official, August 2000.

GOVERNMENT RESOLUTION 1143, AUGUST 11, 1999, "On Issues Regarding Transit of Products That Fall under Export Control," was modified on March 28, 2000, by Government Resolution 450, "On Changes and Additions to Government Resolution 1143 from August 11, 1999."[55]

GOVERNMENT RESOLUTION 694, JUNE 2, 1999, "Statute of State Committee for Export Control." This statute outlines the role and responsibilities of the State Committee for Export Control. The committee is charged with recommending steps for improving government oversight of the export of arms, military technologies, and dual-use goods, improving export control legislation, joining multilateral export control regimes, and generally strengthening Kazakhstan's national export control system.[56]

GOVERNMENT RESOLUTION 278, MARCH 19, 1999, "On Issues Regarding Export-Import of Arms, Military Products, and Dual-Use Goods." This resolution increased governmental oversight of the export and import of controlled goods.[57]

GOVERNMENT RESOLUTION 950, SEPTEMBER 24, 1998, "On the State Committee for Export Control of the Republic of Kazakhstan."[58] This resolution reestablished the interagency State Committee for Export Control and set the Ministry of Energy, Industry, and Trade as its executive organ. The committee comprises high-level officials from all ministries and agencies that have an official role in the export control system.

CRIMINAL CODE OF THE REPUBLIC OF KAZAKHSTAN, JANUARY 1, 1998. The criminal code provides penalties for violations of export controls. There are at least nine articles in the Criminal Code dealing with crimes involving weapons of mass destruction, radioactive materials, smuggling, and export control violations. The two most directly relevant to export controls are Article 243 and Article 250.

- Article 243 provides for penalties of heavy fines or prison terms of three to seven years for the illegal export of technologies, scientific and technical information, and services that could be used in the creation of weapons of mass destruction or other arms and military equipment.
- Article 250 provides for penalties of up to five years in jail and the possible confiscation of goods for smuggling nuclear, biological, and chemical weapons or materials and equipment that could be used in the production of those weapons. The penalties are more severe for multiple offenders, for government officials making use of their official position to smuggle the goods, and for organized crime groups.[59]

GOVERNMENT RESOLUTION 1037, JUNE 30, 1997, "On the Export and Import of Goods (Works, Services) in the Republic of Kazakhstan." This resolution is the seventh and most recent in a series, outlining the procedures for exporting controlled goods from Kazakhstan. The resolution explains the export licensing procedures and includes a general control list of all goods requiring either special permission from the government or an export license before they can be exported. The list of goods requiring special permission from the government includes military equipment and technologies, nuclear materials and technologies, radioactive materials, and radioactive waste. Those goods requiring an export license but no special permission from the government include all materials and dual-use materials that could be used in the production of arms, military equipment, or weapons of mass destruction. Export licenses for this second category of goods are issued only if permission has been granted by the Ministry

55. Ch. T. Masenov and G. Zh. Eligbayeva, "Licensing Nuclear Exports," presentation at the Seminar on Export Control of Nuclear Transfers, in Astana, Kazakhstan, May 19, 2000.
56. V. Koroblyev, "Procedures To Draw up Executive Resolutions for Nuclear Materials Export," presentation at a seminar on export controls for Kazakhstani Kazatomprom officials, Almaty, Kazakhstan, July 1999.
57. Koroblyev, "Exportniy kontrol v Kazakhstane."
58. From the Russian-language text of the decree.
59. "Zakon Respubliki Kazakhstan: Ugolovnyy Kodeks Respubliki Kazakhstan," *Zheti Zharghy*, Almaty, 1997. In accordance with a presidential decree from July 1997, the Criminal Code entered into force on January 1, 1998.

of Science and the Committee for National Security.[60]

GOVERNMENT RESOLUTION 183, MARCH 9, 1993, "Regulations on the Export and Import of Nuclear Materials, Technologies, Equipment, and Facilities; Special Nonnuclear Materials; Dual-Use Equipment, Materials, and Technologies; Radioactive Materials; and Isotope Products." This resolution sets requirements for nuclear exports and outlines the nuclear export control responsibilities of the Kazakhstani Atomic Energy Agency. Although enacted before Kazakhstan officially acceded to the NPT, Article 4 of this resolution specifically requires that nuclear exports be carried out in accordance with the provisions of the NPT. Lists of controlled nuclear and dual-use nuclear materials, which are consistent with Nuclear Suppliers Group lists, are set forth in appendixes 1 and 2 to the resolution.[61]

National Control Lists

An interagency working group was created in July 1998 to develop normative documents for export controls, including detailed national export control lists.[62] In July 1999, Kazakhstani specialists finished drafting control lists in the nuclear, missile, chemical, and biological spheres. These lists are consistent with international export control regimes.[63] The new control lists entered into force on November 18, 2000.[64]

The Export Licensing Process

There are three steps that a potential exporter must follow in order to receive an export license for nuclear, dual-use, or military goods.

- The exporter must apply to the government for written permission to export. In practice, before the government will issue this permission, it forwards the exporter's application to relevant ministries and agencies for review. The Ministry of Foreign Affairs, for example, is responsible for evaluating the political implications of potential exports.[65] There do not appear to be any major decrees or resolutions, however, that require such an interagency review.
- In the case of a nuclear export, the exporter must apply to the Committee on Atomic Energy (formerly the Atomic Energy Agency) for additional written permission to export. The committee uses the criteria described in the following paragraphs in deciding whether to grant permission for the proposed export.
- Once the exporter has received permission from both the government and the Committee on Atomic Energy, it may proceed with a formal application for an export license at the Ministry of Energy, Industry, and Trade's Department of Export Control and Licensing.

The steps required to export weapons, military equipment, and dual-use materials are the same, except that in step two written permission is required from the new Interagency Commission of the Security Council on Issues of Export of Weapons, Military Equipment, and Dual-Use Materials rather than from the Committee on Atomic Energy.[66] Once an export license has been obtained, the Customs Committee is responsible for reviewing that license and other accompanying documents before the items actually leave the country.

The Committee on Atomic Energy may only approve nuclear-related exports to a non-nuclear-weapon state if that state has a full-

60. From the Russian-language text of the decree.
61. From the Russian-language text of the decree.
62. Decree of the Prime Minister no. 146-r, July 29, 1998.
63. CNS staff discussions with Kazakhstani export control officials, Astana, Kazakhstan, July 1999.
64. Dauletbay Ismagulov, "Ob eksportnom konzrole v Respublike Kazakhstan," *Panorama* on-line edition: <www.panorama.kz>, no. 44, November 2000.
65. Timur Zhantikin, "Kontrol Yadernogo Eksporta v Kazakhstane," presentation given at the Seminar on Export Control of Nuclear Transfers, in Astana, Kazakhstan, May 19, 2000.
66. CNS correspondence with Kazakhstani export control official, August 2000.

scope International Atomic Energy Agency (IAEA) safeguard agreement in place. In addition, the relevant government authorities in the importing country must provide assurances that the exported nuclear goods:

- will not be used in the production of nuclear weapons or nuclear explosives, or for any military end
- will be placed under IAEA safeguards
- will be secured under physical protection at levels not less than those recommended by the IAEA, and
- will be reexported from the recipient country to a third country only if the previous three conditions are met and if the Kazakhstan Committee on Atomic Energy has provided written permission.[67]

In addition, the Committee on Atomic Energy noted, in a presentation to Kazakhstani government officials from other ministries, that an export should not be allowed if there is an unacceptable risk that the exported item could be diverted to a nuclear weapons program or an unsafeguarded nuclear fuel cycle, or if the export contradicted the basic principles of nonproliferation.[68] This apparent catch-all policy was included in the 2000 amendment to the Export Control Law.

Once the exporting company has secured permission from the government and the Interagency Commission or the Committee on Atomic Energy, it must formally apply to the Ministry of Energy, Industry, and Trade for an export license. Export licenses are issued by the Ministry's Department of Export Control and Licensing. The Customs Committee is responsible for export licenses and other documents before items cross the border.

Multilateral Agreements

Kazakhstani officials are actively pursuing membership in the Nuclear Suppliers Group and are also interested in joining the MTCR and the Wassenaar Arrangement.[69] At present, Kazakhstan has no concrete plans to join the Australia Group.

Kazakhstan is a party to the "Agreement on Coordination Regarding Issues of Export Control of Raw Materials, Materials, Equipment, Technology, and Services That Could Be Used in the Production of Weapons of Mass Destruction and Their Delivery Systems," also known as the Minsk Accord, signed on June 26, 1992, by CIS member states (described in the section on the Russian Federation, above).

Ukraine

Like Kazakhstan, Ukraine has been building a nonproliferation export control system since the early 1990s.[70] Ukraine currently has a well-developed system in place, although it still has not enacted a comprehensive law on export controls. Several presidential decrees, however, have been issued in the past few years, representing important steps forward in the continued development of national export controls. In addition, Ukraine has established detailed national control lists compliant with the guidelines of all the major international supplier regimes, a clear and straightforward export licensing process (including an interagency review), and a cadre of dedicated export control professionals with a strong understanding of the concept of nonproliferation export controls.

The primary export control body in Ukraine is the State Export Control Service (SSEC), responsible both for providing recommendations on export control policy and for the export licensing process. Unlike in Kazakhstan and Russia, the substantive review of export license applications and the issuing of licenses in Ukraine is done by one organization, the SSEC. In 1999, the SSEC was reorganized, and several new departments were added. One of these departments tracks developments in multilateral export control regimes and assists in the formulation of Ukrainian policy on issues

67. Masenov and Eligbayeva, "Licensing Nuclear Exports."

68. Ibid.

69. CNS staff discussions with Kazakhstani export control officials, Astana, Kazakhstan, July 1999; correspondence with Kazakhstani export control official, August 2000.

70. For a recent analysis in English of the Ukrainian export control system, see Zaborsky, "Ukraine Restructures Its Arms Export Controls," pp. 19–22.

related to regime membership. Another analyzes issues of regional stability and the international arms market. This latter department also advises Ukrainian arms exporters of Ukraine's international and political responsibilities. This department was apparently established in response to international criticism that Ukraine was selling arms and military technology to unstable and warring regions.[71]

Other Ukrainian ministries and agencies participate in the export control process through their membership in the interagency Government Commission for Export Control Policy and Military and Technical Cooperation, which replaced the Commission for Export Control Policy in February 1999.[72] This commission plays a key role in the decision-making process in licensing certain critical exports (as outlined in the February 4, 1999, Presidential Decree discussed below).[73] In addition, the Ministry of Foreign Affairs and the Council on National Security and Defense regularly participate in the coordination of international issues and in the maintenance of national control lists.[74]

In December 1999, Ukrainian President Leonid Kuchma reorganized the structure of the executive branch, depriving the SSEC of the ministerial status it had gained in 1996 and merging it into the Ministry of the Economy. The SSEC retains the same licensing responsibilities it had before the reorganization, however.[75]

Of primary export control concern is Ukraine's advanced missile industry, as well as enterprises that produce dual-use nuclear goods. In the sphere of arms and military-related goods and technologies, the primary exporter is the state company Ukrspetzeksport, which was created in November 1996 and is managed by the Office of the Prime Minister.[76]

Legal Infrastructure

Given the absence of a comprehensive Law on Export Controls, the legal basis for the Ukrainian export control system consists primarily of executive branch decrees and resolutions. The following list contains the key legislative acts and executive decrees that pertain to export controls in Ukraine.

PRESIDENTIAL DECREE 1573, DECEMBER 15, 1999, "On Changes to the Structure of the Executive." This decree merged the SSEC, which had previously been an independent agency, into the Ministry of the Economy.[77]

PRESIDENTIAL DECREE 422, APRIL 21, 1999, "On Measures To Perfect Military and Technical Cooperation between Ukraine and Foreign Countries." This decree lays out the roles and responsibilities of the major institutional players in the arms export control process.[78]

PRESIDENTIAL DECREE, FEBRUARY 4, 1999. This decree transformed the Commission on Export Control Policy into the Commission on Export Control Policy and Military and Technical Cooperation with Foreign Countries. It

71. "Shooting Exports," interview with Alexander Grishutkin, deputy head of the State Service on Export Controls, *International Security*, Kiev, Ukraine, 1999 (no month), on the Center for Army Conversion and Disarmament Studies web site: <www.niss.gov.ua/koi/cacds/magazine/art6.htm>.

72. The commission comprises first deputy heads and deputy heads of the Ministry of Foreign Affairs, Ministry of Foreign Economic Relations and Trade, Ministry of Defense, Ministry of Industrial Policy, Ministry of Internal Affairs, the State Security Service, the Center for Strategic Planning and Analysis under the Council on National Security and Defense, the State Service for Export Controls, State Customs Service. Zaborsky, "Ukraine Restructures Its Arms Export Controls," pp. 19–22.

73. Ibid.

74. Scott Jones, "An Evaluation of Export Controls in Ukraine," *Global Evaluation of Nonproliferation Export Controls: 1999 Report*, Center for International Trade and Security, University of Georgia, 1999.

75. Victor Zaborsky, "The 'New President' of Ukraine: Reforming the Government, Facilitating Arms Exports," *World Affairs* (December 2000).

76. Zaborsky, "Ukraine Restructures Its Arms Export Controls."

77. "Kuchma Decree Abolishes Ministries, National Guard," *UNIAN*, December 15, 2000; see also Zaborsky, "The 'New President' of Ukraine."

78. Ibid.

remains a high-level interagency body but is subordinate to the President's Council on National Security and Defense. (Previously, the commission was subordinate to both the president and the cabinet of ministers.) In addition, the decree more clearly defines the commission's decision-making responsibilities in the sphere of export licensing. The text of this decree has not been made public.[79]

PRESIDENTIAL DECREE 117, FEBRUARY 13, 1998, "On Procedures for Export Control in Ukraine." This decree sets forth the goals and procedures for Ukraine's export controls. It is the first comprehensive document on export controls, and functions as the primary export control legislation pending enactment of a comprehensive export control law. This decree also introduces two new principles into the Ukrainian export control system. First, it requires potential exporters to obtain permission from the SSEC before negotiating a contract with a foreign partner. Second, it establishes catch-all controls for exports. Article 14 states, "An exporter must consult the State Service on Export Control (SSEC) if the exporter knows or comes to learn of the possibility that the goods intended for export will be used to develop weapons of mass destruction, their delivery means, or conventional arms, despite the fact that said goods are not included in the control lists."[80]

CABINET OF MINISTERS RESOLUTION 384, APRIL 22, 1997, "On the Procedures for the Control of Exports, Imports, and Transit of Goods That May Be Used in the Production of Chemical, Biological (Biochemical), and Toxic Weapons." This resolution establishes both the procedures and a national control list in the sphere of chemical- and biological-weapons-related goods and technologies. The procedures and control list set forth by this resolution are consistent with the guidelines of the Australia Group.[81]

PRESIDENTIAL DECREE 1279, DECEMBER 28, 1996, "On Further Improving State Export Control." This decree transforms the Government Commission on Export Controls and the State Expert-Technical Committee, previously the two primary export control bodies in Ukraine, into the Government Commission for Export Control Policy and the State Service for Export Controls. The interagency Government Commission for Export Control Policy is made responsible for ensuring the coordination of export control issues and for resolving any difficult export licensing issues. The State Service for Export Controls is responsible for developing and implementing export control procedures, including export licensing.[82]

CABINET OF MINISTERS RESOLUTION 1005, AUGUST 14, 1996, "On the Rules and Procedures for the Control of Goods That May Have Military Applications (Dual-Use Goods and Technologies)." This resolution establishes both export procedures and a national control list in the sphere of dual-use goods and technologies. The procedures and control list set forth by this resolution are consistent with the guidelines of the Wassenaar Arrangement.[83]

CABINET OF MINISTERS RESOLUTION 302, MARCH 12, 1996, "On the Rules and Procedures for the Control of the Export, Import, and Transit of Goods That Relate to Nuclear Activities and Can Be Used in the Construction of Nuclear Weapons." This resolution establishes both export procedures and a national control list in the sphere of nuclear materials and technologies. The procedures and control list set

79. Zaborsky, "Ukraine Restructures Its Arms Export Controls," pp. 19–22.

80. Ibid.

81. "List of Existing Normative Documents on Export Control Issues," distributed at the conference "Cooperation between Enterprises and State Export Control Organs," organized by the Scientific and Technical Center for the Export and Import of Special Technologies, Equipment, and Materials, Kiev, Ukraine, November 1997; and Jones, "An Evaluation of Export Controls in Ukraine."

82. From an English-language translation of the decree published in *Uryadovyy Kuryer*, January 11, 1997, p. 7, in FBIS–SOV–97–026, January 11, 1997.

83. CNS staff discussion with Ukrainian Foreign Ministry official, May 1997; and "List of Existing Normative Documents on Export Control Issues."

forth by this resolution are consistent with the guidelines of the Nuclear Suppliers Group.[84]

CABINET OF MINISTERS RESOLUTION 563, JULY 27, 1995, "On the Rules and Procedures for the Control of the Export, Import, and Transit of Missile Technologies, Related Equipment, Materials and Technologies." This resolution establishes both export procedures and a national control list in the sphere of missile technologies. The procedures and control list set forth by this resolution are consistent with the guidelines of the MTCR.[85]

LAW ON ADDITIONS TO THE CRIMINAL AND JUDICIAL CODES OF UKRAINE, 2613 KhP, MARCH 17, 1992. This law makes an addition to Article 228–6 of the Criminal Code of Ukraine, specifying the penalties for violating export control procedures for sensitive items. The new language states that the illegal export of raw materials, materials, equipment, and technologies that can be used for the production of missile, nuclear, chemical, or other types of weapons can lead to the confiscation of property and prison terms of three to eight years.[86]

The Export Licensing Process

Enterprises seeking to export controlled items must first apply to the State Service for Export Controls for permission to negotiate a contract with a foreign partner.[87] Only seven Ukrainian firms, including the Antonov aircraft plant and the Artem missile component plant, are permitted under a July 1999 Ukrainian government regulation to negotiate contracts independently for the export of "goods with military applications and goods containing secret information." All other firms must negotiate export contracts through Ukrspetzeksport.[88] Once a contract is in place, the potential exporter must then go back to the SSEC for an export license. In addition to an export license application, the potential exporter must submit a certificate from an authorized government agency in the recipient country stating that:

- the imported items will not be reexported without written consent from Ukraine
- the imported items will not be used in the development of weapons of mass destruction, and
- the imported items will not be used in any way that contributes to a nuclear fuel cycle that is not under IAEA safeguard rules.[89]

In consultation with other relevant ministries, the SSEC evaluates the export license application package, taking into account a number of political, technical, economic, and military factors.[90]

The export of "critical items," as well as exports to "critical countries" must be reviewed and approved by the interagency Commission on Export Control Policy and Military and Technical Cooperation with Foreign Countries before an export license can be issued. "Critical items" are defined as goods, technologies, equipment, and materials that could significantly contribute to the development of weapons of mass destruction. "Critical countries" are those against which either the United Nations or the Organization for Security and Cooperation in Europe has imposed sanctions; those that currently pose or could pose a threat to the national security of Ukraine; and those that support terrorism.[91]

84. Ibid.
85. From the Ukrainian-language text of the decree.
86. Emily Ewell, John Parachini, and William Potter, "Ukrainian Nuclear Export Controls: A Status Report," CNS unpublished report, prepared for the Office of Arms Control and Nonproliferation, U.S. Department of Energy, December 1996.
87. This requirement was established by Presidential Decree 117 in February 1998; Zaborsky, "Ukraine Restructures Its Arms Export Controls."
88. Victor Zaborsky, "Ukraine Arms Plant Struggles in Independence Experiment," *Defense News* (August 7, 2000), pp. 33–46.
89. Jones, "An Evaluation of Export Controls in Ukraine."
90. CNS staff discussion with Ukrainian Foreign Ministry official, May 1997.
91. This requirement was established by a presidential decree passed in February 1999. Zaborsky, "Ukraine Restructures Its Arms Export Controls."

The State Customs Service is responsible for checking customs declarations and export licenses and forwards copies of those documents to the customs archives once the controlled items have left Ukraine.[92]

Multilateral Agreements

Ukraine is a member of three of the four major multilateral export control regimes, as is Russia. Kiev was formally admitted into the Nuclear Suppliers Group in May 1996 and became one of the founding members of the post-COCOM Wassenaar Arrangement in July 1996. Ukraine began to abide by the MTCR guidelines for missile-related transfers in 1995 but was not formally admitted into the regime until September 1998. The United States blocked Ukraine's entry into the MTCR for several years, insisting that Ukraine give up its inventory of Scud-B offensive missiles before joining. In March 1998, the United States and Ukraine announced that they had reached an agreement and that Washington would support Ukrainian membership in the MTCR. The full details of the agreement have not been made public.[93] Ukraine is not a member of the Australia Group but does adhere to its guidelines for exporting chemical- and biological-weapons-related goods and technologies.[94]

Like Kazakhstan and Russia, Ukraine is a party to the "Agreement on Coordination regarding Issues of Export Control of Raw Materials, Materials, Equipment, Technology, and Services That Could Be Used in the Production of Weapons of Mass Destruction and Their Delivery Systems" (described in the section on "Russia," above), signed on June 26, 1992, by CIS member states.[95] Ukraine is not a member of the Customs Union with Belarus, Kazakhstan, Kyrgyzstan, Russia, and Tajikistan. In March 1997, however, Moldova and Ukraine signed a declaration on the creation of a Customs Union between their two countries.[96]

92. Jones, "An Evaluation of Export Controls in Ukraine."
93. Zaborsky, "Ukraine Restructures Its Arms Export Controls."
94. Jones, "An Evaluation of Export Controls in Ukraine."
95. From the Russian-language text of the Minsk Accord, "Agreement on Coordination of Work on Issues of Export Control," June 26, 1992.
96. Natalya Prikhodka, "Kishinev i Kiyev sozdayut tamozhennyy soyuz," *Nezavisimaya gazeta*, on-line edition, March 27, 1997.

Annex

NIS PARTICIPATION IN MULTILATERAL NONPROLIFERATION REGIMES

	Date of Accession to Nonproliferation Treaty[1]	Date of Accession to Chemical Weapons Convention[2]	Date of Accession to Biological Weapons Convention[3]
Armenia	July 15, 1993	January 27, 1995	June 7, 1994
Azerbaijan	September 22, 1992	February 29, 2000	Nonsignatory
Belarus	July 22, 1993	July 11, 1996	March 26, 1975
Estonia	January 7, 1992	May 26, 1999	June 21, 1993
Georgia	March 7, 1994	November 27, 1995	May 22, 1996
Kazakhstan	February 14, 1994	March 23, 2000	Nonsignatory
Kyrgyzstan	July 5, 1994	February 22, 1993 (signed only)[9]	Nonsignatory
Latvia	January 31, 1992	July 23, 1996	February 6, 1997
Lithuania	September 23, 1991	April 15, 1998	February 10, 1998
Moldova	October 11, 1994	July 8, 1996	Nonsignatory
Russia	March 5, 1970[10]	November 5, 1997	March 26, 1975
Tajikistan	January 17, 1995	January 11, 1995	Nonsignatory
Turkmenistan	September 29, 1994	September 29, 1994	January 11, 1996
Ukraine	December 5, 1994	October 16, 1998	March 26, 1975
Uzbekistan	May 2, 1992	July 23, 1996	January 11, 1996

1. "Situation as of 31 December 1998 with Respect to the Conclusion of Safeguards Agreements between the Agency and the Non-Nuclear Weapons States in Connection with the NPT," IAEA web site: <www.iaea.org/worldatom/Programmes/Safeguards>.
2. "States Parties to the Chemical Weapons Convention: List of State Parties to the CWC as of March 23, 2000," OPCW web site: <www.opcw.nl>.
3. "Signatories to the BTWC," Joint SIPRI-Bradford Chemical and Biological Warfare Project web site: <projects.sipri.se/cbw/docs/bw-btwc-rat.html>.
4. "Comprehensive Nuclear Test-Ban Treaty Signatories/Ratifiers," U.S. State Department web site: <www.state.gov/www/global/arms/factsheets/wmd/nuclear/ctbt/ctbtsigs.html>.
5. "Convention on the Physical Protection of Nuclear Material," IAEA web site: <www.iaea.org/worldatom/glance/legal>.
6. "Member States of IAEA," IAEA web site: <www.iaea.org/worldatom/about/member.shtml>.

NIS PARTICIPATION IN MULTILATERAL NONPROLIFERATION REGIMES, CONTINUED

Status with Regard to Comprehensive Test Ban Treaty[4]	Date of Accession to Convention on Physical Protection[5]	Member of IAEA[6]	IAEA Safeguards Agreement (entered in force) [7]	
October 1, 1996 (signed only)	August 24, 1993	Since 1993	May 5, 1994	**Armenia**
February 2, 1999 (ratified)	Nonsignatory	No	April 29, 1999[8]	**Azerbaijan**
September 24, 1996 (signed only)	September 9, 1993	Since 1957	August 2, 1995	**Belarus**
August 13, 1999 (ratified)	May 9, 1994	Since 1992	November 24, 1997	**Estonia**
September 24, 1996 (signed only)	Nonsignatory	Since 1996	September 29, 1997 (signed only)	**Georgia**
September 30, 1996 (signed only)	Nonsignatory	Since 1994	August 11, 1995	**Kazakhstan**
October 8, 1996 (signed only)	Nonsignatory	No	March 18, 1998 (signed only)	**Kyrgyzstan**
September 24, 1996 (signed only)	Nonsignatory	Since 1997	December 21, 1993	**Latvia**
February 7, 2000 (ratified)	December 7, 1993	Since 1993	October 15, 1992	**Lithuania**
September 24, 1997 (signed only)	May 7, 1998	Since 1997	June 14, 1996 (signed only)	**Moldova**
June 30, 2000 (ratified)	May 25, 1983	Since 1957	"Voluntary offer" agreement[11]	**Russia**
June 10, 1998 (ratified)	July 11, 1996	No	No agreement	**Tajikistan**
February 20, 1998 (ratified)	Nonsignatory	No	No agreement	**Turkmenistan**
September 27, 1996 (signed only)	July 6, 1993	Since 1957	January 22, 1998	**Ukraine**
May 29, 1997 (ratified)	February 9, 1998	Since 1994	October 8, 1994	**Uzbekistan**

7. "Situation as of 31December 1998 with Respect to the Conclusion of Safeguards Agreements between the Agency and the Non-Nuclear Weapons States in Connection with the NPT," IAEA web site: <www.iaea.org/worldatom/Programmes/Safeguards>.
8. "Agreement between the Republic of Azerbaijan and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons," INFCIRC/580, May 24, 1999, IAEA web site: <www.iaea.org/worldatom/infcircs/infcirc580.pdf>.
9. "Signatories to the CWC," Joint SIPRI-Bradford Chemical and Biological Warfare Project web site: <projects.sipri.se/cbw/docs/cw-cwc-sig.html.>
10. The Russian Federation inherited the Soviet Union's status as a nuclear-weapons state. The Soviet Union was an original signatory to the Non-Proliferation Treaty on July 1, 1968. The NPT entered into force on March 5, 1970.
11. As a nuclear-weapons state party to the NPT, Russia is not required to accept IAEA safeguards. A voluntary agreement, under which a limited number of Russian nuclear facilities are subject to safeguards, entered into force on June 10, 1985.

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The Non-Proliferation Project at the Carnegie Endowment for International Peace is an internationally recognized source of information and analysis on efforts to curb the spread of nuclear, chemical, and biological weapons and missile delivery systems. Through publications, conferences and the Internet, the Project promotes greater public awareness of these security issues and encourages effective policies to address weapons proliferation and its underlying causes.

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