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 (МС3)
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.